

# Local and state-based collaboration: the key to unlocking the potential of SDI

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## ABSTRACT

Access to reliable and affordable spatial information is now recognised as a critical component of Australia's future economic, environmental and social development. The growth of spatial data infrastructures (SDIs) at all levels of government relies heavily on collaboration both within and between jurisdictions. However, our understanding of the collaborations and partnerships that contribute to building these SDIs is still relatively poor.

Whilst the literature within the spatial information and GIS field explores data-sharing arrangements, technology diffusion, multi-participatory projects and project-based partnerships, little contribution is made to the nature of the interactions between the various organisations and stakeholders. Although useful for understanding advances in spatial information management and how to structure and manage GIS-based projects the literature does not describe how to forge cooperative relationships, what partnership models to engage nor how to nurture ongoing interactions, especially in competitive environments.

This paper investigates the nature of SDI collaborations in order to illustrate the wide variation in the range of stakeholders, forms of interaction and level of engagement. To highlight the various characteristics of collaboration, a number of SDI partnerships will be explored. Differences and similarities between these partnerships will be discussed with a view to identifying important factors for successful collaboration. The need for, and role of central coordination bodies to minimise the duplication and dispersion of effort will be examined in this context.

**KEYWORDS:** Spatial data sharing, Spatial Data Infrastructures, GIS, Collaboration and Partnerships, Organisations, Local and State Government.

## Introduction

Spatial information is the data, maps and information relating to location. It describes the geographic locations of our society and the spatial relationships of these locations. Driven by Internet and communication technology, spatial data is proving crucial to the sustaining the economic, social and environmental needs of society. In Australia, spatial data has long been the domain of the mapping and lands departments in each jurisdiction and produced and managed by mapping specialists. As analogue paper map production made way for digital mapping and GIS through the eighties and nineties, digital spatial data has since pervaded across all sectors and disciplines from land and natural resource management, environmental protection, emergency management through to essential services and community planning. The key findings of several national studies identified that the foremost problems are access to spatial information, consistency of data across agencies, duplication of effort, fragmentation of key data, and the need for better coordination and collaboration in the management of spatial information (National Heritage Trust 2002; Technik Group Ltd. 2003; Bureau of Transport Economics 2003).

Spatial Data Infrastructure (SDI) is recognised as a cohesive framework for the policies, standards, technology and procedures that support the more efficient and effective use, management and production of spatial data for a community. SDI involves the users and providers of spatial information, including all levels of government, the private sector and academia, and is more than a product or collection of datasets. SDI is about 'access' to data and reducing duplication of effort and expense. ANZLIC's (2003) vision for the ASDI is for 'Australia's spatially referenced data, products and services [to be] available and accessible to all users'. To facilitate this access it is critical that organisations begin to collaborate to ensure that effective data sharing arrangements are put in place.

Collaboration can be understood as the interaction of two or more organisations to share resources such as people, skills, information or knowledge for mutual benefit or gain. The spectrum of collaboration spans formal partnerships such as contracts and signed agreements to informal transactions and goodwill between individuals often 'to get the job done' (Stacey et al. 2000). In the spatial information industry where multiple jurisdictional agencies, federal, state and local governments and the private sector interact, with overlapping interests and responsibilities, a better understanding of collaboration is vital to building sustainable SDI. Literature in the spatial and GIS fields on partnering cast an immature understanding of the interaction of organisations, which is largely focused on project outcomes rather than the creation of ongoing data sharing or maintenance regimes. In practice, collaboration is highly dispersed, informal and mostly uncoordinated. The common thread between agencies is data, more so than a common service, activity or responsibility, thus success will be determined on their ability to resolve both the technical and institutional challenges (Ventura 1995).

This paper will review organisational and collaboration literature to provide an insight into organisational collaboration and how partnerships can be forged. Examples of existing collaboration will then be explored with respect to this organisational theory in order to contrast their similarities, differences and complexities. An understanding of these characteristics will then enable further exploration of the issues and barriers to sharing spatial information in the context of building better SDI. The paper argues that through building better partnerships and inclusion of the local level of government as equal partners, organisational, institutional and economic barriers can be overcome to support the development of SDI.

## **Collaboration in SDI**

In approaching a study of the complex partnerships between multiple agencies (both public and private), across multiple jurisdictions and administrative levels, it is important to consider the extensive range of literature that exists on relationships, collaborations, cooperation and competition between organisations. The literature within the spatial information and GIS fields explore data-sharing arrangements (Onsrud & Rushton 1995), organisational management and complexity (Huxhold & Levinsohn 1995), multi-participatory projects and project-based partnerships (Grant & Roeberge 2001; Jacoby et al. 2002; Masser 1998; Mooney & Grant 1997). Whilst this literature is useful for understanding advances in spatial information management and how to structure and manage GIS-based projects, little contribution is made to the nature of partnerships, especially when the interaction is competitive and cooperation is maintained. Further, there is little work on how to forge relationships between the organisations or how to manage their ongoing operational and financial sustainability.

## **Collaboration in GIS**

The uptake of GIS throughout the past two decades came with the realisation that GIS is as much a function of management and institutional issues as of technology alone. This has led to much discussion on how to access spatial data, how to ensure currency and how to obtain it when needed (Huxhold & Levinsohn, 1995). Most GIS initiatives are project and/or data orientated and do not provide a useful framework for understanding the institutional culture of data sharing. Selected author perspectives from Onsrud & Rushton (1995) will be examined as a sample of the GIS related discussion of data sharing arrangements.

Pinto & Onsrud (1995) identified that the continued inability of various public agencies at federal, state and local levels to develop collaborative arrangements restricted the ability of agencies to effectively share spatial information, system integration and the widespread use of GIS. This resulted in the duplication of spatial

information systems and services at different levels. Others repeat the institutional theme, such as Craig (1995) who describes 'institutional inertia' as the overriding reason why data sharing is restricted. He points to the mission and mandates of organisations that guide their existence and day-to-day activity, precluding possibilities for sharing and cooperation. Overcoming organisational boundaries is a message repeated by Pinto & Onsrud (1995) and Obermeyer (1995: p.138), where Obermeyer argues that inter-organisational information sharing is achieved through a framework of inter-organisational alliances, grown from negotiation between relative equals.

Kevany (1995: p.76) in an attempt to empirically quantify sharing environments, does provide a useful framework of issues for consideration. Although the detail of the approach is beyond the scope of this paper, the issues provide areas for analysis to determine factors and relationships affecting data sharing and are summarised in Table 1.

Azad and Wiggins (1995) document a simple typology of three spatial database sharing arrangements to highlight the 'ideal' arrangement termed multi-participant GIS. Type 1: One-way provision—An organisation is the provider of spatial data for a nominal charge to other organisations, or provision for a one-off project where maintenance is not an issue. Type 2: One-way provision moderated by user demand—An organisation is the provider of spatial data with universal value to other organisations. The continued maintenance and upgrade is dependent on users contributing to expenses and their requirement to demonstrate the usefulness to the provider agency. Type 3: Two-way mutual provision—Several organisations in collaboration undertake the development and maintenance of spatial data by sharing costs and resources in order to minimise duplication. The success of the collaborative effort is dependent on the mutual consent of participant organisations.

### **An organisational and collaboration management perspective**

A review of organisational and collaboration management literature results in many and varied schools of thought (Axelrod 1984; Axelrod 1997; Child & Faulkner 1998; Lorange & Roos 1992). The main areas of literature comprise economics, game theory, collaborative theory, cooperative strategy, strategic management, joint ventures, strategic alliances and organisational behaviour (Child & Faulkner 1998). Table 2 summarises the nature of organisations and collaboration from the perspective of four schools of thought. For the purpose of this study, the interest lies with highlighting the nature of organisational interactions rather than an in-depth investigation of the factors exclusively. It is anticipated that the introduction of organisation and collaboration literature will provide insight to the management of partnerships in the development of SDI.

A vast range of definitions of collaboration exist, each dependant on the context and the perspective of the authors as will be discussed shortly. Lawrence et al. (2002: p.3) define collaboration as a cooperative, inter-organisational relationship that is negotiated on an ongoing communicative basis independent of market or hierarchical mechanisms for control. Cousins (2002: p.71) argues that partnership relationships do not exist, referring to the range of collaborative relationships, all of which are competitive. This paper builds on the definition by Lawrence et al. (2002: p.3) to consider the broad range of collaboration forms: informal, formal, partnership, consortia, coalition, joint venture, alliance, networks and associations. The term partnership is used commonly across the spatial information field in the sense of organisations working together. A matured definition of partnership is adopted throughout the paper to denote a formal-collaboration, underpinned by binding agreements, contracts or legislation. Figure 1 charts the various types of collaboration against the level of organisation integration from the perspective of three disciplines: from highly integrated formal arrangements (hierarchical order) to independent or ad hoc interactions (open market).

**Table 1 Table of data sharing issues and description of factors**

Issue	Description of factors
Sharing classes	<ul style="list-style-type: none"> <li>• Classes of sharing arrangements, data, resources, skills</li> <li>• Access to a common dataset by multiple organisations</li> <li>• Copying separate datasets for each organisation</li> <li>• Sale or purchase of data by an organisation</li> </ul>
Environment	<ul style="list-style-type: none"> <li>• Number of organisations involved</li> <li>• Organisational goals/mission</li> <li>• Organisational relationships, current and historic</li> <li>• GIS specific (technical) relationships</li> <li>• Control of information, custodianship, centralised or distributed or ad hoc</li> <li>• Growth rate and rate of development, the need and benefits of sharing with respect to development rate in an area</li> <li>• Leadership/politics, local support, partisan or non-partisan, will support impede sharing</li> </ul>
Need	<ul style="list-style-type: none"> <li>• Adequacy of internal data and resources</li> <li>• Data of another organisation is needed</li> <li>• Need that can best be developed and maintained jointly</li> <li>• Level of dependence from sharer perspective</li> </ul>
Opportunity	<ul style="list-style-type: none"> <li>• Organisation(s) have a need for data: sharing may be greatly facilitated if organisations already maintain data that is required by others</li> <li>• Organisations(s) have a need for resources: the sharing of maintenance and development costs is the most effective means of establishing a successful sharing environment</li> </ul>
Willingness	<ul style="list-style-type: none"> <li>• Organisation that own data, offer or a willing to share</li> <li>• Organisation offers to share or is willing to share cost of data development/maintenance</li> <li>• Level of dependence from lead organisation perspective: the level of perceived dependence of user organisations, may encourage the lead agency to facilitate sharing</li> </ul>
Incentive	<ul style="list-style-type: none"> <li>• Government program, policy or regulations that encourage or require sharing</li> <li>• Recognition of the value of sharing data: management recognise the value of sharing for cost reduction, improved availability, the sharing environment will be improved. Sharing tied to program funding or performance.</li> </ul>
Impediments	<ul style="list-style-type: none"> <li>• Real or perceived requirement for confidentiality</li> <li>• Incompatibility in the definition, specifications or structure of available data: the cost of redefinition, translation or modification could exceed value of sharing the data</li> </ul>
Technical capability	<ul style="list-style-type: none"> <li>• Basis for sharing will facilitate or impede sharing: range from a formal detailed agreement to informal working relationship or ad hoc interaction.</li> <li>• Level of planning</li> <li>• Capacity and capability of organisations to support data sharing</li> <li>• Usefulness of technical specifications</li> </ul>
Resources	<ul style="list-style-type: none"> <li>• Funding source will determine the level of data sharing: whether funded by the lead agency, equitable contributions across organisations, payment for fees or for information provided or no payment for shared data</li> <li>• Data or source materials are available for shared data</li> <li>• Service area size in determining conditions of sharing: such as the area in square kilometres, number of parcels, population size</li> </ul>

Source: adapted from Kevany (1995).

**Table 2 Summary of perspectives of the nature of organisations and collaborations from four schools of thought, and their implication to management**

Economic theory	<ul style="list-style-type: none"> <li>Cooperative strategies can enhance market power, enabling a smaller or new player to gain greater influence in the sector</li> <li>One consideration for an organisation in choosing whether to collaborate with another, and the form of the cooperation, is the level of transaction cost involved.</li> <li>Without common interests and mutual trust, an alliance needs to provide each partner with adequate incentives not to take advantage of the other and systems in place to monitor respective contributions</li> </ul>
Game theory	<ul style="list-style-type: none"> <li>There is a need to balance and reconcile cooperation and competition between partner organisations</li> <li>Highly self-interested behaviour of interacting organisations tends to be self-defeating</li> <li>If cooperation between partner organisations is established in accordance to clear principles, it is more likely that the relationship will become self-strengthening</li> </ul>
Strategic management theory	<ul style="list-style-type: none"> <li>Executive level managers need to be clear about their motives for adopting cooperative strategy generally and in particular for entering a specific partnership</li> <li>The selection of a suitable partner is of fundamental importance and is heavily dependent the success of the partnership</li> </ul>
Organisation theory	<ul style="list-style-type: none"> <li>The ability of a partner to exercise control (dominance) over an alliance is determined by the level of dependency on partners for the provision of specialised resources (specialised skills, know-how, ability) which are crucial for the alliance's operation</li> <li>From this we infer that formal rights set out in contracts may not be sufficient to ensure control</li> <li>Alliances are hybrid organisations that combine features of conventional hierarchical management with those of networks.</li> <li>This hybrid nature means the alliance organisation must address resultant dilemmas such as the tension between the ability to control it and to learn (new skills, knowledge) from it</li> </ul>

Source: adapted from Child & Faulkner (1998: p.40).

<p>Integration</p> <p>Independence</p>	<b>Hierarchy</b>		
	<b>SDI theory</b>	<b>Economic theory</b>	<b>Strategic management theory</b>
	Registered business, Central Regulatory Authority, Departmental restructure/merger	Mergers and Acquisitions	Strategic Alliance
	Registered business of collective organisations, Central council or body funded by member organisations	Joint Ownership	Virtual Organisation, Alliance is effectively a new Organisation
	Partnership for mutual benefit, Formal agreement, contract, legislated	Joint Venture	Dominated Network, Central Organisation
	Formal Collaboration, SLA, MOU etc.	Formal Cooperative Venture	Unilateral Agreements
	Informal Collaboration, 'Getting the job done'	Informal Cooperative Venture	Equal-Partner Networks
<b>Markets</b>			

**Figure 1 Hierarchy of Collaboration type and level of ascending integration [Adapted (Column 1), (Lorange & Roos 1992) (Column 2), (Child & Faulkner 1998: p.121) (Column 3)].**

Even within the organisational and collaborative literature, there is no unified approach to understanding collaboration and partnering between organisations. Child and Faulkner (1998: p.17) remark that 'one looks in vain for a unified theory or approach to provide the basis for understanding cooperative strategy'. In the absence of a unified strategy for forging cooperation or managing a partnership, the review of the various schools of thought across disciplines yields a broader understanding of the nature of collaboration enabling comparison of methods and perspectives.

## **Case studies—characteristics of collaboration**

We have explored the nature of collaboration from the perspective of the GIS field, organisational and collaboration management fields and related theories in the approach of collaborative studies. Several collaborative arrangements will be reviewed to highlight a range of characteristics and factors discussed so far. The four case studies have been selected for their common theme of sharing spatial data, resources or skills and potential for supporting the development of sustainable SDI.

A review rather than rigorous analysis of all characteristics and their effects will be performed to demonstrate the complexity of collaboration and highlight the presence of factors identified in the literature. The authors hope to make preliminary propositions based on observed correlations and illicit further discussion as a basis for further research. Differences and similarities between these cases will be discussed with a view to identifying important factors for successful collaboration.

### **The New South Wales, Community Access to Natural Resources Information Program**

The Community Access to Natural Resources Information (CANRI) program provides information products tailored for community-based local and regional environmental management in the State of New South Wales (NSW). CANRI is a collaborative initiative involving all NSW State agencies with natural resource information management within their portfolios, in a jointly commissioned system redefining whole-of-government service delivery (Atkinson & van der Vlugt 2001). The NSW Government has allocated \$4 million to the four-year program, which began in July 2000 with assistance from the Commonwealth Atlas project. CANRI allows anyone, from individuals, local community groups to ministerial advisers to access the latest spatial data and key natural resource information on topics such as salinity, vegetation, wildlife, inland and coastal waters, and pollution, all publicly available via the Internet (see <http://www.canri.nsw.gov.au>) (CANRI 2003).

The CANRI program relies on inter-agency and stakeholder cooperation, and maintains several committees and groups working towards building an integrated information access framework. CANRI is built on an open technology framework that consists of a suite of applications, catalogues and data repositories that enable maps from various websites to be accessed and operate on one system (Atkinson & van der Vlugt 2001). The CANRI program addresses six themes: coordination; data; systems; quality and standards; products and services; and communications (CANRI 2003).

### **The Victorian Property Information Project**

The Property Information Project (PIP) is a highly regarded partnership between the Victorian State Government through Land Victoria and the State's 78 Local Governments. Prior to the PIP initiative, Local Government was treated identically to any other prospective user or licensee, resulting in approximately one-third not utilising the State cadastral map. Land Victoria proposed funding an initiative to match or reconcile each Council's rating database with the cadastral map base, creating a State property layer to overcome state-wide inconsistencies and duplication of property information. The partnership arrangement offered each Council free use of the cadastral map base and periodical supply of fully maintained updates. In return, Council's agreed to adopt the State cadastral map base Vicmap Property™ maintained by Land Victoria (see <http://www.land.vic.gov.au>); allow key property information owned by the Council to be fed into Vicmap; and advise Land Victoria of all proposed plans of subdivision and changes to property information (ie. new street addresses) (Jacoby et al. 2002).

An approximately 12-month start-up phase introduced the concept to local governments, which saw 53 Councils signing the 'in-principle agreement' by June 1998. By early 2001, all 78 Councils had signed the initial contract and the 'agreement in-principle' with 73 having signed the formal agreement. PIP also brought some capital funding to assist local governments mostly with data reconciliation. Between AUD 15 000 and AUD 35 000 was made available to Councils, based upon agreed recommendations in the works program (Jacoby et al. 2002). One of the Councils reported 'finding' 400 land parcels which were not included in their property database, generating an additional AUD 90 000 pa income (increasing their annual budget 3%) (Jacoby et al. 2002). PIP went far beyond data reconciliation, encompassing allocation of property addresses, identification and incorporation of Crown lands into Council map bases and importantly, establishment of processes to support ongoing maintenance. The success of PIP has meant Vicmap is well positioned to supply Victoria's contribution to a Geographic National Address File (G-NAF) currently being constructed by the Public Sector Mapping Agencies Australia Ltd. (PSMA).

### **The Herbert Resource Information Centre**

The Herbert Resource Information Centre (HRIC) is a best practice Joint Venture GIS facility that supports the management of natural resources in the Herbert River catchment by providing and allowing access to geographic information, GIS tools and expertise (HRIC 2003). The HRIC developed from the Herbert River Mapping Project, which started in 1994. It was formed to facilitate the collection and sharing of data between eleven agencies from industry, community and the three tiers of government (local, state and federal) (Walker et al. 1999). It currently involves six Joint Venture Partners from three tiers of government, industry and primary producers to facilitate a common geographic view of the catchment and to enable synergistic planning amongst partners and the community (Walker et al. 1999).

The HRIC's vision is to disseminate geographic information within a collaborative framework to the advantage of all interested in the ecologically sustainable development of the Herbert River Catchment. Whilst the HRIC does not resource data capture and maintenance directly, it acts as a project manager to coordinate these activities. Through the centre's activities it aims to provide leadership and high level technical advice to assist all the Joint Venture Partners (JVPs) and improve communication and collaboration with the wider community (see <http://www.hric.org.au>). The HRIC is funded through annual cash and in-kind contributions from the JVPs and other project funding acquired during its operation.

### **The Queensland Property Location Index**

The Property Location Index (PLI) project provides a state-wide index of property street addresses matched to unique cadastral plan identifiers for all properties in Queensland (QSIIS Information Office, 2002). The project is a partnership arrangement involving Local Government Authorities (LGAs) and the Queensland Government Department of Natural Resources and Mines (NR&M). The PLI is intended to be a single, authoritative index for the whole of Queensland and is maintained and managed on behalf of the State by a Custodian appointed by the Queensland Spatial Information Infrastructure Council (QSIIC). The authoritative source for Real Property descriptions is the Queensland Government and the Department of Natural Resources and Mines administers these descriptions. The authoritative sources for street address are the relevant Local Authorities. There are 125 of these in Queensland.

The benefits to the Local Authorities from contributing to the PLI include improved data quality through the use of validation techniques, free use of the revised dataset within the LGA, an annual payment for their contribution and reduced requests for data from government and private organisations. The PLI is established through a Data Sharing and Licensing Agreement between each of the local governments and the state. Each participating local government receives an upfront fee for the exchange of the information and then a proportion of the sales of the combined product. As of May 2003, approximately 54 local governments or 43% had signed the formal agreement for supply of data. It is expected that up 90 local authorities will eventually participate in the data sharing and potential profit sharing arrangements (Barker, 2003).

The data in the PLI has been modelled on Australian Standard AS4212 and will contribute to the PSMA's development of the G-NAF. The first PLI agreements were established in 2000 and will expire in September

2003. A major stumbling block to date with the PLI has been the failure to gain the support of the major local authorities in SE Queensland. These local authorities comprise the major population base of the state.

### Comparison of case studies

Based on the GIS, organisational and collaboration literature and the Kevany (1995) approach, a series of collaboration factors were identified as common to the various fields in defining a collaborative arrangement. The humanistic factors such as trust, willingness or incentive, while acknowledged as important factors, have not been included due to the inability to make assertions from the available references alone. Such factors require further qualitative techniques such as interview. Table 3 summarises the four case studies in term of the collaboration factors. This will be used as a basis to contrast and compare the various collaboration types. The factors include; class, form of interaction, duration, funding, resources, sector and level of dependence of participating agencies on each other.

**Table 3 Factors of collaboration identified in the four case studies**

Collaboration factors	CANRI (NSW)	PIP (Vic)	HRIC (Qld)	PLI (Qld)
Sharing Class: Outcome/Purpose	Community data access, sharing resources and development	Reconciliation of datasets, reduce duplication, sharing resources, mutual needs	Joint Venture Partner and community access, sharing resources	Reconciliation of datasets, value added product, free partner access and paid external access
Interaction: Formal/Informal	Formal inter-agency agreements, informal community consultation	Initial informal agreement, final formal agreement	Overarching formal agreements, informal project arrangements	Formal agreements and licensing
Duration: Project or Ongoing Collaboration	Potential to be ongoing, subject to further funding	PIP project phase winds-up, transition to ongoing process	Initially project based, moving to greater independence and self sufficiency	Initial project, anticipated to be ongoing process
New Committees, Organisation Formed	Yes	No	Yes	No
Funding Source	State and Commonwealth, 'one-off'	Initial State funding, mutually self sustaining	Mainly State funded initially, move to support by Joint venture Partners	State incentives during first stage of operation, self funding in longer term
Resources Being Shared	Data, resources, skills	Data, resources, skills	Local data, resources, skills	Primarily data and some technical assistance
Number of Participants, Collaborators	12 State agencies, many other public, private, community participants	1 State agency, 78 local governments	6 Joint venture partners, numerous community groups	2 State agencies and 125 local governments
Benefit: Mutual, One-Way, Two-Way	Mutual benefit to partners, benefit to community	Two-way, Mutual Benefit to partners	Mutual benefit to partners, community benefit	Two-way, primary benefit to lead agencies
Sector: Public-Public, Public-Private	Predominantly State agencies, other public, private, community interactions	Local-State interaction	Multiple sector interaction including State, Local, NGO, private and community	Local-State interaction
Lead Agency	Yes, through committee representation	Yes	Not specifically as equal partners	Yes
Dependence (of Participants on each other)	Moderate	High	High for State, Low for Local	Moderate

Common to all of the case studies is the class of sharing. In each instance the outcome or purpose is to improve access and sharing data, resources and skills. The PIP and PLI have a central purpose to reconcile data and



benefit from reduced duplication of data and effort. All case studies enjoy a mutually benefiting collaboration. All the collaborations are largely project-orientated or initiated programs with the future possibility for long-term sustainable collaboration not assured. Initiatives are dependent on continued funding, rather than the collaboration becoming another function of each organisations business processes. The PIP and PLI project are well positioned for the collaboration to be integrated to the day-to-day activities of the organisations with their respective focus on a process outcome rather than managing collaboration through structured committees. The collaborations have a moderate to high level of dependence of participant organisations on each other. This moderate to high integration indicates a stronger collaborative framework and greater requirement for closer management of the relationships.

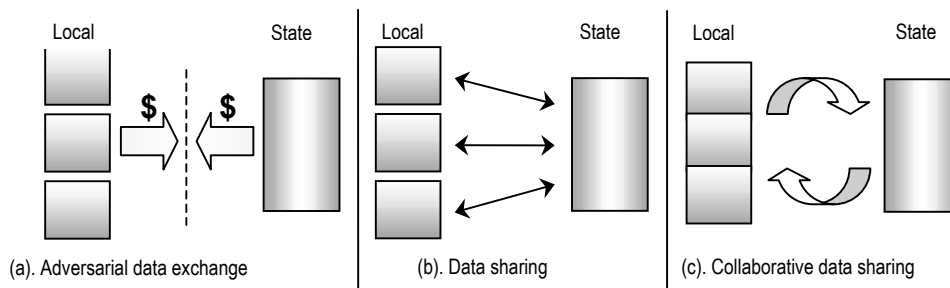
CANRI and HRIC both have a common community access mandate; they are both mutually benefiting collaborations, with community benefit as an outcome of the cooperative efforts. PIP and PLI also have a common mandate or purpose, to reconcile property information held by local government with the State datasets. While these two groups have related objectives, they differ in scale and size. CANRI has a core inter-agency agreement between 12 State agencies and many participating public (from all levels), private and community groups and bodies. HRIC involves a joint venture core of six agencies and similarly, many participating public, private and community groups and bodies. The Victorian PIP is lead by a single State agency and enjoys relatively high reach to 78 Councils across a small state. The Queensland PLI is lead in-conjunction by 2 State agencies and is striving to collaborate with 125 Councils across a very expansive state.

With the state-local collaborations of PIP and PLI, the lead agencies provided initial lump sum contributions in an effort to encourage up-front goodwill and assist local government to bring their systems up to speed. The 'carrot' approach was successful in Victoria where the majority of councils already had relatively advanced information systems. Also, previous years of local Government amalgamation had reduced the number of municipalities to 78, which provided an ideal environment of recent change to foster the new project. In the large states and territories that have to cope with immensely vast areas and dense coastal populations, collaborating with in excess of 100–150 municipalities with very different needs, responsibilities and capabilities has proved very difficult.

Although the 'carrot' approach was successful, it is unlikely to be the only answer to encouraging collaboration. A barter arrangement may be entered into where data of different types could be exchanged. Alternatively data could be 'traded' for training or skills-transfer. Capacity building in regional areas could have greater returns than through direct funding and will improve trust and goodwill. Collaboration between regional local governments could also be rewarded, to encourage sharing or consolidation of their spatial information efforts and the needs of their districts. Initiatives such as the New South Wales Inner Metropolitan Regional Organisation of Councils (IMROC) and the Illawarra region of Councils (IROC), and the South East Queensland Regional Organisation of Councils (SEQROC) are well-established collaborative arrangements.

## Discussion

The data distribution culture has proliferated throughout Australia with public data-provider agencies selling data to a customer base that includes the private industry, other public agencies and the community. Although these business models provide a relatively steady stream of revenue to support the maintenance and update of the spatial data, they restrict the opportunity for sharing, particularly between public agencies and levels of government, where two or more custodians may have mutually benefiting data. Figure 2 illustrates the various flows of data in local-state interactions. In many cases, data custodians are purchasing data to update their datasets, in-turn selling the complete datasets back to supply agencies as depicted in Figure 2 (a). In Figure 2 (b) and (c) the flow or access to data is not restricted as in the PIP and PLI programs.



**Figure 2 Local–State interactions: (a). Data flow restricted by business model, (b). Data/resource sharing regime, (c). Collaborative data/resource sharing and update regime.**

Improving access to data is central to SDI. Data is only useful if it can be discovered, is in a usable format, has sufficient metadata to determine its fitness for use and can be readily obtained (Atkinson & van der Vlugt 2001). The price of data is not necessarily a barrier where the purpose for which it is required justifies the expense. However, the intellectual property restrictions imposed or vested with the data provider can reduce an organisations ability to use the data for the required purpose.

Importantly, data sharing is not solely about mutual exchange of datasets. Rather, sustainable data-update regimes need to be established between organisations or agencies that have a responsibility to collect a particular data type and those agencies that are responsible for maintaining the complete dataset for the entire region or jurisdiction. Baker (2002) in a study of public topographic map production in NSW, notes that changes made to each new map edition may already be recorded by other government bodies as a result of their specific core business activities. There is a wealth of spatial data held and recorded in duplication by multiple agencies that can be liberated through collaboration in order to harvest its full potential.

This theory is consistent with hierarchical model of SDI documented by Rajabifard et al. (2000a; 2000b) such that lower administrative levels contribute to SDI at a higher level. It furthers this thinking, with emphasis on the return contribution from higher levels to the lower, and proposes that equal-partner relationships flourish outside of the hierarchical order of responsibility, where all stakeholders have an equally important role. Such an environment fosters data sharing and can only be achieved through willing collaboration.

Review of the various fields of literature and of four case examples confirms that collaborations are a complex set of relationships, both formal and informal, they are dynamic and difficult to classify in the absence of a unified approach to their understanding. The review reveals that increasing the number participants increases the complexity and difficulty in managing a collaborative arrangement. Consolidation of collaborative arrangements could potentially overcome difficulties in managing large initiatives; while the Victorian PIP benefited from reach across a small state, the PLI may benefit from the collaboration of local government regions, rather than numerous individual Councils.

Success of collaboration is dependent on the uptake and integration to the business processes of partner-organisations. Organisations participating do not readily transfer cooperative agreements or policies back to the organisation for local change. This raises the question of the ability and authority of an agency representative to speak on behalf of the organisation, their ability to act in the group or organisations best interest, and ability to influence organisational change as a result of cooperative outcomes. Ventura (1995: p.172) recognised that GIS and related technologies are being independently implemented without coordination or control across jurisdictions and levels of government. The same can be said for data sharing and collaborative initiatives. The common response to this problem is creation of an overarching body to coordinate and synchronise these efforts, usually in the form of councils, inter agency agreements and new organisations. Ventura (1995) states that the effectiveness of such organisations is likely to be dependent on underlying institutional, organisational and behavioural factors together with their specific mandate.

Of the case examples, duration of the collaboration does not appear assured; all are partially or wholly dependent on continued funding allocation rather than self or mutually perpetuating. The cases are all of a

project nature and unlikely to yield ongoing collaboration, funding and effort without the project framework to stimulate activity amongst participants. This potentially indicates a need for a virtual organisation or coordination structure to support sustainable collaboration. Of the case examples, the simpler one-to-many arrangements appear to have strong short-term outcomes, a focused direction and relatively easier to manage. The difficulties in many-to-many arrangements (in the absence of a central, dominant or lead agency) may cause a higher risk of relationships deteriorating.

## Conclusion

In summary, this study has confirmed that collaborations are a complex set of relationships, both formal and informal, they are dynamic and difficult to classify. The case examples demonstrated that the basis for the collaboration is not data sharing alone, and involves the sharing of resources, development efforts and technical skills. Also, different data types and themes involved a different array of stakeholders and set of relationships. The review identified that an increase in size and scale, increases the complexity and difficulty in managing a collaborative arrangement. Further, the success of collaboration is dependent on its uptake and integration to the business processes of partner-organisations.

Project orientated collaboration was clearly the common approach, providing a strong framework to stimulate activity amongst participants and proving successful in achieving strong short-term outcomes. However, sustainability of the collaboration is not assured with a project approach, which is highly dependent on funding renewal. Unless a key objective of the project is to integrate collaborative activities into the day-to-day the business processes of partner-organisations, or to become self-perpetuating, the relationship will likely deteriorate after the term of the project. Simpler one-to-many arrangements with a single lead agency appeared to have strong short-term outcomes with focused direction, and appeared relatively less effort to manage.

The data distribution culture has proliferated throughout Australia, restricting the opportunity for resource sharing, particularly between public agencies and levels of government. To reduce duplication of data and effort and facilitate access, it is critical that organisations begin to collaborate more effectively. Organisational, institutional and economic barriers can be overcome through collaboration and building better partnerships. Collaboration is the key to unlocking the potential of sustainable SDI that will underpin Australia's future economic, environmental and social development.

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