

Home	Table of Contents	Titles & Subject Index	Authors Index
----------------------	-----------------------------------	--	-------------------------------

An assessment of the accessibility of spatial data from the Internet to facilitate further participation with geographical information systems for novice indigenous users in South Australia

Paul A. Corcoran

Geospatial Information Science Lecturer, Barbara Hardy Institute, School of Natural and Built Environments, University of South Australia, Adelaide, South Australia, Australia. E-mail: Paul.Corcoran (at) unisa.edu.au

Received May 30, 2012; Accepted August 21, 2012

Abstract

Geographical Information Systems (GIS) are becoming more widespread, but there is still debate as to whether the use of GIS is a socially inclusive activity and, within this debate, the accessibility of spatial data is a pertinent issue. Governments around the world have developed Spatial Data Infrastructures (SDI) to facilitate the dissemination of spatial data and Australia, Canada and the United States are acknowledged leaders in this field. Such initiatives have the potential to bring new users, for example Indigenous people, to GIS but with this expansion there is a consequential demand for up-to-date and freely available spatial data. This paper evaluates the accessibility of spatial data from the Internet within Australia and contextualises performance with a comparison with Canada and the United States. The GIS industry has a variety of terms for data and this research uses the most popular of these to search the Internet for webpages containing spatial data. A traditional information retrieval technique (Precision) is used to analyse the webpages returned, and is supplemented with further analyses regarding webpage ranking and industry sector. The main findings indicate approximately 50% of retrieved webpages contained free data, but reveal that Australia performs worse than North America in comparison. The highest ranking websites are Canadian, and governments are the dominant spatial data providers. This research indicates that Australian data is not easily accessible and, if the public are to be more engaged, the delivery options should be reviewed.

Keywords

Spatial data infrastructures; Social inclusion; International comparison; Internet; Accessibility; Geographical information systems; Australia

Introduction

An initiative within the State of South Australia, Australia, assessed and promoted the use of Geographical Information Systems (GIS) by Indigenous and non-Indigenous people involved with the management of Indigenous lands and waters (Corcoran, 2008). This initiative identified minimal use of GIS by Indigenous people in South Australia and acknowledged that the next phase was to expand the use of GIS within an Indigenous group. GIS, which began in the 1960s (Tomlinson, 2007), integrates hardware, software and spatially referenced data (Fazal, 2008) and has been purported to be a useful tool and a mechanism by which to engage and empower marginalised groups such as Indigenous peoples with decision-making capabilities that affect their lives (Kyem, 2000). Examples exist of successful Indigenous GIS projects; for example Carver et al. (2009) and Grech et al. (2008). Conversely, others have questioned the use of GIS within an Indigenous context indicating that such groups may not have sufficient access to GIS, therefore do not engage with GIS and thus miss out on opportunities that GIS may provide, especially in relation to participatory policy-making (Rundstrom, 1995; Obermeyer, nd). Therefore, to facilitate further participation with GIS for Indigenous people and counter such concerns as those of Rundstrom (1995) and Obermeyer (nd), it would seem prudent to take the first important step and make spatial/geographic data as freely available as possible for, as Cowan (2008) indicated, '... without data there are no GIS applications'.

A number of governments across the world have developed strategies to promote the use of spatial data to all groups in society irrespective of their use or familiarity with GIS via SDI ([Masser et al., 2008](#)). A SDI is a mechanism to enable the wide dissemination of spatial data through a GIS and mapping search engine ([Longley et al., 2011](#)). Countries such as Australia, the United States and Canada that have been at the forefront of SDI developments are acknowledged as leaders in this field ([Masser, 2002](#)) and consequently have been used as role models to assess the effectiveness of SDI ([Holland et al., 2010](#)). However, in Australia many potential users of GIS still face problems due to the vast number of spatial datasets and the disparate levels of government and multiple jurisdictions providing spatial data ([Kelly & Searle, 2009](#)). They suggested that with the advent of technologies such as Google Earth, user expectations have been raised and Australia needs a quick response from the governmental and private sectors.

Given these differing opinions with regards to spatial data accessibility, facilitating an expansion of GIS with the novice Indigenous users in South Australia could be problematic. As such, this paper assessed if free spatial data is readily available via the Internet, by undertaking Internet searches for spatial data that could be used in South Australia using a variety of search engines and search terms. The webpages returned were analysed and discussed to assess the level of spatial data available, evaluated as to whether the main providers of data are prominent, determined if governments dominate the delivery of spatial data via the Internet and finally highlighted issues that are raised through this research. In order to contextualise the Australian performance, a comparison with the other leaders in SDI, namely Canada and the United States, is included.

Background

Indigenous peoples' attachment to land and water underpins their sense of community and provides a basis for social, ritual and economic life ([Butt et al., 2001](#)). In countries such as Australia, the United States and Canada the loss of connection to lands and waters due to colonisation and the subsequent struggle for recognition and management has added anxiety, pressure and hostility to the relationships between modern day first-nation peoples and the incumbent post-settler governments. Indigenous people view the battle for restoration of their rights as key to self-determination and economic survival ([Lane & Hibbard, 2005](#)). As of June 2007, approximately 20% of the Australian landmass has been returned to the Indigenous peoples ([Altman et al., 2007](#)) and the approach to the management of these lands has shifted towards what [Reddell](#) (2004) referred to as the Third Way, an approach that incorporates governments and communities working towards devolution, inclusion, and partnership.

Within the context of GIS, if government agencies wish to work with people, expand their services and make spatial data widely available, the Internet would be the most appropriate vehicle to do this. With the rapid expansion of the Internet through the 1990s and 2000s, new opportunities arose for organisations to create competitive advantage through e-business ([Roberts & Toleman, 2007](#)) and the use of good web tools was identified as critical to any future success for organisations operating in the e-commerce environment ([Jansen & Mollina, 2006](#)). Governments embraced e-business and developed a strategy that could deliver "...citizens and organizations with more convenient access to government information and services; and to provide delivery of public services to citizens, business partners and suppliers, and those working in the public sector" ([Turban et al., 2002](#)). On the consumer side, Internet users tend to use search engines to locate the information they need ([Gandal, 2001](#); [Awad, 2004](#)) and exhibit two types of behaviour: goal directed or experiential ([Spiteri, 2000](#)). Goal directed searchers often have a specific website (or part thereof) in mind, as in the case of locating spatial data, whereas experiential searchers are more open ended surfers of the Internet. The United Nations (UN) further developed the concept of e-inclusion through 'The Socially Inclusive Governance for Information Society Framework' that aimed to provide equality of opportunity to participate in e-business. The foundations of the UN e-inclusion vision were based on the belief that all people should have equal access to data and this could only be achieved if political, technological, economic and social barriers were removed. Furthermore, an e-inclusive government has the potential to address the issues of the digital access-divide and promote opportunities for economic and social empowerment of all citizens ([UN, 2005](#)).

A variety of terms are used to refer to 'data' within GIS professional circles, for example, 'spatial data' or 'geographical data' ([Heywood et al., 2006](#)), 'spatial information' ([Bolstad, 2008](#)), 'geographic data' and 'geospatial data' ([Wilson & Fotheringham, 2008](#)) and 'geographically referenced data' ([Chang, 2008](#)). Furthermore, as data and information are sometimes used interchangeably having an understanding of these different terms would be useful for potential GIS users. Data can be characterized as actual facts and figures collected and stored in a database ([Stair & Reynolds, 1998](#)), whereas information is produced once data has been transformed through a process (Figure 1).

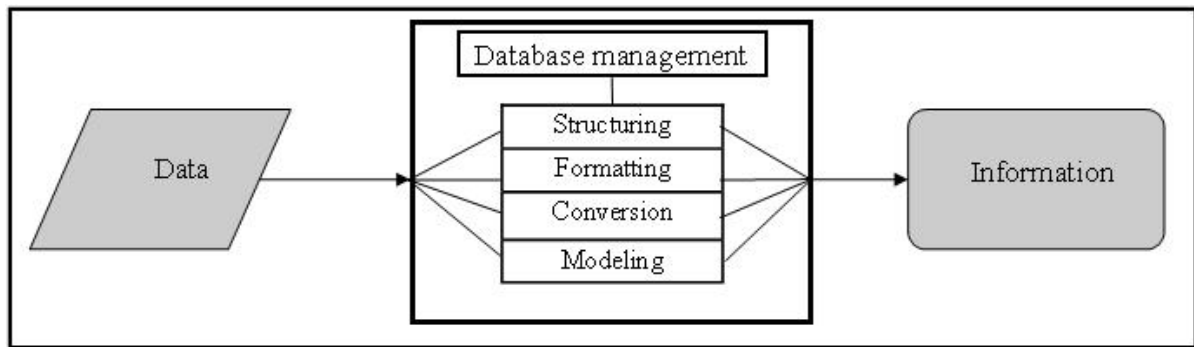


Figure 1. Transformation of data into information (Adapted from [Lo and Yeung, 2007](#))

Nevertheless, whichever term is used, GIS requires data in a digital format and a source for supply, e.g. SDIs. Canada, the United States and Australian governments have continued to develop SDIs with an emphasis on a bottom up approach, as the majority of value-adding occurs at local or regional levels ([Craglia & Campagna, 2009](#)). Additionally, [Craglia & Campagna \(2009\)](#) indicated that the most effective SDIs involved social interactions between people and organisations, in effect indicating that best practice is driven by users and not data providers. However national approaches are still evident, as in Australia, with the data distribution framework known as the Australian Spatial Data Infrastructure (ASDI) that involves people, policies and technology to deliver data ([ICSM, 2012](#)). The ASDI was initiated in the late 1990s and a recent review concluded that ASDI should:

- lead with a vision to 'facilitate the spatial enablement of Australia';
- contribute to and help support the Virtual Australia concept; and
- act as a foundation for the delivery of resources ([Geomatic Technologies, 2008](#)).

An important part of the ASDI that had been developed is the Australian Spatial Data Directory (ASDD) which, although predominantly a metadata service, is regarded as one of the main sources for data in Australia ([Najar et al., 2006](#)). Other national sources for data acquisition in Australia include the national mapping agency known as Geoscience Australia which has a dedicated free data delivery service known as MapConnect that enables datasets at or below 1/250,000 scale data to be downloaded. In addition Australia also has the Public Sector Mapping Agency (PSMA) which is an unlisted public company owned by the Federal and State governments ([PSMA, 2012](#)). The PSMA offer, at a price (a significant cost for most users), six datasets namely: administrative boundaries, cadastral boundaries, postal information, points of interest, post code boundaries, and transport and topography. On a regional level the South Australian government provides certain datasets free through facilities such as the South Australian Resources Information Geoserver (SARIG) developed and managed by Primary Industries and Resources of South Australia (PIRSA), NatureMaps produced by the Department of Environment and Natural Resources (DENR), Department of Planning and Local Government (DPLG) and, finally, the South Australian Government wide Atlas of South Australia.

GIS has a role to play in the management of Indigenous lands and waters but to be successfully employed it needs to be an inclusive process. To attain this, the basics of GIS - namely spatial data - need to be readily and freely accessible and there seems to be debate within the literature as to whether or not this is apparent in Australia and consequently there is a need for this to be examined.

Method

To achieve the research aim proposed in this paper, the method was split into data collection and data analysis. In order to maintain a consistent approach in the data collection procedure across the geographical localities the data collection method selected standard search terms, coupled with a consistent set of search engines, which enabled replication in Australia, Canada and the United States. The data collected was then analysed using an assessment of the success of accessing spatial data through the use of Information Retrieval (IR) techniques, an evaluation of whether the main providers of data were in prominent positions on the first page of results returned through a ranking procedure and, finally, gauged whether governments were indeed the main providers of data with an assessment of webpage industry sector.

Data collection

The data collection method adopted the approach of [Smith \(2003\)](#) in that the research was about the search results not user behaviour and, consequently, researchers undertook all the Internet searches. [Wang et al. \(2005\)](#) indicated that the geographical location of a user has the potential to bias results and, as such, this factor was incorporated to maximise the chances of obtaining data by undertaking the searches in the respective geographical locations. Furthermore, to investigate if a regional or national approach to SDI was preferable, e.g. the searches undertaken in South Australia were prefixed with 'South Australia' and 'Australia', to determine whether a national geographical prefix affected webpage returns.

With regards to the spatial data, keywords were derived from a combination of the previously identified GIS terminology, peak professional bodies such as Australia's Surveying and Spatial Sciences Institute and education establishment initiatives that promote the public use of GIS such as Pennsylvania State University's Geospatial Revolution ([PSU, 2012](#)). The resulting terms used in the searches were 'Spatial data', 'Spatial information', 'Geospatial data', 'Geospatial information', 'GIS data' and 'GIS information'. Therefore, combining geographical location and keywords, examples search terms were '*South Australia* spatial data', '*Australia* spatial data'. [Wang et al. \(2005\)](#) also commented that bias could be introduced through choice of search engine. To alleviate this, searches were performed using four global search engines (Google, Bing, Yahoo and AOL) and one local to the geographical location (e.g. Webwombat in Australia).

The research involved an international comparison with the other leaders in SDI development, namely Canada and the United States, and therefore there was a need to identify a suitable province/state within those countries to compare with South Australia. In the process of benchmarking, comparisons are made with others to determine good practice ([Evans, 1994](#)) and as such the locations need to be prominent in the use of GIS within an Indigenous setting. Using a combination of a literature review (e.g. [Carver et al., 2009](#)) and snowball sampling (where contact was made with prominent people in locations involved with Indigenous GIS) the province of British Columbia in Canada and the State of Montana in the United States were chosen. Indeed, British Columbia is the home of the Aboriginal Mapping Network, an organisation created by First Nation to promote the use of GIS by Indigenous people. The Internet search method performed in South Australia was replicated in British Columbia and Montana respectively, e.g. using search terms encompassing 'British Columbia spatial data' and 'Canada spatial data'.

Regardless of the search engine and search terms used, a multitude of identified webpages could result. As [Spink & Jansen \(2005\)](#) pointed out, users for e-commerce tended to use the first one or two pages of results and [Lewandowski \(2005\)](#) reported that a typical search lasted less than 15 minutes. For the purposes of this research, the first 10 identified webpages (i.e. first page) returned by each query and search engine were included.

Data analysis

To assess the success of retrieving data, Precision and Recall are two classic information retrieval techniques that can be employed ([Lewandowski and Hochstotter, 2008](#)) with both techniques relying on a subjective judgement regarding the relevance of a webpage. For the purposes of this spatial data research, a webpage was deemed relevant if spatial data could be supplied for use in the respective regional location via physical media such as a Compact Disc (CD), webportal or geoportal. A webportal guides users to other related websites ([Tatnall, 2005](#)), whereas as geoportal enables spatial data to be directly downloaded from a website ([Longley et al., 2011](#)). This approach excluded spatial metadata as this only gives details about spatial data such as content, lineage, coordinate system and characteristics ([Bolstad, 2008](#)). [Shafi and Rather \(2007\)](#) noted that Precision related to the proportion of relevant webpages returned but, given the potential for a high number of webpages resulting from a query, this could be problematic. Therefore, to manage the problem, the approach used by [Tongchim et al. \(2007\)](#) that calculated precision measured at a certain cut-off value, i.e. the first 10 results was employed. For example, if all webpages returned relevant spatial data then a score of 1.0 would result:

$$\text{Precision} = \frac{\text{Number of relevant webpages returned by a search engine (10)}}{\text{Total number of webpages selected for evaluation (10)}} = 1.0$$

Sampath [Kumar and Prakash \(2009\)](#) identified that Recall, conversely, was the ability to retrieve all relevant webpages, but they highlighted that knowing the number of all the webpages available was impossible and therefore a Relative Recall (RR) was required. RR was created by pooling the number of

all relevant webpages found by all search engines. So, using the spatial data example again, if all webpages returned from a query were relevant:

$$\text{Precision} = \frac{\text{Number of relevant webpages retrieved by a search engine (10)}}{\text{Sum of the relevant webpages retrieved by all 5 search engines (Google, Yahoo, Bing, AOL, local search engine) (300)}} = 0.033$$

However, [Smith](#) (2003) cautioned about the use of both techniques when a cut-off value was used, for example the first 10 webpages, as Precision and Recall would be proportional and consequently there would be little value in employing both techniques. As this spatial data research needed to evaluate accessibility, knowing the different options available to retrieve data would be of interest. [Sampath Kumar & Prakash](#) (2009) noted that a Scale of Relevancy could be employed when using Precision and consequently was chosen as the preferred option from the two alternatives. Accordingly, each webpage was given a score; 0 = No GIS topic, GIS article, spatial metadata , 1= Physical media, 2 = webportal , 3= geoportal.

To complete the spatial data example using Precision (Relevancy), if each of the 10 webpages returned a geoportal, each webpage was given a score of 3:

$$\text{Precision (Relevancy)} = \frac{\text{Sum of the scores of webpages received by a search engine (30)}}{\text{Total number of webpages selected for evaluation (10)}} = 3.0$$

With regards to an evaluation of whether the main providers of data were prominent for users to access data, [Craswell and Hawking](#) (2009) suggested that in addition to users investigating the first page of results it may, in fact, be the first one or two results that are pursued. Consequently, it was interpreted that the main providers of spatial data needed to occupy these positions. Therefore, a webpage returned was ranked 1st, 2nd, 3rd etc. and then given a score relative to the position it attained on the search results. For example, 1st position was awarded 10, 2nd 9, 3rd 8 etc. The relevant webpages were then extracted and webpage ranking totals calculated.

Finally, with reference to e-commerce, and to gauge whether governments were making their spatial data accessible, the industry sector (i.e. government, private or education) of the webpage was also recorded. Allied to this, the aforementioned initiative in South Australia that researched GIS use by Indigenous people involved reviewing the use of spatial data from different industry sectors, so it was useful to highlight the data sources.

Results

Using the six geographic locations, six search terms and five search engines returned a total of 1800 webpages. Evaluation of each webpage determined that of the 1800 sites 1016 were relevant, but many were duplicates. Removing the duplicates reduced the number of relevant webpages to 306.

Accessibility of data ((Information Retrieval - Precision (Relevancy)))

The maximum Precision (Relevancy) score attainable under this analysis was (3.0), and the results (Figure 2) revealed that Canada (1.7) had the best overall return across all the search terms and all search engines, whilst South Australia (1.07) returned the least relevant webpages.

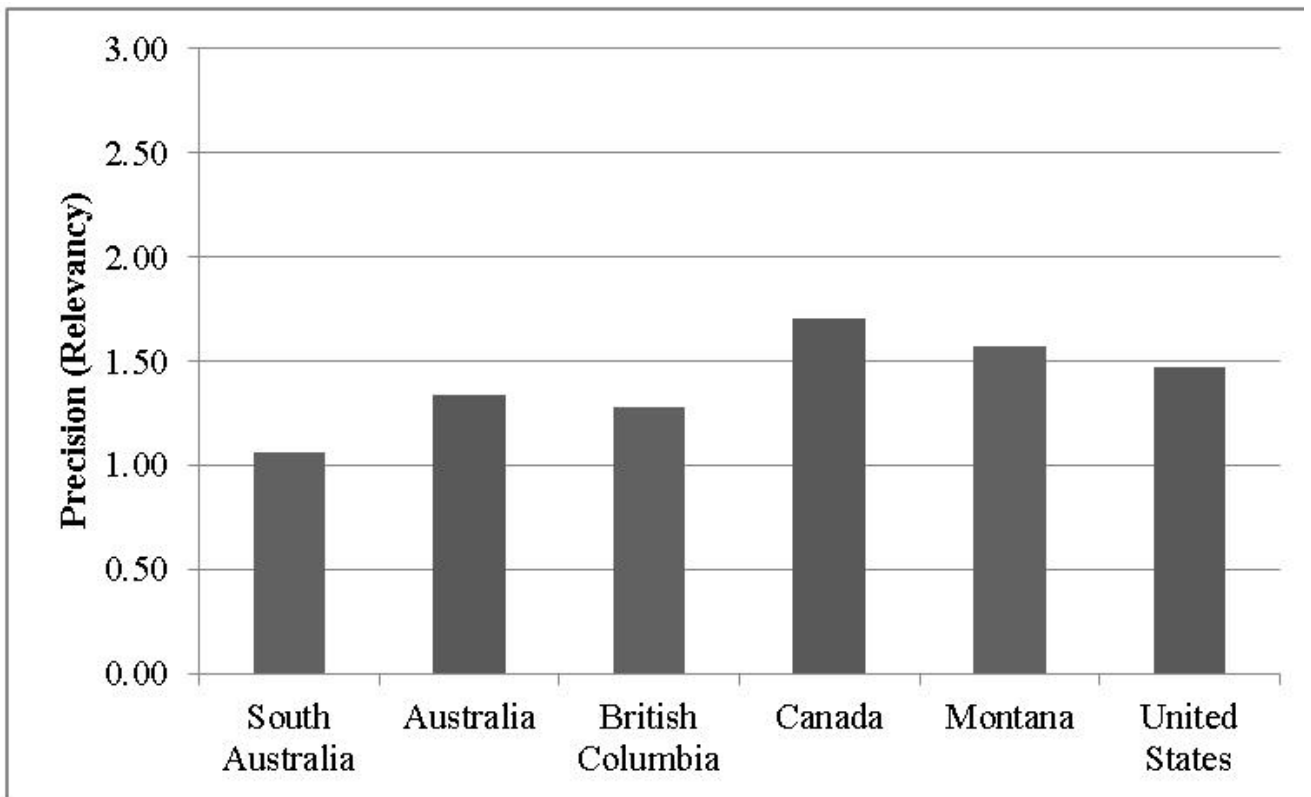


Figure 2. Overall result from Precision (Relevancy) analysis

The search terms used both 'data' and 'information' and, to this extent, the analysis (Figure 3) indicated that 'data' was more frequent with the first 6 positions out of the 12 search terms applied. Conversely, the worst result was for 'information' when used in conjunction with the search term South Australia (0.77).

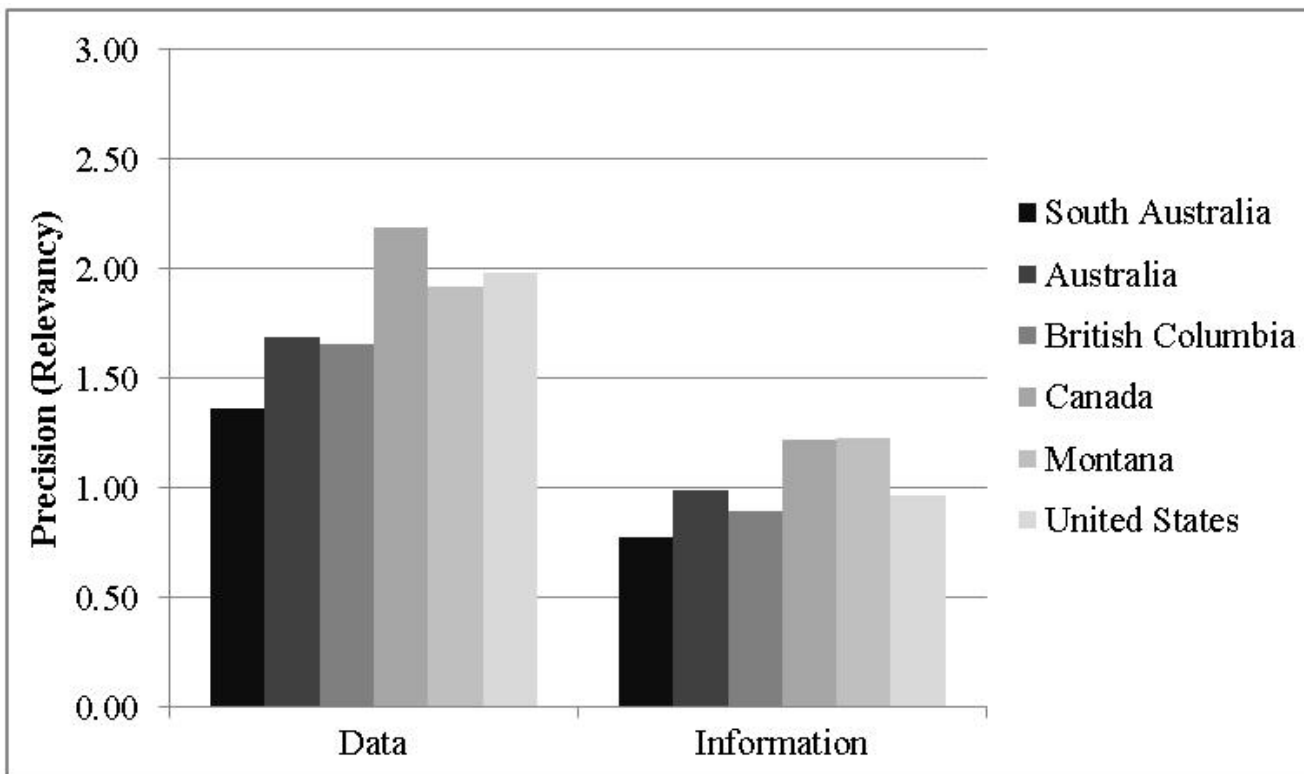


Figure 3. Comparison of the terms 'data' against 'information'

Subdividing 'data' into 'spatial', 'geospatial' and 'GIS'; revealed the dominant term was 'GIS' with a mean precision (relevancy) of (2.09), while 'spatial' and 'geospatial' were more closely aligned on (1.64) and

(1.66) respectively (Figure 4).

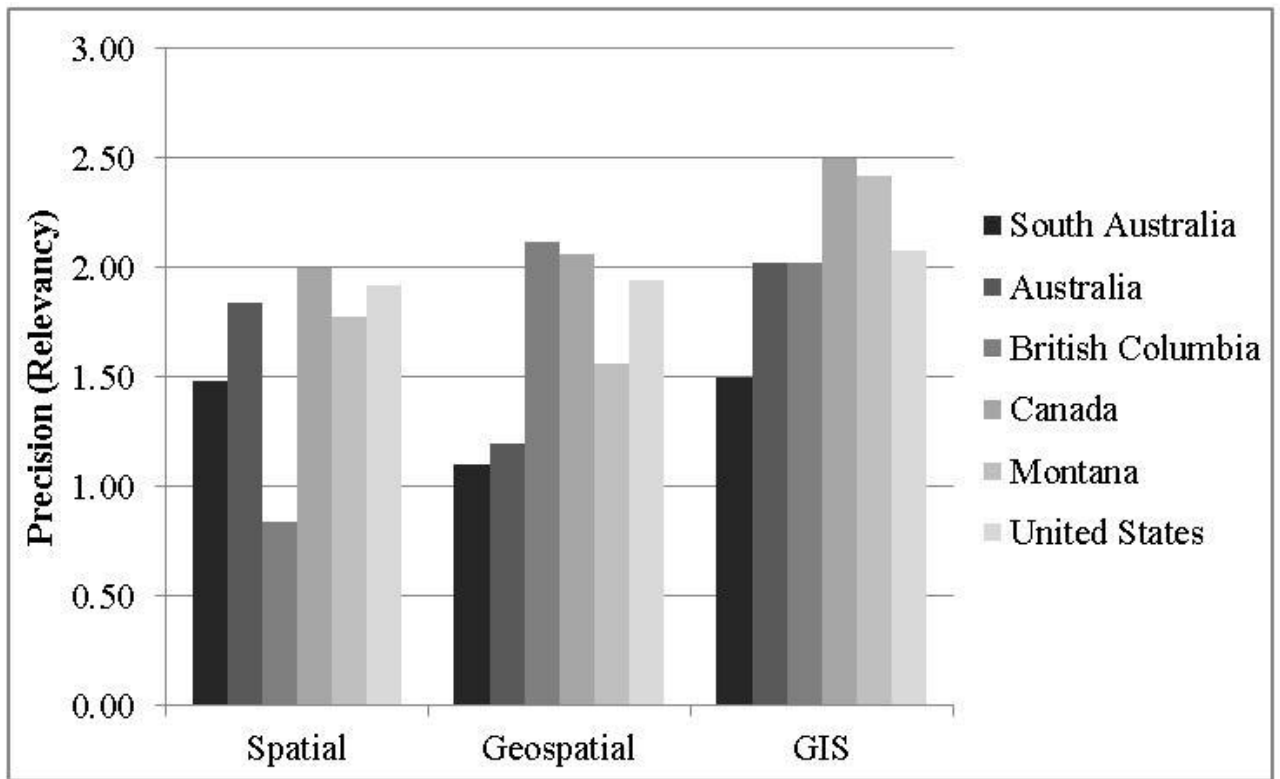
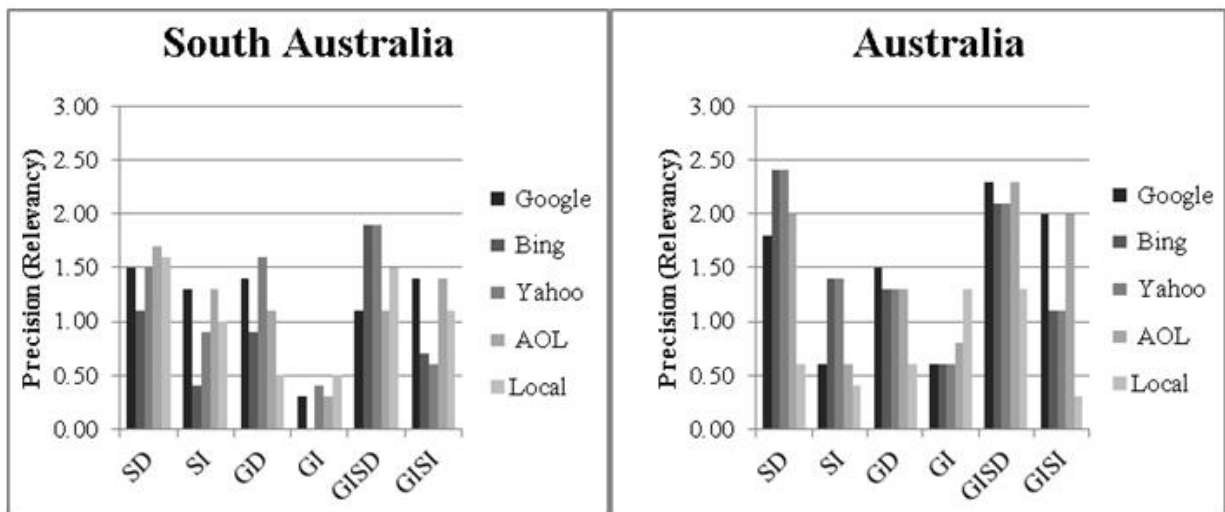


Figure 4. Comparison of terms used with 'data'

Breaking the analysis down further into the results for each combination of geographic location, search term and search engine (Figure 5), GIS data resulted in a value of (2.70) in Montana with Bing and Yahoo search engines, and in Canada using AOL. The worst result (0.00) occurred from the following combinations; (Bing&South Australia&Geospatial information), (Google&Montana&Geospatial information), (Local&United States&Spatial information). The mean precision using all search engines varied from (2.50) (Canada&GIS Data) to (0.30) (South Australia&Geospatial information).



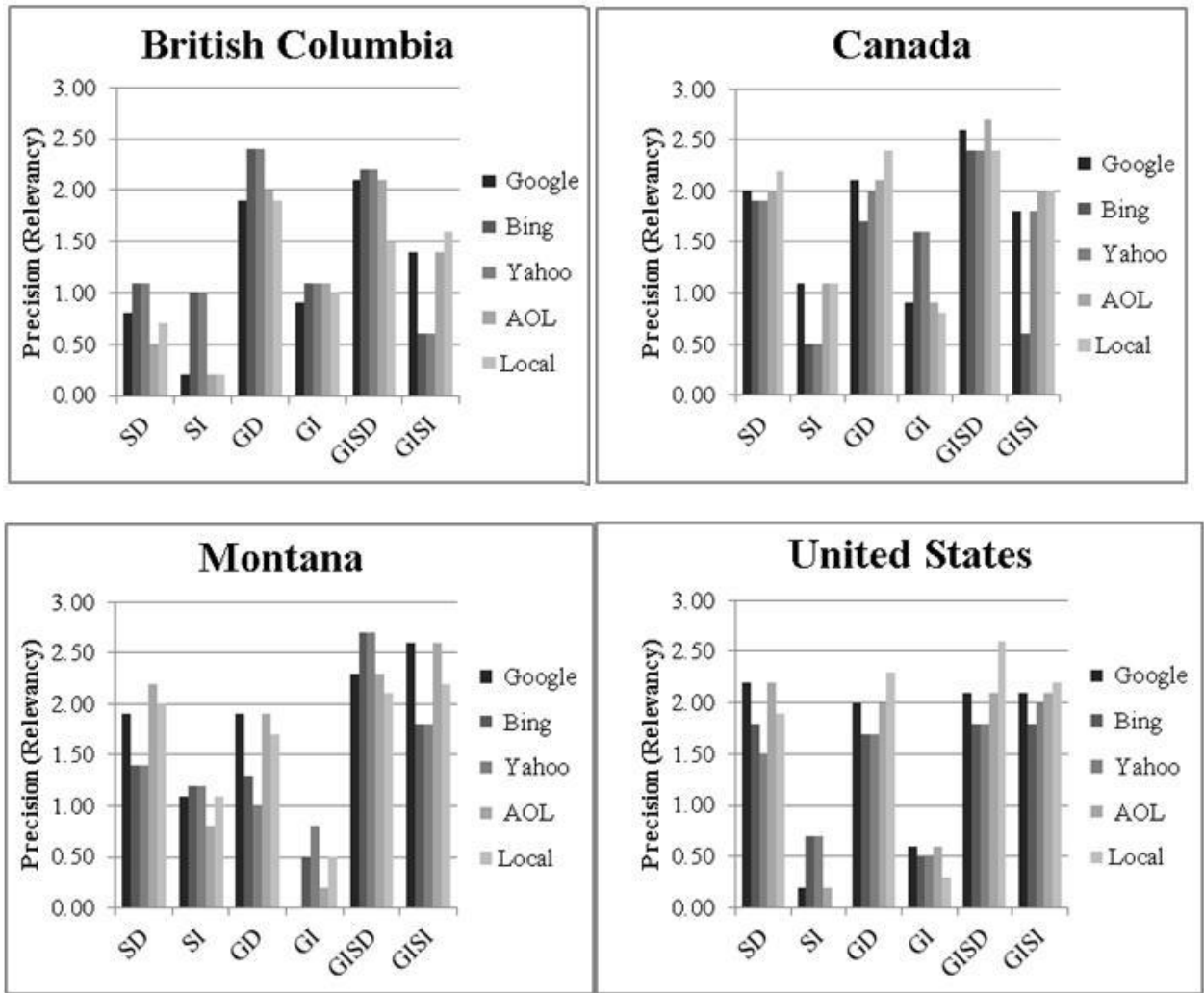


Figure 5. Precision (Relevancy) and mean per search term for each geographic location

[Note: for chart clarity, the following abbreviations were used; Spatial data (SD), Spatial information (SI), Geospatial data (GD), Geospatial information (GI), GIS data (GISD), GIS information (GISI)]

Main providers of data prominence (Ranking)

The importance that [Craswell and Hawking](#) (2009) attributed to the position of a webpage on an Internet search result listing is an indication that webpages with the highest position will be evaluated further. As such, the top 5 webpages from each location that gained the highest score due to their position on the first page of results were recorded and from that list of 30, the top 2 from each location were identified (Table 1). The ranking measure had a maximum score of 300 ((1st position on each search engine (5x10) x 6 search terms)). Canadian organisations were at the fore with Natural Resources Canada (168) and GeoBC (164) occupying the first 2 positions, followed by United States organisations in positions 3 and 4 (the United States Geological Survey (136) and Montana State Library (133)). Australian organisations scored poorly and ranked 15th, 18th, and 21st (Primary Industries and Resources South Australia (66), GITA (60) and Department of Planning and Local Government South Australia (56)) and the Australian search was also a little less independent returning an international private webpage GIS Lounge (62).

Table 1. Webpage rankings

Overall ranking	Search location	Score	Webpage	Organisation	Precision (Relevancy)
1	Canada	168	geogratis.cgdi.gc.ca/	Natural Resources Canada	3
6	Canada	100	www.lib.uwaterloo.ca/discipline/Cartography/gis/statedata.html	University of Waterloo library	2
2	British Columbia	164	geobc.gov.bc.ca/	GeoBC - British Columbia Govt	3

13	British Columbia	67	empr.gov.bc.ca/Mining/Geoscience/MapPlace/geoData/Pages/default.aspx	Ministry of Energy and Mines and Responsible for Housing - British Columbia Govt	3
3	United States	136	usgs.gov/ngpo/	United States Geological Survey	3
7	United States	95	data.geocomm.com/catalog/US/	Geo Community	3
4	Montana	133	nris.mt.gov/gis/	Montana State Library - MT Govt	3
5	Montana	125	giscoordination.mt.gov/msdi.asp	Dept of Administration Information Technology Services Division - MT Govt	3
15	South Australia	66	pir.sa.gov.au/minerals/data/geoscientific_gid_datasets/south_australian_solid_geology	Primary Industries and Resources of South Australia - South Australia Govt	3
21	South Australia	56	planning.sa.gov.au/go/spatial-data-download	Dept of Planning and Local Govt - South Australia Govt	3
16	Australia	62	gislounge.com/australian-gis-data-and-resources/	GIS Lounge	2
18	Australia	60	gita.org.au	Geospatial Information & Technology Association	2

Government supply of data (Industry Sector)

The results from the retrieval processes were categorised by geographic locality and industry sector, either government (G), education (E) or private (P). The webpages were also subdivided according to the delivery media where physical media was allocated (1), a webportal (2) and a geoportal (3). Very few suppliers used physical media, education suppliers preferred webportals and government predominately supplied downloadable spatial data through geoportals (Table 2).

Table 2. Number of retrievals per industry sector and country by relevancy

	Relevant webpages	Relevancy 1 physical media	Sector G E P			Relevancy 2 Webportal	Sector G E P			Relevancy 3 Geoportal	Sector G E P		
			G	E	P		G	E	P		G	E	P
South Australia	51	2	1	0	1	27	14	8	5	22	22	0	0
Australia	61	1	1	0	0	44	29	6	9	16	14	0	2
British Columbia	45	0	0	0	0	29	3	18	8	16	12	1	3
Canada	59	0	0	0	0	31	4	15	12	28	25	0	3
Montana	51	0	0	0	0	14	7	5	2	37	31	1	5
United States	39	1	0	1	0	17	2	15	0	21	18	2	1
Total	306	4	2	1	1	162	59	67	36	140	122	4	14

Discussion

If the public are to be encouraged to use GIS then readily accessible spatial data is a necessity. [Masser \(2002\)](#) indicated that Australia appeared to be one of the better countries in the world for SDIs, along with Canada and the United States. Thus Australia was in a position to provide its citizens with online access to spatial data; however, [Kelly and Searle \(2009\)](#) countered this claim and indicated that access to data was difficult.

Accessibility of data ((Information Retrieval - Precision (Relevancy)))

The Precision (relevancy) analysis reinforced [Kelly and Searle's](#) (2009) result with Australia lagging behind Canada and the United States both on a regional and national level. There were some similarities though in the results; for example all locations returned more webpages using the term 'data' which could reinforce the assertion of [Lo and Yeung](#) (2007) that data are required to produce information. Additionally, all locations returned more webpages using 'GIS' than 'geospatial' or 'spatial' which could reflect 'GIS' being the overarching terminology used since the inception of the technology in the 1960s and as such is the 'familiar' term as opposed to the more recent terms of spatial and geospatial. But the differences between Australia, Canada and the United States became apparent when individual location webpage returns were analysed. Searches using national prefixes, Canada (1.7) and the United States (1.47) performed better than Australia (1.34) and similarly for the searches using province or state prefixes; British Columbia (1.28) and Montana (1.57) scored higher than South Australia (1.07). This analysis also suggested that even though [Craglia and Campagna](#) (2009) emphasised that a regional approach to SDI was preferable these results showed that the national approach resulted in more "hits".

Main providers of data prominence (Ranking)

With the importance attributed by [Craswell and Hawking](#) (2009) to being first or second on a list of webpage returns, it would seem imperative for the main providers of data to be in these positions. Within the ranking analysis, webpages from the data delivery services of the main government departments responsible for mapping in Canada (Natural Resources Canada - GeoGratis), British Columbia (Government- GeoBC), United States (United States Geological Survey - Geo-spatial One-Stop) and Montana (State Library -NRIS) held the top positions. The highest ranking webpages returned for Australia and South Australia were the private company GIS Lounge and the State government department PIRSA respectively, neither of which are recognised as the main provider of data for those respective locations. The highest ranked webpage using the national 'Australia' prefix was the ASDD, which reflected [Najar et al.](#) (2006) assertion of it being the main source of data in Australia. However, its low position in this analysis could be reflective of an acknowledged need to improve the ASDD with Geoscience Australia, the Australian national mapping agency, being given the task of piloting a replacement web service, GeoNetwork ([Geomatic Technologies](#), 2008). Even Geoscience Australia's own MapConnect data delivery service did not directly appear on any of the searches. Indeed, out of the 600 webpages visited in Australia only 21 were set up by Geoscience Australia and, of those, only six gave direct access to data and two of these were specific mineral promotion exercises within South Australia. Geoscience Australia underwent a Strategic Review in May 2011 conducted by Vanessa Lawrence, the Chief Executive of the Ordnance Survey, Great Britain's national mapping agency, and a recommendation from this review called for a new whole of government department dedicated to the coordination and development of spatial data with technical and data support from Geoscience Australia ([Australian Govt](#), 2012). This review, coupled with the GeoNetwork initiative, highlights the importance of Geoscience Australia to Australia's spatial data future and should position it to overcome some of the shortcomings identified in this research. Australia's other national organisation supplying data, the PSMA, was also absent for the webpage returns and even though it has been suggested as the lead organisation to collate datasets for the ASDI ([Geomatic Technologies](#), 2008). Given the recommendations emanating from the strategic report and the future role of Geoscience Australia, it could be that Geoscience Australia is best suited to lead the ASDI, especially given the PSMA model of cost for service.

Government supply of data (Industry Sector)

The research into GIS use in South Australia initiative was created by stakeholders involved with the management of Indigenous lands and waters and membership of the working group was predominantly government. [Bolstad](#) (2008) suggested that this sector dominates the supply of data and the results from this research reinforced this assertion with 183 Government webpages returned compared to 72 Education and 51 Private.

Issues

The differing Australian government data supply models are disjointed, confusing and to novice users such as Indigenous peoples in South Australia may well be a significant impediment to spatial data access. A system at the national level that is split into the national mapping agency ([Geoscience Australia](#)) providing free data and then another government representative body (PSMA) selling spatial data is both confusing and counter intuitive. At the regional level, the State of South Australia government does provide spatial data but not in a holistic or coordinated way. For example PIRSA, the

Department of Planning and Local Government (DPLG) and the Department of Environment and Natural Resources (DENR), all provide spatial data but none are regarded as the main spatial data provider. South Australia does have a government initiative; the Atlas of South Australia, but the results of this research indicated that it is not the focal point of spatial data delivery for the State. PIRSA ranked the highest in the list of webpages via the South Australian Resources Information Geoserver (SARIG) and DPLG came second through its Spatial Data Download service. However, the DENR data download service, NatureMaps, did not register on any webpage return list, but this could be attributed to a difference in terminology used i.e. PIRSA use 'geo', DPLG use 'spatial' whereas DENR use 'map'. This scenario could also account for the omission of Geoscience Australia's MapConnect service and, to an extent, this could warrant searches to be performed for these terms as well. However, expanding the searches only highlights the inherent problem for the GIS industry of too many terms describing spatial data, which is exemplified by the terms used by [Heywood et al.](#) (2006), [Bolstad](#) (2008), [Wilson and Fotheringham](#) (2008) and [Chang](#) (2008). Indeed, other terms such as location data, geocoded data, location information, geolocation or location intelligence are common place in the GIS industry. The lack of clarity is amplified when the term associated with the lowest returns in this research 'spatial' is used by the Australian industry professional representative body, the Surveying and *Spatial* Sciences Institute.

In addition to identifying the variety of nomenclature and sites for spatial data download, the actual spatial data that could be downloaded is also critical, especially those data sets that could be viewed as the basic requirements for GIS queries such as transport, cadastre, water, vegetation and elevation. In Canada and the United States these spatial data are accessible through federal government initiatives. For example, the United States has the National SDI which has eight layers freely available through the United States Geological Survey including Administrative Boundaries, Cadastral, Elevation, Geodetic Control, Geographic Names, Hydrography, Orthoimagery and Transportation. Furthermore, on a regional level, Montana has augmented the United States national approach by creating the Montana Spatial Data Infrastructure (MSDI) that added a further six free datasets to its State Library download webpage service comprising Geology, Hydrologic Units, Land Use/Land Cover, Soils, Structures and Wetlands ([Montana Govt.](#), 2007). In Australia, and South Australia, these basic datasets were not freely available and a potential outcome of this situation is the proliferation of uncoordinated ad-hoc subsystems such as the South Australia and Salmat Integrated Land Information Systems, a semi national land information system which does not include all base layers ([CIO](#), 2012).

To overcome these issues, at a national level, it could be worthwhile for the Australian government to investigate and adopt either the model of the Natural Resource Canada's GeoGratis service or the United States Geo-spatial One-Stop geoportal. At the regional level, the State of South Australia government could review the SDI which operates in Montana within their Natural Resource Information System (NRIS). Indeed, the Montana SDI has been lauded for its supply of the cadastre dataset and its subsequent benefit to Montana's economy with an estimated annual return on investment of approximately US\$9 million per year ([ESRI](#), 2012). Adopting this type of approach would reinforce [Masser's](#) (2002) phased SDI implementation strategy.

Conclusion

This research has explored the accessibility of spatial data from the Internet for the purpose of facilitating an increase in the use of GIS by novice Indigenous users and found spatial data are accessible, but not easily so. Australia has been cited as one of the leaders in supplying spatial data through SDIs but this research has indicated that accessing data in the other leading SDI countries, such as Canada and the United States, is far more straightforward and consequently there is significant room for improvement in Australia.

Presently, it would be advisable for people searching for spatial data in South Australia to explore the Internet using searches conducted via the Bing or Yahoo search engines and the key words 'Australia spatial data'. However, the situation could be improved by the major providers identified in this research, i.e. State and Federal governments, taking a coordinated approach and reviewing data delivery models.

The first component of the delivery processes to be improved is the terminology used for spatial data. Ambiguity abounds with the variety of search terms available and there seems to be no consistency in the use of, or understanding of, the term 'spatial data' within the literature and this research only used those terms that were most often used in the literature. The terminology cannot be resolved by this research, but it would be pertinent for the matter to be debated and settled. If not, the ambiguity will persist and act as a barrier in the facilitation of more GIS use by novices.

The second component requiring attention is the actual mechanism used to provide the spatial data to the end user. Both regional and national organisations were well represented in this research, but the number and type of delivery options was also a problem in that it exhibits disjointed and uncoordinated approaches. South Australia should consider building upon the Atlas of South Australia initiative and, by using the British Columbia and Montana spatial data delivery models for guidance, create a 'one stop shop' geoportal for spatial data supply within South Australia that is managed across the South Australian government. It would be worthwhile for the Australian Federal government to build on Geoscience Australia's position and investigate and adopt either the model of the Natural Resource Canada's GeoGratis service or the United States Geo-spatial One-Stop geoportal.

The third and final component relates to the spatial data itself. The one-stop shop models could be a long term goal to allow freely available data regionally and nationally but, given the [Kelly and Searle](#) (2009) indications that users are demanding services now, South Australia and Australia should at least make the fundamental datasets available as is the case in Canada and the United States. While this approach may seem to be in direct opposition to the ASDI vision of collating *all* spatial datasets ([Geomatic Technologies](#), 2008), this vision is 2-3 years out-of-date and, according to this research, well short of making all datasets available. An interim measure, based on the Montana SDI, may well provide the users in South Australia with improved access, especially as [Craglia and Campagna](#) (2009) noted it is the *users* that determine best practice not the *custodians*.

If the Australian GIS industry wishes to engage a wider audience it should consider acting upon these recommendations and work towards the revitalisation of the ASDI, as identified by [Geomatic Technologies](#) (2008), and create a more consistent, coherent and efficient delivery of spatial data. This could restore Australia's preeminent position alongside Canada and the United States as a world leader in spatial data delivery and, more importantly, become more socially inclusive for the increasing number of spatially aware public users.

Acknowledgements

Gratitude is extended to Sharene Foord (Independent GIS consultant - British Columbia) and James Tricker (Visiting GIS specialist, Aldo Leopold Wilderness Institute - Montana) for assistance with webpage data collection within their respective localities. Appreciation is also given to Associate Professor David Bruce and Neil Coffee from the University of South Australia and Dr Steve Carver from the University of Leeds for constructive comments on the paper. Finally, to the University of South Australia for providing travel funds to enable this International research to be undertaken.

References

- Altman, J.C., Buchanan, G.J. and L. Larsen (2007). *The environmental significance of the Indigenous Estate: Natural resource management as economic development in rural Australia*. Canberra, Australia: CAEPR. Retrieved August 21, 2012, from http://caepr.anu.edu.au/system/files/Publications/DP/2007_DP286.pdf
- Australian Government. (2012). *Strategic review of geoscience Australia*. Canberra, Australia: Department of Finance and Deregulation. Retrieved July 10, 2012, from http://www.finance.gov.au/publications/strategic-reviews/docs/strategic_review_ga.pdf
- Awad, E.M. (2004). Electronic commerce: From vision to fulfilment. Upper Saddle River, NJ: Pearson-Prentice Hall In Jansen, B.J. & Mollina, P.R. (2006). The effectiveness of web search engines for retrieving relevant ecommerce links. *Information Processing and Management*, 42(4), 1075-1098.
- Bolstad, P. (2008). *GIS fundamentals: A first text on geographic information systems*. (3rd ed.). White Bear Lake, MN: Eider Press.
- Butt, P., Eagleson, R., & Lane, P. (2001). *Mabo, Wik & native title*. (4th ed.). Sydney, Australia: The Federation Press.
- Carver, S., Watson, A., Waters, T., Matt R., Gunderson, K. and B. Davies (2009). Developing computer-based participatory approaches to mapping landscape values for landscape and resource management. In S. Geertman, & J. Stillwell (Eds.), *Planning support systems best practice and new methods*, (pp. 431-448). Springer Science Business Media.
- Chang, K. (2008). *Introduction to geographic information systems*. (4st ed.). Boston, MA: McGraw-Hill.
- CIO. (2012). *Salmat and the SA government to deliver cutting edge new land information system*. Retrieved August 21, 2012, from <http://www.cio.com.au/mediareleases/12208/salmat-and-the-sa-government-to-deliver-cutting/>

- Corcoran, P.A. (2008). Spatial information in aboriginal and Torres Strait Islander lands and water management. *South Australian Geographical Journal*, 107, 103-116.
- Cowan, D.J. (2008) The availability of geographic data: the current technical and institutional environment. In J.P. Wilson & A.S. Fotheringham (Eds.), *The handbook of geographic information science* (pp.11-34). Malden, MA: Blackwell Publishing.
- Craglia, M., & Campagna, M. (2009). [Advanced regional spatial data infrastructures in Europe](#). Ispra, Italy: European Commission Joint Research Centre, Institute for Environment and Sustainability. Retrieved August 21, 2012, from http://inspire.jrc.ec.europa.eu/documents/Study_and_Workshop_Reports/arsdi_report.pdf
- Craswell, N., & Hawking, N. (2009). Web information retrieval. In A. Göker & J. Davies, (Eds.), *Information retrieval: Searching in the 21st century*, (pp.85-101). Wiley.
- Evans, A. (1994). *Benchmarking: Taking your organisation towards best practice!*. Melbourne, Australia: Business Library.
- Environmental Systems Research Institute (ESRI). (2012). [The Big Sky State Finds Gold in Statewide Cadastral Database Montana's GIS-Based Cadastre Layered with Riches](#). Retrieved August 21, 2012, from <http://www.esri.com/news/arcnews/summer11/articles/the-big-sky-state-finds-gold-in-statewide-cadastral-database.html>
- Fazal, S. (2008). *GIS basics*. Delhi, India: New Age International.
- Gandal, N. (2001). The dynamics of competition in the Internet search engine market. *International Journal of Industrial Organization*, 19 (7), pp. 1103-1117. In Jansen, B.J. & Mollina, P.R. (2006). The effectiveness of web search engines for retrieving relevant ecommerce links. *Information Processing and Management*, 42(4), 1075-1098.
- Geomatic Technologies. (2008). [ICSM ASDI consultancy spatially enabling Australia recommendations](#). Retrieved August 21, 2012, from http://www.icsm.gov.au/icsm/asdi/ASDI-Spatially_Enabling_Australia-V2.pdf
- Geoscience Australia. (2012). [Topographic mapping](#). Retrieved July 10, 2012, from <http://www.ga.gov.au/topographic-mapping/mapconnect.html>
- Grech, A., Ambar, S., & Marsh, H. (2008). *Torres Strait Community GIS: Building the capacity of Torres Strait Islander communities in Natural Resource Management through integration of Traditional Ecological Knowledge and Western Scientific Knowledge*. Cairns, Australia: Report to the Marine and Tropical Sciences Research Facility, Reef and Rainforest Research Centre Limited.
- Heywood, I., Cornelius, S., & Carver, S. (2006). *An introduction to geographical information systems*. Harlow, England: Pearson Education Limited.
- Holland, P., Rajabifard, A., & Williamson, I. (2010). Towards an assessment framework for spatial enabled government. In A. Rajabifard, J. Crompwoets M. Kalantari, & B. Kok (eds), *Spatially enabling society research, emerging trends and critical assessment*. Leuven. Belgium: GSDI and Leuven University Press.
- ICSM. (2012). [Australia spatial data infrastructure](#). Retrieved July 10, 2012, from <http://www.icsm.gov.au/asdi/index.html>
- Jansen, B.J., & Mollina, P.R. (2006). The effectiveness of web search engines for retrieving relevant ecommerce links. *Information Processing and Management*, 42(4), 1075-1098.
- Kelly, P., & Searle, B. (2009). *Converging paths to an Australian SDI*. Rotterdam, GSDI 11.
- Kyem, P.A.K. (2000). Embedding GIS applications into resource management and planning activities of local and indigenous communities: A desirable innovation of a destabilising enterprise. *Journal of Planning education and Research*, 20(2), 176-186.
- Lane, M.B., & Hibbard, M. (2005). Doing it for themselves Transformative Planning by Indigenous peoples. *Journal of Planning and Education and Research*, 25(2), 172-184.
- Lewandowski, D. (2005). Web searching, search engines and Information retrieval. *Information Services and Use*, 25 (3-4), 137-147.
- Lewandowski, D., & Hochstotter, N. (2008). [Web searching: A quality measurement perspective](#). In A. Spink, & M.T. Zimmer (Eds.), *Web search, Springer series in information science and knowledge management 14* (pp.309-340), Springer-Verlag Berlin Heidelberg. Retrieved August 21, 2012, from <http://www.springerlink.com/content/k7uw582vq6241730/fulltext.pdf>
- Lo, C.P., & Yeung, A.K.W. (2007). *Concepts and techniques of geographical information systems*. (2nd ed.). Upper Saddle River, NJ: Prentice Hall.
- Longley, P.A., Goodchild, M.F., Maguire, D.J., & Rhind, D.W. (2011). *Geographic information systems and science*. (3rd ed.). England: John Wiley and Sons.
- Masser, I. (2002). *Report on a comparative analysis of NSDI's in Australia, Canada and the United States*. Sheffield, United Kingdom: Geographic Information Network in Europe.
- Masser, I., Rajabifard, A., & Williamson, I. (2008) Spatial enabling governments through SDI implementation. *International Journal of Geographical Information Science*, 22 (1), 5-20.

- Montana Government. (2007). [Montana geospatial strategic plan 2006-2010](http://itsd.mt.gov/content/policy/councils/mliac/docs/Strategic_Plan). Retrieved August 21, 2012, from http://itsd.mt.gov/content/policy/councils/mliac/docs/Strategic_Plan
- Najar, C., Rajabifard, A., Williamson, I., & Giger, C. (2006). A framework for comparing spatial data infrastructures: An Australian-Swiss case study. *GSDI-9 Conference Proceedings, 6-10 November 2006*, Santiago, Chile.
- Obermeyer, N.J. (n.d.). [PPGIS: The evolution of public participation GIS](http://dusk.geo.orst.edu/ucgis/web/oregon/ppgis.pdf). Retrieved August 21, 2012, from <http://dusk.geo.orst.edu/ucgis/web/oregon/ppgis.pdf>
- Pennsylvania State University. (2012). [Geospatial revolution](http://geospatialrevolution.psu.edu/). Retrieved August 6, 2012, from <http://geospatialrevolution.psu.edu/>
- Public Sector Mapping Agency. (2012). [About PSMA](http://www.pdma.com.au/aboutpdma/a_index.html). Retrieved August 21, 2012, from http://www.pdma.com.au/aboutpdma/a_index.html
- Reddell, T. (2004). Third way social governance: Where is the state? *Australasian Journal of Social Issues*, 39(2), 129-142.
- Roberts, B., & Toleman, M. (2007). The role of government in e-business adoption. In L. Al-Hakim (Ed.), *Global e-government: Theory, applications and benchmarking*, (pp.64-85). Hershey, PA: Idea Group Inc.
- Rundstrom, R.A. (1995). GIS, indigenous peoples, and epistemological diversity. *Cartography and Geographic Information Systems*, 22(1), 45-57.
- Sampath Kumar, B.T., & Prakash, J.N. (2009). Precision and relative recall of search engines: A comparative study of Google and Yahoo. *Singapore Journal of Library & Information Management*, 38, 124-137.
- Shafi, S.M., & Rather, R.A. (2007). [Precision and recall of five search engines for retrieval of scholarly information in the field of biotechnology](http://www.webology.org/2005/v2n2/a12.html). *Webology*, 2 (2), Article 12. Retrieved August 21, 2012, from <http://www.webology.org/2005/v2n2/a12.html>
- Smith, A.G. (2003). Think local, search global? Comparing search engines for searching geographically specific information. *Online Information Review*, 27 (2), 102-109.
- Spink A., & Jansen, B. (2005). [Web search: Public searching of the Web](http://link.springer.com/book/10.1007/1-4020-2269-7/page/1). Netherlands: Springer. Retrieved August 21, 2012, from <http://link.springer.com/book/10.1007/1-4020-2269-7/page/1>
- Spiteri, L.F. (2000). Access to electronic commerce sites on the World Wide Web: An analysis of the effectiveness of six Internet search engines. *Journal of Information Science*, 26 (3), 173-183.
- Stair, R.M., & Reynolds, G.W. (1998). *Principles of information systems: A managerial approach*. (3rd ed.). Cambridge, MA: Course Technology.
- Tatnall, A. (2005). *Web portals: The new gateways to Internet information and services*. Hershey, PA: Idea Group Publishing.
- Tomlinson, R. (2007). *Thinking about GIS: Geographic information system for managers*. (3rd ed.). Redlands, CA: ESRI press.
- Tongchim, S., Sornlertlamvanich V., & Isahara, H. (2007) Improving search performance: A lesson learned from evaluating search engines using Thai queries. *IEICE Transactions*, 90 (10), 1557-1564.
- Turban, E., King, D., Lee, J., Warkentin, M., & Chung, H.M. (2002). *Electronic commerce 2002: A managerial perspective*. Upper Saddle River, NJ: Prentice Hall.
- United Nations. (2005). [Global e-government readiness report 2005: From e-government to e-inclusion](http://unpan1.un.org/intradoc/groups/public/documents/un/unpan021888.pdf). Retrieved August 21, 2012, from <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan021888.pdf>
- Wang, C., Xie, X., Wang, L., Yansheng, L., & Ma, W.Y. (2005). Detecting geographic locations from web resources. IN C. Jones & R. Purves (eds.), *Proceedings from 2005 workshop on geographic information retrieval, GIR 2005*, Bremen, Germany.
- Wilson J.P., & Fotheringham, A.S. (2008). *The Handbook of geographic information science*. Malden, MA: Blackwell Publishing.

Bibliographic information of this paper for citing:

Corcoran, Paul A. (2012). "An assessment of the accessibility of spatial data from the Internet to facilitate further participation with geographical information systems for novice indigenous users in South Australia." *Webology*, 9(2), Article 97. Available at:
<http://www.webology.org/2012/v9n2/a97.html>

