

Results of three case studies for assessing motivators and barriers of address data sharing in South Africa

Malete Daniel Sebake^{1,2}, Serena Coetzee²

¹Spatial Data Management Unit, Council for Geoscience, Pretoria, South Africa,
dsebake@geoscience.org.za

²Centre for Geoinformation Science, University of Pretoria, Pretoria, South Africa

Abstract

The value of GIS data in the functioning of both public and private organizations has increased enormously, to the extent that it is difficult to imagine a modern organization without the use of GI technologies. Currently, organizations use GIS data, especially spatial address data, to locate their customers and to deliver products and services to their doorsteps. In South Africa, the spatial address data are found in separate address databases, which are maintained by different organizations, with minimal or no cooperation among them. Contrary to research evidence pointing to the benefits of organizations sharing spatial data, most organizations still show inability and reluctance to participate in spatial data sharing initiatives; thus perpetuating the costly duplication of efforts in data handling and storage. The authors used a case study approach to assess the issues that motivate or obstruct GIS data sharing among three address organizations in South Africa. This paper presents the results of the three cases, and their implications on the interorganizational GIS data sharing initiatives as they occur in spatial data infrastructures (SDIs), particularly the South African SDI. It is our hope that these findings pertaining to motivators or barriers for interorganizational GIS data sharing (as it was applied to the three cases) will provide valuable lessons to guide organizations to develop and implement successful data sharing initiatives.

1. Introduction

The capabilities of geographic information systems (GIS) – including capturing, managing, integrating, manipulating, analyzing and displaying spatial data (DOE, 1987; Masser, 2007) – have grown in leaps and bounds to the extent that it is hard to imagine a modern society without these technologies. In order to realize the full potential of GIS, researchers agree that a type of multi-participant arrangement is required to coordinate the spatial data sharing efforts of private and/or public organizations at local, national or transnational levels. This is referred to as interorganizational GIS (Nedović-Budic and Pinto, 2000; Onsrud, 2007; Thellufsen *et al*, 2009), which is a precursor to the more mature, high-level spatial data infrastructure (SDI), the ultimate goal of interorganizational coordination and spatial data sharing.

An SDI is a framework of coordinated actions on policies, organizational remits, data, technologies, standards, delivery mechanisms, financial and human resources to support ready access to geographic information in the possession of both public and private organizations (Masser, 2005). According to Thellufsen *et al* (2009), the aims of the SDI are to allow easy access, smooth sharing and seamless integration of data among government institutions, private branches and ordinary citizens. A number of major multi-participant GIS projects were initiated in Europe (Craglia and Annoni, 2007; Vandebroucke *et al*, 2009), the United States of America (Masser, 2007; Onsrud, 2007; Lance *et al*, 2009; Masser, 2010; Nedovic-Budic *et al*, 2011), Canada (GeoConnections, 2009) and Australia (Masser, 2005), with other countries following in their footsteps (Masser, 2005).

Even with the increased proliferation of SDIs and/or GIS data sharing initiatives, there has been an inability and reluctance to share data and information among organizations (Bhudhathoki and Nedovic-Budic, 2007). According to researchers, spatial data sharing among organizations is not a spontaneous activity, but depends on a nexus of motivators and barriers, which are inherent to the interorganizational relationships (Nedovic-Budic and Pinto, 2000; Masser, 2007; McDougall *et al*, 2007). This article presents the results of the investigation into the motivators and barriers of interorganizational GIS data sharing among South African organizations that maintain address databases.

An address is the description of a location not only for postal delivery, but for all kinds of service delivery, ranging from 'physical' services such as utility services, billing, courier, goods delivery, and emergency dispatch; to more 'abstract' services such as opening financial accounts, credit applications, tax collection, and land and property registration (Coetzee and Cooper, 2007). A spatial address is an address together with the coordinates of its geo-referenced location (Coetzee and Bishop, 2009). As a result of two important South African developments, an assessment of the motivators for and barriers to spatial address data sharing is as relevant now as ever. Firstly, the publication of the South African Address Standard (SANS 1883), which provides opportunities for improving address data interoperability and sharing through a common terminology and conceptual model (Coetzee *et al*, 2008). Secondly, the Committee for Spatial Information (CSI) was created to implement the South African SDI (SASDI). The SASDI is the technical, institutional and policy framework to facilitate the capture, management, maintenance, integration, distribution and use of spatial information (South Africa, 2003).

The authors posit that without the understanding of underlying issues that motivate or obstruct the sharing of spatial data among organizations, the development of national SDIs remains elusive. In this paper, the authors present the findings of three case studies of South African GIS organizations maintaining national spatial address databases. Initially, the paper identifies the motivators and barriers of spatial data sharing from literature on interorganizational GIS, spatial data sharing, SDIs and spatial address data. It further explains the methodology, including the semi-structured questionnaire that was used for interviews. Finally, it presents the results of the studies, followed by a discussion of their

implications to interorganizational GIS data sharing initiatives, CSI and SASDI.

2. Motivators and barriers for spatial data sharing

Motivators are factors which provide organizations with incentives to move them into action; barriers are immaterial factors which obstruct or impede organizations from fully participating in spatial data sharing initiatives. Table 1 presents a summary of motivators and barriers of interorganizational GIS data sharing from literature, including Nedovic-Budic and Pinto (2000), Masser (2005), Harvey and Tulloch (2006), Onsrud (2007), Mansourian and Valadan-Zoej (2008) and Thellufsen *et al* (2009).

Table 1. Motivators and barriers for interorganizational GIS data sharing initiatives

Motivators	Details
Cost saving	Sharing the cost of implementation of spatial databases among participating organizations
Data quality	Common data definitions, formats and standards perceived to improve data quality
Return on investment	Exchange of information to optimize productivity and decision making
Reduced time on data collection	Spatial data sharing reduces time spent collecting data that has already been collected
Incentivization	Money or other incentives to stimulate GIS data sharing
Improved user satisfaction	Perception of effectiveness and satisfaction for users of multi-participant systems
Barriers	Details
Institutional culture issues	Any issues related to the different behaviours of organizations, e.g. disincentives, historical and ideological barriers, power disparities, differing risk perceptions; technical complexity; political and institutional culture
Conflicting priorities among participating organizations	Separate organizational interests, e.g. concessions over access to information, leadership, data standards, equipment, and training
Lack of resources	Lack of human and technical resources
Poor implementation of standards	Organizations not applying common data definitions, formats, and models
Costs of coordination	Costs of coordinating activities of different organizations, e.g. networking costs

3. Methodology

A multiple case study method was applied to evaluate three organizations collecting and maintaining spatial address databases. The case study method was deemed appropriate to answer the 'why' and 'how' questions (Yin, 1994) pertaining to the motivations and barriers for spatial data sharing among the organizations. The questions to be answered in the research were the following:

1. *Why* will organizations share spatial address data for the development of the national address database? What are the motivators?
2. *Why* will organizations not share spatial address data for the development of the national

address database? What are the barriers?

3. *How will the understanding of motivators and barriers for sharing spatial address data influence the existing theory on interorganizational GIS data sharing frameworks?*

The selected organizations were representative of the key role players in address data management in South Africa and included a local municipality, a public organization and a private organization.

Key informants, well-conversant with the GIS data sharing activities in their organizations, were identified in each organization, and verbal interviews were conducted with them. For the case study method to be reliable and repeatable, a data collection protocol was put in place to ensure that procedures were well-documented and could be repeated with the same results when conducted again. Data collection focussed on two main sources of evidence to ensure construct validity: interviews and documentation.

A semi-structured questionnaire was used to interview the informants. It led informants to provide information on a wide range of issues that motivate or hinder organizations from sharing spatial address data. The questions were constructed in such a way that they offered leeway for informants to fully express themselves with minimal or no prejudice from the interviewer. The questionnaire consisted of three parts as shown in Table 2 below. The full questionnaire is available in Sebake (2011).

Table 2. Parts of the research questionnaire and their descriptions

Parts of questionnaire	Description
Part 1 – Particulars of the organization	This part, which is rather structured, collects the information about the organization, such as its size (i.e. number of employees), spatial data sharing equipment and resources, and whether its GIS activities are for private or public consumption.
Part 2 – Motivators for spatial address data sharing	This part consists of open-ended questions, which assess the motivators for spatial address data sharing among organizations, including issues of cost, data quality, return on investment, improved decision making and incentives.
Part 3 – Barriers for spatial address data sharing	This part comprises of a list of open-ended questions, which assess barriers that obstruct spatial address data sharing initiatives among organizations, including issues of the impact on revenue-generating streams of the organization, conflicts in priorities, accuracy and reliability of the data, copyrights, data privacy and ownership issues, staff turnover and technical resources.

Verbal interviews were recorded on the voice recorder and transcribed later for further analysis. The transcripts were corroborated by other sources of information, such as interorganizational agreements, website pages describing the activities of the organizations, research papers (i.e. conference proceedings and journals), internal and project reports in order to minimize biasness of the data.

4. Results

In this section, the responses from the three address data organizations are presented. Below we describe each organization and in subsequent subsections we discuss their responses to the questions about motivators and barriers regarding a multi-participant initiative for spatial address data sharing.

Case A (public). Case A is a public organization with more than 500 employees, responsible for collecting and distributing census data in South Africa. The census data guides planning and policy directives of the country as a whole. Case A experienced a lack of addresses for census purposes, making census data collection difficult. They therefore started capturing address data for their own purposes, which could result in a conflict with local authorities' mandate to collect and register addresses. However, Case A emphasized that they are not trying to generate a national address database (i.e. mandate of local authorities), but are establishing a dwelling framework to show the dwelling places as geocoded points or polygons with associated census attribute data. The dwelling framework is still maintained in-house by Case A, providing them with invaluable data needed for census purposes.

Case B (private). Case B is a private organization with more than 50 employees, offering GIS services to its South African and international clientele. The organization specializes in location-based services which are required for geocoding, geo-marketing, mobile applications, transportation modelling, etc. In order to provide these services, the organization required a quality spatial address database. The lack of this prompted them to create their own spatial address database by sourcing the address data from local authorities in paper and/or digital formats. Addresses are captured and geocoded to produce spatial address data, used for the development of location-based products.

Case C (municipality). Case C is the local metropolitan municipality of Johannesburg, one of the biggest cities in Africa with a population of approximately 3 million. Their challenge is to keep an updated street address register for different purposes, such as property valuations, provision of emergency services, delivery of utility services, establishment of townships and debt collection. The Land Information System (LIS), a registry of geocoded properties with their attribute data, is currently their sole source of property information. Case C has instituted a process whereby a property is captured in the spatially-enabled LIS when it is registered, ensuring that the database is up to date.

4.1 Case responses: motivators

4.1.1 Reduce the cost of data handling

In all three cases, the benefit of pooling resources to capture and validate the spatial addresses was recognized as a significant motivator to establishing a common spatial address database. The use of disparate databases was seen as duplicating efforts and a waste of time and money as the data from

different sources would still need to be validated before it is useable. Case B, the private organization, felt it was an unfair burden for them to be handling spatial address data from different sources; the cost should be borne by local authorities. Although Case B have doubts about the reduction in cost of handling data, they have a strong conviction that the cost of capturing and validating the spatial address data should be taken up by the local authorities, because it falls within their mandate. Nevertheless, the responses indicate that there is a role for both public and private organizations (i.e. public-private partnerships) in the management of spatial address databases.

4.1.2 Improved data quality

Case A, B and C identified *improved data quality* as a significant motivator to establishing a spatial address data sharing initiative. The perception is that contributions to the same database would foster compliance to common definitions, standards, protocols and formats, improving the usability of the data. The improved data quality was also attributed to the involvement of well-trained personnel in terms of technical skills and GIS data standards in a spatial data sharing initiative.

4.1.3 Return on investment, and improved decision making and planning

According to the responses, the returns to be derived from a spatial address data sharing initiative are manifold. A common spatial address database would enable public organizations to unlock potential for improving their functions, *inter alia*, collection of census data, collection of rates and taxes, delivery of emergency and utility services, establishment of townships/new developments and overall decision making and planning. Private organizations could focus their energy on developing new applications (e.g. location-based technologies); instead of wasting their time and resources on recapturing and validating spatial address data.

4.1.4 Incentivization

The public organizations (Case A and C) were not keen on any kind of incentives, because it is their mandate to establish spatial address registers for their specific purposes. However, Case C uses key performance indicators, linked to participating in an SDI, in their Balanced Scorecard – a strategic performance management tool. Only Case B, as a private organization, considered financial compensation to be an appropriate incentive for recapturing and validating spatial address data. It is clear from the responses (on incentives) that organizations have not given enough thought to the benefits that a public-private partnership could bring to an address data sharing initiative.

4.1.5 Other motivators

The three cases acknowledged that participation in a common national spatial address database would create an enabling environment for organizations to use similar standards, e.g. South African Address Standard (SANS 1883), making it possible for public and private organizations to work from

the same address dataset.

4.2 Case responses: barriers

4.2.1 Negative impact on revenue-generating streams

The public organizations are not expected to generate revenue from their address database efforts and this is therefore not an impediment to contributing to a data sharing initiative. Although it is not a pronounced practice, the local municipality expressed that they are at times expected to fund their own operations; thus, they are tempted to sell the data in their custody. On the other hand, the private organization has an inherent commercial interest, including selling their value-added data and products. This will make them a reluctant player in any initiative where they are expected to contribute their services without consideration of their commercial interests, i.e. to make profit.

4.2.2 Priorities of the organization

The priority of the public organizations is to collect and register addresses for their own use. But, this priority depends on whether the budget is available to maintain the SDI, i.e. ‘if money is tight, it (SDI) will take the back burner’ (Case A). In the private organization, the commercial priority comes first, but they alluded that they could participate in establishing a common spatial address database, despite their commercial interest.

4.2.3 Accuracy and reliability of spatial address data

Even though public organizations have used the same methods of collecting and validating address data for many years, data from custodians, such as municipalities, might still be suspicious in terms of accuracy and reliability. Lack of capacity building and training in GIS data handling are possible causes, because ‘data management is not a priority of these organizations’ (Case B).

4.2.4 Copyright issues, data privacy and data ownership issues

For the public organizations with the mandate to distribute and share data, the copyright issues were not as pronounced as in private organizations. In public organizations, licensing agreements are not required and data is distributed for free. The private organization’s license agreement prohibits its clients to share their spatial address data. Privacy issues could be raised if personal/private information is attached to an address, but that was not a problem in all cases as it is easy to distribute the address data without private data.

4.2.5 Lack of common data definitions, formats and models

All three cases showed no reluctance to adhere to standards. They all participated in the formation of the South African national address standard (SANS 1883). Case A mentioned that adapting their

internal systems to the standard is a challenge that will take a long time to address. Although there is still a concern about common data definitions, formats and models, the three cases were positive about the future in which the national address standard would be mandatory.

4.2.6 Staff turnover and technical resources

Case A, a public organization, mentioned that ‘attracting the right people and retaining them is a concern’, as the organization has experienced a high staff turnover for some time now. Although both public organizations appeared to be well-resourced, their budgets were not limitless. A high staff turnover results in less technical skills, paralysing spatial data sharing initiatives these organizations were involved in. Retention of GIS staff should be boosted by the introduction of Occupation Specific Dispensation (OSD), which allows registered GIS professionals to advance on their career path, with appropriate remuneration, but only after pre-determined periods based on specific criteria such as performance, qualification, scope of work and experience (Department of Public Services and Administration, 2007).

4.2.7 Unequal commitment from organizations in an SDI

Because most public organizations are mandated to distribute and share data, they might feel obliged to make promises to a multi-participant initiative which they cannot fulfil. Case A mentioned that ‘in a public forum, organizations might make promises, but the bureaucratic structures make data sharing difficult’. There is a perception that some organizations (both public and private) use data as a currency to elevate their importance and power base, thus creating unnecessary restrictions on data sharing.

4.2.8 Inadequate support from strategic management plans and policies

The strategic documents and policies of public organizations largely support the building of partnerships and creating an enabling environment for distributing and sharing data among organizations. Case C, the local municipality, uses Balanced Scorecards to align spatial data sharing targets with their strategy.

4.2.9 Other barriers

Other barriers to the sharing of spatial address data that were raised, include the fear of one organization dominating the spatial address data sharing initiative, thus denuding other organizations of their say (Case A); the risk of putting more emphasis on the theoretical details and structures, while neglecting the practical application of the data, e.g. rules that an address should follow a certain naming conventions or hierarchies, while overlooking the existing practices (Case A); the fear of an authoritarian or single agency promising to build an SDI, which in a few years abandons the initiative due to lack of resources or because the spatial data sharing initiative is not seen as its core business anymore (Case A); the sharing of spatial address data not been part of the key performance indicators

of the organizations, thus resulting in less commitment on the part of these organizations to data sharing initiatives (Case B); and different GIS software platforms that make it difficult to share data among organizations (Case C).

5. Discussion

This section reflects on the barriers and motivators identified in the previous section and how these can be respectively addressed and leveraged in a multi-participant address data initiative. We also discuss the implications of the results on the CSI's implementation of SASDI.

Participating organizations in an SDI can be motivated by issues such as reduced costs of collecting and maintaining the datasets and increased data quality due to subscription to the same standards. There is consensus among the case studies that an address data sharing initiative will foster standards compliance, will improve the usability of the data, will assist the public sector to improve their service delivery to the citizens of the country, and allow the private sector to focus on developing value-added products and services. There are additional benefits, not identified by the case studies. For example, standardized addresses facilitate the development of tools for maintaining address data and also facilitate cross-border trade and commerce (Coetzee *et al*, 2011). Most of these benefits apply to all other spatial datasets in SASDI.

The case studies prove that the behaviour of public organizations differs from that of private organizations; the former is motivated by issues of public good, while the latter is driven by profit margins. A middle ground is possible through public-private partnerships, which enables public and private organizations to collaborate on capturing and validating spatial address data; while at the same time allowing the private sector to develop commercial value-added products, e.g. location-based services. From the case studies it was clear that none of the organizations had given enough consideration to the potential value of a public-private partnership.

This finding is significant for SASDI, because the study respondents indicated that the cost of maintaining data is high. The CSI will have to propose how spatial data is maintained within SASDI, and find viable financial mechanisms to support its activities. A suitably structured public-private partnership could contribute to paying for the costs. For example, private organizations could offer their data maintenance services at a reduced fee in exchange for incorporating the address data into their value-added products. Another option is a private sector consortium forming a special company that builds and maintains the database for a contracted period. The companies building and operating some of the national toll roads in South Africa are illustrative of what can be achieved through public-private partnerships.

The case studies further show that data ownership needs to be addressed to ensure that private organizations are not alienated by SDI initiatives that advocate sharing of data at all costs or by the fear that a custodian will use its dataset as a power base or bargaining tool in negotiations. Copyright and data ownership should also be resolved to allay fears of one organization taking control of all the data

and distributing it without acknowledging (or compensating) the efforts of others.

It is important that aspirations of contributing to a multi-participant data sharing initiative are reflected in an organization's strategy. Without this, data sharing is overlooked by decision makers who approve budgets. In addition, aligning performance measurement with this strategy (in support of data sharing) encourages staff to carry out data sharing activities in their daily operations and decisions. These are tricky issues for the CSI and SASDI: they will have to find ways to ensure that the strategies and performance measurements of participating organizations, in the very least of the data custodians, reflect the required data sharing aspirations. This could well turn out to be one of the CSI's major challenges.

Finally, high staff turnover and lack of technical resources must be addressed to prevent them from negatively impacting the data sharing initiative in the long run. This should be countered by the introduction of the Occupation Specific Dispensation (OSD) in the South African public sector.

6. Conclusions

The aim of this paper was to report about three case studies on motivators and barriers for establishing an interorganizational data sharing initiative among South African organizations maintaining spatial address databases. The research findings indicate that there are significant motivators that underlie the data sharing activities; but, there are also barriers that make organizations reluctant to enter into a data sharing initiative. While our case studies focused on address data in South Africa, most of the findings are equally applicable to other spatial datasets and are therefore relevant to the recently established CSI, which is tasked with the implementation of the South African SDI, as discussed in the previous section.

There is consensus among the case studies about the significant benefits to be gained from a multi-participant address data sharing initiative. There is also a willingness to collaborate on address data, provided that relevant barriers are addressed. It is as if organizations are ready and waiting for someone or some organization to lead them towards a data sharing initiative. The CSI is ideally positioned to fulfil this task. The motivators and barriers identified by our research provide valuable guidance for establishing a multi-participant data sharing initiative in South Africa.

For further guidance, a survey of many address data organizations could be done to quantitatively assess the patterns that emerge from their motivators, barriers and complex relationships in data sharing activities. A study of public-private partnerships for interorganizational spatial data sharing in other parts of the world, as well as successful public-private partnerships in other industries of South Africa, would be valuable for identifying a suitable route for South African data sharing partnerships.

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