

Address Data Sharing: Organizational Motivators and Barriers and their Implications for the South African Spatial Data Infrastructure*

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Abstract

An address is a common reference for a multitude of information. In South Africa, multiple address datasets are developed and maintained by various public and private organizations with little or no cooperation on data sharing. We identified motivators and barriers for address data sharing in South Africa through case studies of three typical organizations, which prepare, distribute and use address data. The most significant motivators are improved data quality and an expected return on investment for better decision-making and service delivery. However, the quality of data produced by organizations participating in a data sharing initiative needs to be clearly described and evaluated, in order to avoid prejudiced perceptions of poor quality; and expectations about the timing and value of the expected return on investment from an SDI need to be managed to avoid losing support from stakeholders. Even if organizations have the best data sharing intentions and agreements in place, high staff turnover, which is a considerable problem in South Africa, can jeopardize data sharing. Technical barriers, such as common definitions, models and formats, are less significant

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and can be overcome by implementing appropriate standards. Public-private partnerships are not given enough consideration in South African data sharing initiatives. Our findings have significant implications for the recently established Committee for Spatial Information (CSI), which is tasked with the implementation of the South African Spatial Data Infrastructure (SASDI), but they are also of interest to other countries and for other spatial datasets.

Keywords: spatial data infrastructure, SDI, spatial data sharing, address data, South Africa

1. INTRODUCTION

An address is one of the most common ways of directing people to a location. The notion of directing someone or something is evident in the origin of the word 'address', which is derived from the Latin *directus*, past participle of *dirigere*, to direct. An address should be considered, in the broader sense, as 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, goods delivery, and emergency dispatch; to more 'abstract' services such as credit application, tax collection and land administration (Coetzee and Cooper, 2007). Addresses act as reference key to link citizen's personal data and administration information, hence making it possible to locate and deliver services and goods to eligible persons (Lind 2003; Coetzee and Bishop, 2009).

Advances in information technology make it possible to use addresses in new ways, such as routing and vehicle navigation, automated processing of mail items, utility planning and maintenance, spatial demographic analysis and geo-marketing. Typically, local governments establish and maintain an address database to facilitate service, infrastructure and land administration responsibilities within their areas of jurisdiction (Williamson et al, 2005; Coetzee et al, 2008). In other instances, such as for opening financial accounts, tax collection or census (Coetzee and Cooper, 2007), the need for address data in areas extending beyond these jurisdictional boundaries calls for the integration of address databases on a national and/or international scale (Coetzee and Bishop 2009). The current trend in most of the countries is to collate address data into single national address databases (NADs), also known as address master files, registers, gazetteers or directories (Lind, 2003; Morad, 2002; Coetzee and Cooper, 2007; Coetzee and Bishop, 2009). Some of the prominent NAD initiatives include Geocoded National Address File (G-NAF) in Australia (Paull, 2003) and National Land and Property Gazetteer (NLPG) in UK (Morad, 2002).

In South Africa, disparate address databases are developed and maintained by different public and private organizations – with little or no cooperation on data sharing (Sebake and Coetzee, 2012). These address datasets are developed for different purposes, thus are represented in different formats and data models, which are difficult to reconcile at a later stage (Sebake, 2011). As a result of two South African developments, organizations now have the opportunity to collaborate towards a single address dataset for South Africa. Firstly, the publication of the South African Address Standard (SANS 1883) in 2009, which provides opportunities for improving address data interoperability and sharing through a common terminology and conceptual model (Coetzee et al, 2008). Secondly, the formation of the Committee for Spatial Information (CSI) – the high-level body comprised of decision makers from government departments and agencies which is responsible for the implementation of the South African Spatial Data Infrastructure (SASDI). SASDI was established through the Spatial Data Infrastructure Act 54 of 2003 as a national framework to facilitate the capturing, management, maintenance, integration, distribution and use of spatial information. As with the implementation of any spatial data infrastructure (SDI), one of the main challenges is the reluctance of participating organizations to cooperate with each other for data sharing (Nedovic-Budic et al, 2004; Harvey and Tulloch, 2006; McDougall et al, 2007; Vandenbroucke et al, 2009; Masser, 2010; Nedovic-Budic et al, 2011; Harvey et al, 2012). Accordingly, this article argues that the implementation of a successful address data sharing initiative depends on the understanding of motivators and barriers of organizations participating in it.

In this article we present the results of three case studies on motivators and barriers for establishing an inter-organizational data sharing initiative among South African organizations maintaining address databases. The study was conducted with reference to the conceptual framework for spatial data sharing developed by Nedovic-Budic and Pinto (2000). We discuss the implications of these results for the recently established Committee for Spatial Information (CSI), which is tasked with the implementation of the SASDI. The CSI met for the first time in 2010 and is still clarifying its roles. Hence, our work is relevant now.

The remainder of this article is structured as follows: section 2 provides background to our research; section 3 presents the nature of address data in South Africa; section 4 outlines the method and describes the three selected case studies; section 5 describes the motivators and barriers identified by the case studies, and their significance; section 6 discusses the implications of the motivators and barriers for SASDI; and we conclude in section 7.

2. BACKGROUND

The capabilities of geographic information systems (GIS) – including capturing, managing, integrating, manipulating, analyzing and displaying spatial data – 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 (Nedovic-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.

A number of major multi-participant SDI projects were initiated in Europe (Craglia and Annoni, 2007; Vandenbroucke et al, 2009), the United States of America (Onsrud, 2007; Lance et al, 2009; Nedovic-Budic et al, 2011), Canada (GeoConnections, 2009) and Australia, with other countries following in their footsteps – as it was widely documented in Masser (2007). 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).

The publication of SANS 1883 (2009) and recent SDI activities in South Africa prompted us to investigate the motivators and barriers of interorganizational GIS data sharing among South African organizations that maintain address databases. To understand why these SDI activities are happening now, a brief overview of the history of the South African SDI follows.

The first attempt to build the South African SDI began in 1997 with the establishment of the National Spatial Information Framework (NSIF), initially as a Sub-Directorate in the then Department of Land Affairs (now the Department of Rural Development and Land Reform). The purpose of NSIF was to establish the technical and policy framework for enabling unimpeded access to, and utilisation of, geographic data for effective and efficient governance, planning and decision making, through all spheres of government. The focus was on standard development, framing policy and institutional arrangements, and developing a clearinghouse for geographic data (Cooper and Gavin, 2005). By 2002, there were about 3000 metadata records available.

The NSIF initiated the Spatial Data Infrastructure Act 54 of 2003, which places requirements on data custodians. Unfortunately, the NSIF was in decline at that time, losing most of its staff over an 18-month period for various reasons. Other than the enactment of the Spatial Data Infrastructure Act 54 of 2003 and the preparations of draft regulations to support the Act, SDI activities effectively ceased in NSIF and their metadata catalogue was no longer operational (Smit et al, 2009). Even though officially little happened between 2003 and 2010, some SDI-like activities could still be observed. For example, the South African National Space Agency (SANSA) continued to receive, process, and archive satellite imagery, which are available through an online catalogue (Harvey et al, 2012).

CSI members, who have to implement the Act, were finally appointed in 2010 and the CSI met for the first time in June 2010. In March 2011, the CSI adopted its reference document and established its sub-committees. At the moment, the CSI is still clarifying its roles and a study to establish the criteria for the identification of South Africa's core spatial datasets and data custodians is in progress. Thus, the South African SDI seems to have awakened from its period of hibernation and there is now an opportunity to leapfrog ahead of other countries by leveraging advances in science and technology without the burden of investment in old technology. Our research results provide input to CSI and the implementation of SASDI.

3. THE NATURE OF ADDRESS DATA IN SOUTH AFRICA

According to Coetzee and Cooper (2007) formal addresses were not assigned to vast areas of South Africa, which include farms, rural villages and former black townships (in the cities). Since 2001, after South Africa was demarcated into 262 local municipalities, their responsibilities were to deliver services such as water, electricity, sewerage and waste removal within the areas under their jurisdiction. As noted by Williamson et al (2005), the responsibilities of local governments often cause them to become the custodians of street address and other land-related data in a country. SANS 1883-1 (2009) defines an address as *an ambiguous specification of a point of service delivery*, thus, it is critical for the local authorities and public utilities rolling out the delivery of services (Coetzee and Cooper, 2007). Although it is naturally the responsibility of local authorities to collect and maintain address data in areas under their jurisdiction, various sources of address data have emerged in South Africa (Table 1).

Table 1: Address Data Sources in South Africa

Source	Type of data	Purpose
GIS departments at municipalities	Land parcels and their assigned street name and numbers	Support function to other municipal departments
Property valuation rolls at municipalities	Property description(as per deeds registry) together with a postal address	Property valuation
Consulting town planners	Plan showing the layout of proposed erven and their assigned street names and numbers for new development	Town planning
South African Post Office	A list of South African post office approved place names with their postcodes, no spatial information included	Postal mail delivery
Statistics South Africa	Database of dwelling locations, address not always included	Household surveys, census
Private initiatives	Sources address data from data producers listed above, and aggregate it into a national database	Address-related service provision, either by the company itself or sold to a third party

Source: Coetzee and Cooper, 2007

As illustrated in Table 1, the implication of not having a NAD results in unnecessary duplication of assigning addresses and maintaining address databases. When utilities, government departments and government agencies needed to provide services to areas without formal addresses, it led to these organizations devising their own addressing schemes (Coetzee and Cooper, 2007). This further led to different organizations assigning multiple identifiers to a single household (Rossouw and Kgope, 2007), contributing to more address ambiguities.

Table 1 indicates that while there is not an official national address database (NAD) in South Africa, there are a number of sources from which a national database can be derived. The lack of a definite national address database or register – which is widely used by the public – created opportunities for the private organizations to provide address-related products and services at a fee. The private organizations acquire the address data from the sources listed in Table 1, and further collate the data into a national address database (NAD). The privately owned NADs are updated on a quarterly basis and distributed to clients such as debt collectors, media companies, banks, insurance companies, government departments and agencies.

With all the disparate address datasets held by both public and private organizations, the publication of SANS 1883 (2009) provided an opportunity for collation of these into a single NAD. The NAD can bring together public and private organizations into a multi-participant data sharing initiative that facilitates the collection, validation and maintenance of address data. To ensure the success of the national address database initiative, the underlying motivators and barriers for data sharing among organizations need to be identified and taken into consideration when establishing the relationships among participating organizations.

Although the local municipalities still assign addresses in their areas of jurisdiction, the role of the private organizations in creating address-related products and services is critical to the functioning of the economy. The synergy among the public and private organizations in establishing and maintaining the NAD will benefit all users of address data in the long run. This research aims to improve the understanding of the motivators for and barriers to establishing a NAD in South Africa.

4. DESCRIPTION OF THE CASE STUDIES

Three South African organizations, key role players in address data in the country, were used as case studies for our research: a metropolitan municipality, a public organization (national) and a private company. The metropolitan municipality represents the need for an address database that is collected and maintained within a single area of jurisdiction. The public organization represents the need for an integrated national address database. It was chosen because out of necessity to perform its functions, it had to develop and maintain its own address scheme – different from any other existing in the country. The private organization also represents the need for an integrated national address database. It was selected due to its integrated address dataset product, collated from local municipalities, and also due to its address-related market-oriented products. The private company would shed light on the user expectations and the quality of the data provided by the local municipalities. The selection of these varied case studies was informed by the reality of developing the NAD, which will involve collaboration of multiple participants with different interests. More details about each of the case studies are discussed later in this section.

Key informants, well conversant with the spatial 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 document procedures and to ensure that these could be repeated with the same results when conducted again. In addition to the interviews, available supporting documentation was studied.

The interview aimed to get answers to the following questions:

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 and practice of inter-organizational spatial data sharing?

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. Part 1 of the questionnaire required information about the organizations, so it was structured to guide the informants on what kind of information was needed. Parts 2 and 3 were open-ended questions on motivators and barriers for spatial address data sharing. These parts were based on extensive literature review of the motivators for and barriers against data sharing. But the informants were not only restricted to these questions; instead they were given opportunities to raise any other motivators and barriers from their work experiences. The full questionnaire is available in Sebake (2011).

Table 2: Structure of the Questionnaire

Part 1 Particulars of the organization	-	This part, which is rather structured, collects 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.

A brief description of the three case study organizations follows. More details are available in Sebake (2011) and Sebake and Coetzee (2012).

Case A (public). Case A is a national government department with more than 500 employees. Because of the lack of national address data in South Africa, Case A could not fulfil its mandated responsibilities. Case A therefore maintains a dataset of dwelling locations as geocoded points or polygons with associated attributes containing information relevant to their mandate. Case A emphasized that they are not working on a national address dataset, i.e. they are not interfering with the mandate of the local authorities and the South African Post Office.

Case B (private). Case B is a private company with more than 50 employees, offering GIS services to its South African and international clientele. Their offering includes location-based services, geocoding, geo-marketing, mobile applications, transportation modelling, etc. The company requires quality spatial address data to deliver these services. The lack of national address data prompted them to start their own spatial address dataset, which is sourced from local authorities in paper and/or digital format.

Case C (municipality). Case C is a local metropolitan municipality for one of the biggest cities in Africa with a population of more than 3 million. Their challenge is to maintain an address register for various purposes, such as, property valuations, emergency response, delivery of utility services, establishment of townships and debt collection. Case C has instituted a process to capture property details, including the address, in their spatially enabled land information system as soon as the property is registered.

The verbal interviews were recorded on the voice recorder and transcribed later for further analysis. The interview 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.

5. MOTIVATORS AND BARRIERS

In section 5.1 and 5.2 we describe the motivators and barriers that were identified in the three case studies. These are described in more detail in Sebake and Coetzee (2012). We include a summarized list here. In section 5.3 we expand on our earlier work by analyzing the significance of the individual motivators and barriers for the three respective case studies.

5.1. Motivators Identified by the Three Case Studies

5.1.1. Reduced 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 was useable.

5.1.2. 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.

5.1.3. 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.

5.1.4. Financial Incentives

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. Only Case B, as a private organization, considered financial compensation to be an appropriate incentive for recapturing and validating spatial address data.

5.1.5. 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. SANS 1883 (2009), making it possible for public and private organizations to work from the same address dataset.

5.2. Barriers identified by the three case studies

5.2.1. 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.

5.2.2. 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.

5.2.3. 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).

5.2.4. 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 any private data.

5.2.5. Lack of Common Data Definitions, Formats and Models

All the data collected from different sources does not yet conform to SANS 1883 (2009) and the resulting lack of common data definitions, formats and models will remain a barrier for some time. Case A mentioned that adapting their internal systems to the standard is a challenge that will take a while to address. Although there is still a concern about common data definitions, formats and models, the three cases were positive about a future in which SANS 1883 (2009) would be mandatory.

5.2.6. *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.

5.2.7. *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.

5.2.8. *Inadequate Support from Strategic Management Plans and Policies*

Although this was suggested as a barrier, only the private organization perceives it as a barrier. 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. For example, Case C, the local municipality, uses Balanced Scorecards to align spatial data sharing targets with their strategy.

5.2.9. *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).

5.3. The Significance of Individual Motivators and Barriers

The significance of individual motivators and barriers for the respective address organizations is shown in Table 3 and 4 below. Significant motivators and barriers are indicated with a '+', non-significant motivators and barriers with a '-', depending on how the cases responded during the interviews.

Table 3: Significance of Motivators, as Indicated by the Case Studies

	Case A (public)	Case B (private)	Case C (municipality)
Reduced cost of data handling	+	-	+
Improved data quality	+	+	+
Return on investment and improved decision making and planning	+	+	+
Financial incentives	-	+	-

Table 4: Significance of barriers, as Indicated by the Case Studies

	Case A (public)	Case B (private)	Case C (municipality)
Negative impact on revenue generating streams	-	+	-
Priorities of the organization	-	+	-
Accuracy and reliability of spatial address data	-	-	-
Copyright issues, data privacy and data ownership issues	+	+	-
Lack of common data definitions, formats and models	-	-	-
Staff turnover and technical resources	+	+	+
Unequal commitment from organizations in an SDI	-	+	-
Inadequate support from strategic management plans and policies	-	+	-

All three case studies regard *improved data quality* and *return on investment* as significant motivators, which improve decision-making and planning for service delivery.

The public organization and local municipality identified *reduced cost of data handling* as significant, while the private organization recognized the financial benefit of pooling resources, but raised the concern that the cost of validating data might rise in a multi-participant setup.

Financial incentives were considered a significant motivator by the private organization, which, understandably, expects financial compensation for doing

the work of capturing and registering address data. In contrast, because this work is part of the mandate of the public organizations, they do not expect a financial incentive.

The significant barrier for all the cases is high staff turnover and the resulting lack of technical skills. Another barrier – *copyright issues, data privacy and ownership* – played a significant role for two of the cases.

Other barriers appeared to be not significant for the public organization and local municipality but were significant for the private organization, namely, the *negative impact on the revenue generating streams, priorities of the organization, unequal commitment from organizations in an SDI and inadequate support from strategic management plans and policies*. The fact that only the private organization regarded the negative impact of spatial address data sharing on revenue streams as significant is in line with the *financial incentives* motivator above.

Barriers, which are not significant for all the cases are *accuracy and reliability of spatial address data* and the *lack of common data definitions, formats and models*.

6. IMPLICATIONS OF THE RESULTS FOR THE SOUTH AFRICAN SDI

In this section we discuss results from the case studies and their implications for SASDI.

Although there was consensus among the organizations that sharing spatial address data would lead to improved data quality, the organizations were sceptical of data from other organizations. Each organization believed that their data was of high quality as it has been serving their purposes well, while there was a perception that the people responsible for handling the GIS data in other organization were not well trained or lacked the skills required for data management. This observation shows that even if technical barriers are removed (e.g. through implementation of a standard), people related barriers could remain.

The case study results show that return on investment through improved decision-making and planning is perceived as a significant motivator. The question is how can this be measured? Research findings from Europe show that estimating SDI benefits is even more difficult than estimating costs. Furthermore, research shows that it is worth focusing on specific application areas (e.g. addressing) rather than generic SDIs, and on small benefits taking place many times rather than looking for a big once-off benefit. Of the many application areas, those based on land and property are some of the most widely used (Craglia and Campagna, 2010). Generally, studies in Europe have shown that investing in SDIs pays, but “one needs to be in the frame of mind of running a

marathon and not the 100 meters” (Craglia, 2011). This is an important message to SASDI implementers who currently have to motivate investments into SASDI: it is important to understand and communicate to stakeholders how to measure the return on investment and when to expect this return.

Craglia and Campagna (2010) also point out that measuring the costs and benefits of establishing reference data in a so-called first generation SDI is quite different to measuring the costs and benefits in a process-based second generation SDI where services and technologies are provided. In South Africa, some national datasets, such as a national address dataset, still need to be established, while others, such as the topographical layers, have a long history and can probably be regarded as being in the second generation SDI, where the focus is on processes and services. SASDI should differentiate between these two types of datasets.

The case studies confirm that the behaviour of public organizations differs from that of private organizations: the former is motivated by the advancement of the public good, while the latter is driven by profit margins. For example, the private organisation will be 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. Nevertheless, the responses indicate that a middle ground is possible through public-private partnerships, which enable public and private organizations to collaborate on capturing and validating spatial address data. This does not prohibit the private sector from producing commercial value-added products, such as location-based services.

Despite wide publication about the benefits of public-private partnerships (Miraftab, 2004; Iossa and Martimort, 2012), none of the case studies have given enough consideration to the potential value of a public-private partnership for covering the costs of maintaining South African address datasets. SASDI is still struggling to obtain funds to get off the ground and given the current global financial constraints, public-private partnerships should be evaluated. For example, private organizations could offer their data maintenance services to public organizations at rates that are set off against the potential profit gain from integrating the address data into the company's value-added products. Another option is a public/private sector consortium that builds and maintains the address dataset for a contracted period. This has proved to be a success in Australia through the inter-organizational Public Sector Mapping Agency (PSMA), which produces the Australian Geocoded National Address File (G-NAF; PSMA, 2012).

The case studies agree that staff turnover is a significant barrier. This problem is not unique to the GIS industry in South Africa, but it is exacerbated in South Africa by a low supply for skilled resources, resulting from increased emigration among knowledge workers and lower standards of education, as well as the

impact of legislation and regulations that are aimed at redressing historical racial and gender practices in the workplace (Kotze and Roodt, 2005). The Occupation Specific Dispensation (OSD) in the South African public sector (Department of Public Services and Administration, 2007) has been introduced as a measure to ensure that the abilities and experience of GISc professionals are recognised and remunerated accordingly to avoid job-hopping in search of a better salary.

The results of the three case studies indicate that copyright, data privacy and data ownership need to be addressed to ensure that organizations are not alienated by SDI initiatives that advocate data sharing at all costs or by the fear that data custodians will use their datasets as a bargaining tool in negotiations. These issues also have to be resolved to allay fears of one organization taking control of all the data and distributing it without acknowledging the efforts of others or ignoring the needs of others when maintaining the dataset. The implication for SASDI is that regulations will have to clearly specify the copyright, data privacy and data ownerships of SASDI core datasets.

The less significant barriers, such as, accuracy and reliability of spatial address data and lack of common data definitions, formats and models can be overcome, among others, through the determination and prescription of standards by the CSI. The Spatial Data Infrastructure Act 54 of 2003 provides for the determination and prescription of standards to which a custodian must adhere. SANS 1883 (2009) has already established a common terminology for different South African address types and their elements. ISO/DIS 19157 (2011), *Geographic information – Data quality*, and the proposed ISO 19160-3, *Addressing – Quality management of address data* (ISO/TC 211, 2011), could provide the necessary measures to assess and communicate address data accuracy and reliability.

There was agreement among the case studies that an address data sharing initiative fosters standards compliance, improves usability of the data, assists the public sector to focus on developing their service delivery to citizens of the country, and allows the private sector to focus on developing value-added products and services. These benefits also apply to other spatial datasets in SASDI.

7. CONCLUSION

Our study shows that there are significant motivators for, but also barriers to, an address data sharing initiative in South Africa. These have implications for SASDI but are also of interest to other countries and for other spatial datasets. The quality of data produced by SASDI data custodians needs to be clearly described and evaluated in order to avoid prejudiced perceptions of poor quality. Expectations about the timing and value of the expected return on investment

from SASDI need to be carefully managed to avoid losing support from stakeholders along the way.

South Africa's high staff turnover problems and resulting lack of technical skills could jeopardize the SASDI implementation, even if all other aspects of SASDI are well managed. Technical barriers, such as common definitions, models and formats, are less significant and can be overcome by implementing appropriate standards. Public-private partnerships are not yet given enough consideration in South African data sharing initiatives, but with financial constraints in the public sector, these should be explored as options for data sharing in SASDI.

The responses of the case studies indicate that despite the barriers that have been mentioned, the organizations are eagerly awaiting guidance from the CSI on address data sharing and coordination in the SASDI implementation. The question remains whether this eagerness among those who do the technical work will get enough political support (and corresponding budgets) to finally get SASDI off the ground.

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