

# Facing the Facts: The extent of spatial data sharing

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## 1. Introduction

In the context of implementing Spatial Data Infrastructures (SDI), the extent to which spatial data sharing among different organisations is already taking place is of considerable interest to policy makers. Greater data sharing is one of the principle aims of any SDI. This paper presents the results of empirical research aimed at measuring the extent of spatial data sharing activities. The theoretical underpinnings of this approach are discussed in Section 2. On the basis of the empirical evidence, the paper presents an assessment of the magnitude of spatial data exchanges (Section 3), who is sharing with whom (Section 4) and the terms and conditions under which spatial data is shared (Section 5). In Section 6, these results are then interpreted according to a specific categorisation of spatial data sharing levels.

## 2. Assessing the extent of spatial data sharing

In attempts to capture the various conditions that may facilitate spatial data sharing, different classifications have been proposed in the literature, focusing on access, exchange dynamics and conditions, and on the frequency and scope of sharing. A summary of these classifications is provided in Table 1.

Table 1: Classifications of spatial data sharing

Focus	Classification	Author(s)
Access	<b>Different levels of access to spatial data</b> <ul style="list-style-type: none"><li>access to information from the database (access to only part of the information stored in the database, request for a specific maps (layers of information) for specific locations (cities, areas))</li><li>access to all of certain kinds of information in the database (i.e. data sets)</li><li>access to the database itself (a copy of the actual database)</li></ul>	King (1995: 264-5)
Access & distribution	<b>Classes of sharing</b> <ol style="list-style-type: none"><li>Direct access to a single database that is shared among multiple organisations.</li><li>Joint compilation or acquisition of data by multiple organizations, each of which obtains a separate copy of the data.</li><li>Acquisition of a copy of one organization's data by another organization on a one-time or periodic basis.</li><li>Sale of copies of data by an organization to other organizations.</li><li>Distribution of copies of maps or geographic data reports by one organisation to other organisations.</li></ol>	Kevany (1995: 81-2)
Exchange dynamic & conditions	<b>Typology of multi-participant GIS setting sharing a geographic database:</b> <ol style="list-style-type: none"><li>An organization undertakes to provide geographic databases to other organisations at a nominal charge that does not reflect the production costs, or in a "one-shot" project where maintenance is not a concern. The dominant inter-organizational dynamic here is "one-way" (i.e., the organization providing the database is not affected by the user organizations wanting or not wanting to take part in the production of the database).</li><li>An organization undertakes to provide geographic databases of universal value to a variety of other organizations. Continued maintenance and expansion of the database depends to a large degree on the using organizations picking up a portion of the tab for this effort as well as the demonstration of the usefulness of this data to resource-providing bodies. Moderated "one-way" dynamic between organizations with</li></ol>	Azad & Wiggins (1995: 25-26)

	<p>demonstrated demand for the product by user organizations.</p> <p>3. Several organizations undertake building and maintaining geographic databases by sharing the costs and products as a response to resource scarcity and to minimise duplication/ redundancy. "Two-way" dynamic reliant on mutual consent and participation of each organisation.</p>	
Frequency & scope	<p><b>Inter-organizational information sharing context:</b></p> <p>Non-routine, non-recurring: Situation-specific, project driven, work on a common problem, data and expertise shared to solve the problem.</p> <p>Case-by-case or long-term data sharing: Need for similar information by different agencies addressing different problems, develop procedures for regular sharing and exchange of information but protocol inappropriate for sharing with broader community or additional parties.</p> <p>Routine sharing process: Standardised, generalisable pattern of exchange: information readily accessible to all parties in terms of its location and format.</p>	Pinto & Onsrud (1995: 46), Obermeyer & Pinto (1994);

Moreover, a comprehensive taxonomy of the characteristics of spatial data exchanges has been developed by Calkins and Weatherbe (1995) which enables recognition of particular types of occurrences of spatial data sharing (see Table 2).

Table 2  
**Measurements of sharing behaviour**

<b>Aspects of Sharing Behaviour</b>	
Type of the organisation	private sector / commercial academic institution non-governmental organisation local authority provincial government national government para-statal organisation
Spatial data role of the organisation	spatial data recipient spatial data supplier spatial data broker
Type of spatial data exchange of the organisation	data supplier <-> end user data suppliers <-> data broker end user <-> data broker between data suppliers between end users between data broker
Types of sharing partners of the organisation	vendor private sector / commercial academic institution non-governmental institution local authority provincial government national government para-statal organisation
Schedule of spatial data exchanges	on schedule (regularly) on demand (ad hoc)
Frequency of spatial data exchanges	daily weekly monthly yearly project-basis once-off never
Most recent spatial data exchanges	this week last week last month last 6 months more than 6 months ago
Sharing arrangement	informal / voluntary formal contract mandate to share or distribute profit-making venture
Charges for shared spatial data	free of charge barter

	license fee consortium membership marginal cost of reproduction cost recovery basis market value
Average quantity	single observation summary / aggregate observations selected subset theme entire database

Source: based on Calkins and Weatherbe (1995)

The approach adopted in this paper to measure spatial data sharing behaviour is to base the empirical data gathering on the Calkins and Weatherbe taxonomy (see Table 2) and to interpret these findings drawing on relevant elements of the classification schemes presented above (Table 1). However, in terms of operationalising this approach, the observation of spatial data sharing activities by an outside observer can present considerable difficulties. An alternative means of examining actual behaviour to *direct* observation of that behaviour is to use self-reports of past behaviour. Ajzen and Fishbein (1980) suggest that, in many instances, the observation of the behaviour by an outside observer provides considerable difficulties. As this is the case with spatial data sharing across organisational boundaries and since this method would also encompass a considerable effort that is beyond the scope of this research, self-reporting of past sharing behaviour was chosen. Ajzen (1988) has argued that this is an acceptable method for relatively non-sensitive behaviours in which the relationship between people's self-reports and their actual behaviour is high. In this respect, spatial data sharing can be regarded as non-sensitive and respondents to the survey were asked to report on their past sharing behaviour. Implementation details of the survey are presented next.

## 2.1 Research Methods

In order to gauge the extent of actual spatial data sharing activities, multiple choice questions were devised for a questionnaire instrument as measures for the aspects of sharing presented in Table 2. The target population was the GIS community in South Africa. As identified by Abbott (1996), there are distinct groups within this community that stem from the wide range of possible applications of GIS and the actual spread of GIS in South Africa. The different sectors included in the GIS community are presented in Table 3 together with the distribution of the responses. The survey was carried out using face-to-face interviews (targeting key individuals for GIS within the organisations) in three provinces (Gauteng, Kwazulu Natal and the Western Cape) and the total number of respondents included in the final analysis was 112 from 73 different organisations.<sup>1</sup>

Table 3: Distribution of respondents per sector

Sector	Valid responses	No. of organisations
National government	15	9
Provincial government	12	7
Local authorities	18	11
Para-statal organisations	20	12
Academic/research institutes	16	11
GIS industry	13	11
Private sector	13	8
Non-governmental, not-for-profit	4	3
other	1	1
<b>Total</b>	<b>112</b>	<b>73</b>

<sup>1</sup> This survey assessed the extent of sharing activities within the GIS community at large. For a survey focusing on sharing 'clusters' (sharing consortia), see Nedovic-Budic et al (2001).

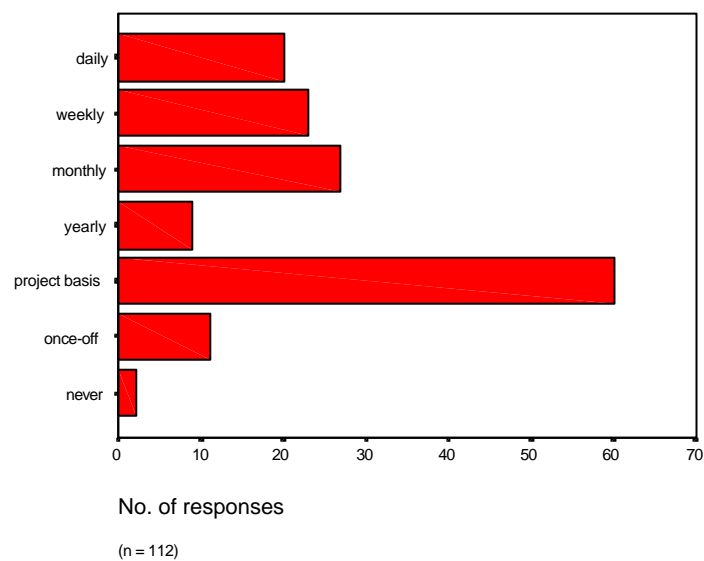
Respondents were provided with the following definition of spatial data sharing so that they would depart from a common understanding of the concept: *Spatial data sharing entails making the digital spatial data used in Geographic Information Systems (GIS) accessible to, or from, other parties. These exchanges may or may not include barter, financial payment or payment in kind.*<sup>2</sup> Using the questionnaire, the following information was gathered. The type of the organisation, the spatial data role and exchanges of the organisation, and the type of sharing partners provide information on who is sharing with whom. The average quantity of spatial data shared, together with the schedule, frequency and most recent spatial data exchanges supply information about the magnitude of spatial data exchanges. Information about the sharing arrangements and the charges for shared spatial data are used to give insight into the terms and conditions under which spatial data are shared. The results of the survey are presented in the following sections.

### 3. Magnitude of spatial data exchanges

The magnitude of actual spatial data exchanges among the sample respondents is indicated by the frequency, schedule and recency of reported spatial data exchanges, and by the average quantity of spatial data that is reported to have been shared.

As shown in Figure 1, only a small minority of respondents reported that their organisation had never engaged in spatial data sharing activities at all. The remaining responses are not mutually exclusive. Respondents indicated that by far the most frequent spatial data exchanges were taking place on a project basis.

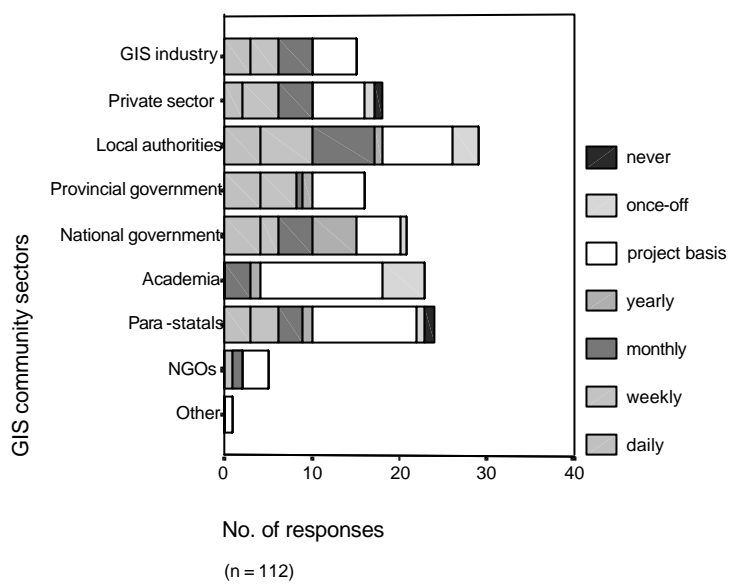
Figure 1: Frequency of spatial data exchanges



<sup>2</sup> This definition was derived from a literature review. For details, see Wehn de Montalvo (2002).

Figure 2 distinguishes the frequency of spatial data exchanges according to the different GIS community sectors. It is important to note that respondents were able to indicate multiple frequencies (unless they indicated 'never' to share); hence the total number of responses per sector may exceed the total number of respondents per sector. From Figure 2, it is possible to detect the sectors in the sample that indicated their organisation was not engaging in any sharing activities. These respondents were from the private sector and from para-statal organisations.

Figure 2: Frequency of spatial data exchanges by sector



The schedule of spatial data exchanges reported by the respondents is indicated in Figure 3. It shows that the majority of exchanges across organisational boundaries were reported to have been on demand (72.6%) and that less than a fifth took place on a scheduled basis (18.5%).

Figure 3: Schedule of spatial data exchanges

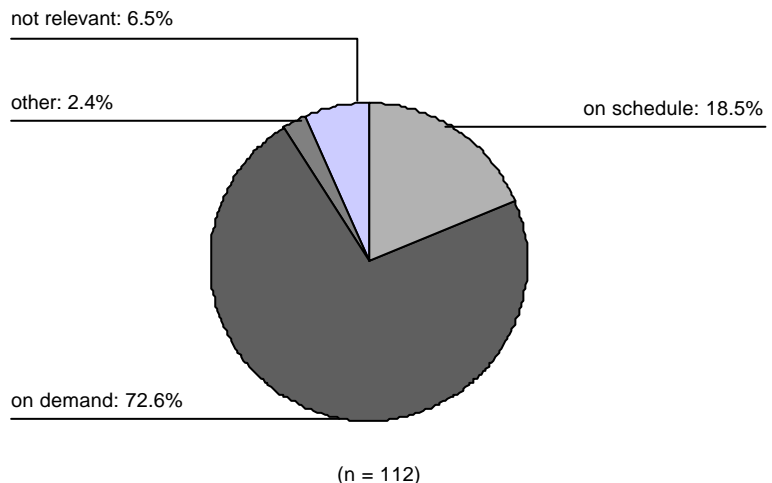
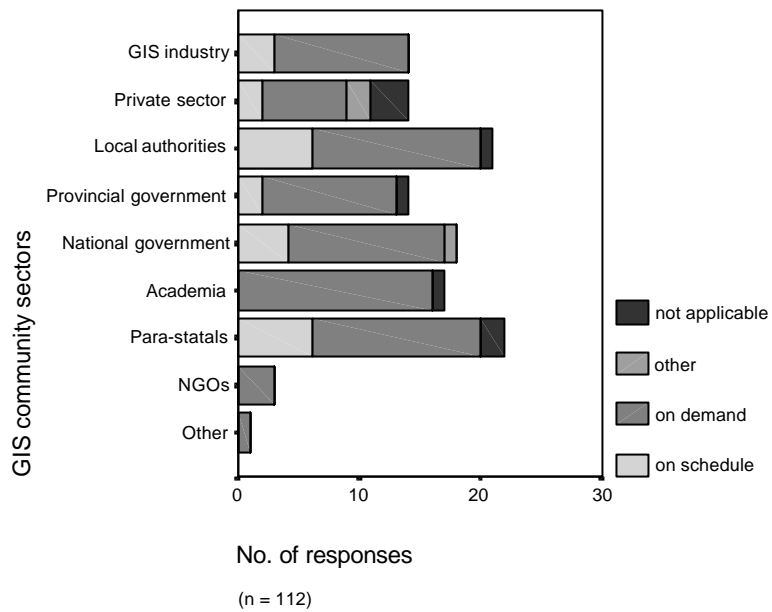


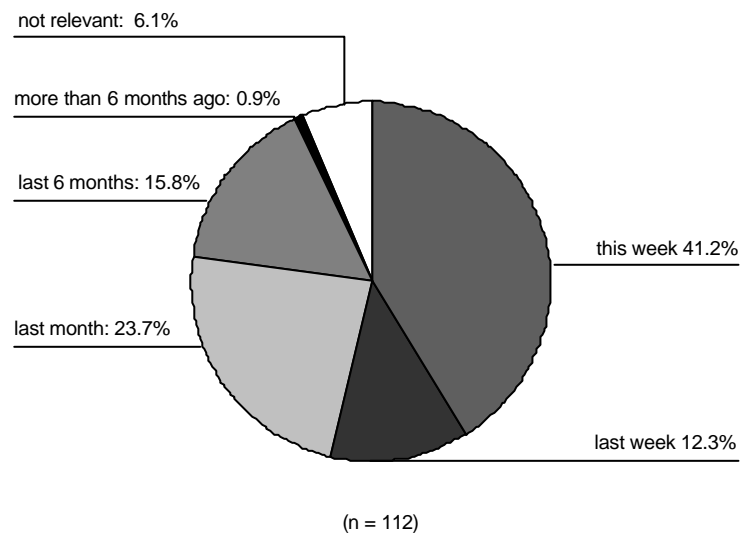
Figure 4 presents the reported schedule of spatial data exchanges by sector. It is noticeable that more respondents from local authorities and para-statal organisations than from any of the other sectors reported that exchanges took place on a scheduled basis.

Figure 4: Schedule of spatial data exchanges by sector



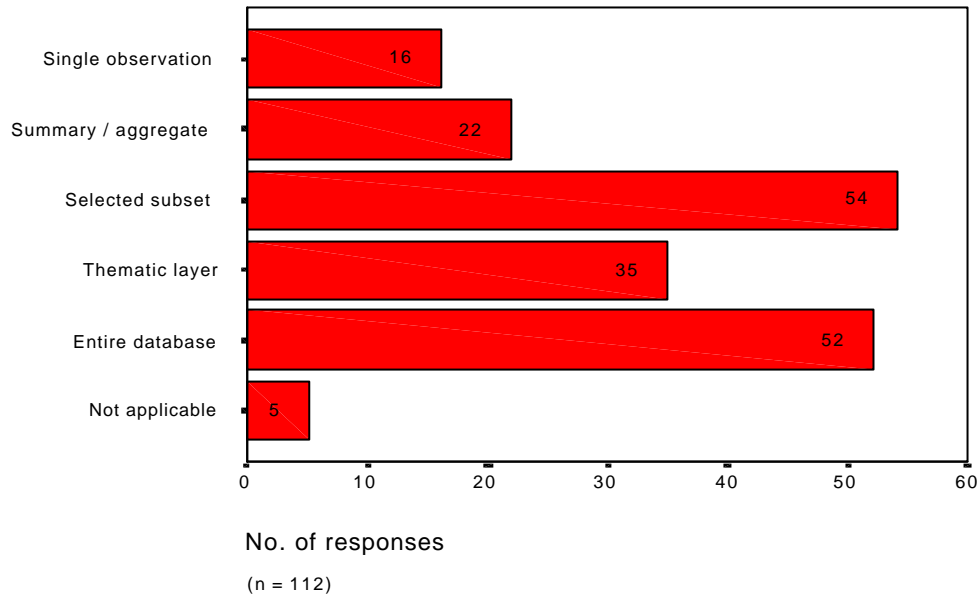
Respondents were also asked to indicate when the most recent spatial data exchanges of their organisation had taken place. Figure 5 shows that more than three-quarters of the exchanges had taken place within the last month or more recently (at the time of implementing the survey).

Figure 5: Recency of spatial data exchanges



Details of the average quantity of spatial data exchanged by organisations as indicated by the respondents in the sample are presented in Figure 6. Almost half of the respondents reported that entire spatial data bases were exchanged. Frequent options were also to exchange a selected subset or a thematic layer of spatial data. There were far fewer indications of the exchange of single or summary observations.<sup>3</sup>

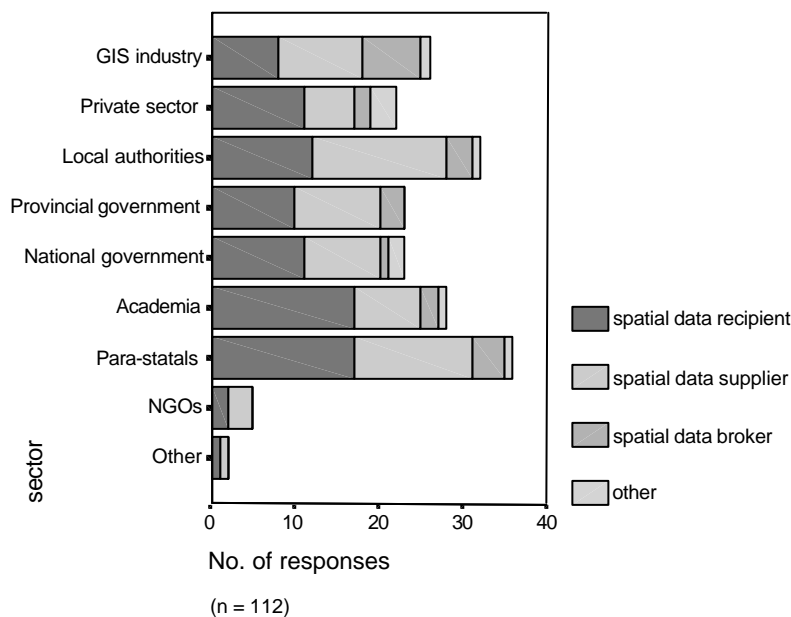
Figure 6: Average quantity of spatial data exchanges



#### 4. Who is sharing with whom

Figure 7 shows the role of the organisations in the sample (as reported by the respondents) with respect to their involvement with spatial data. In all of the sectors, apart from the NGOs, there are spatial data recipients, suppliers and brokers.

Figure 7: Spatial data role of the organisation by sector



<sup>3</sup> Summarising spatial data (such as classifying various types of vegetation under one title) limits the amount of information disclosed.

Figure 8 indicates the types of spatial data exchanges that the organisations engage in. The most frequent exchanges were indicated between data suppliers and end users, and among the end users themselves.

Figure 8: Types of spatial data exchanges by sector

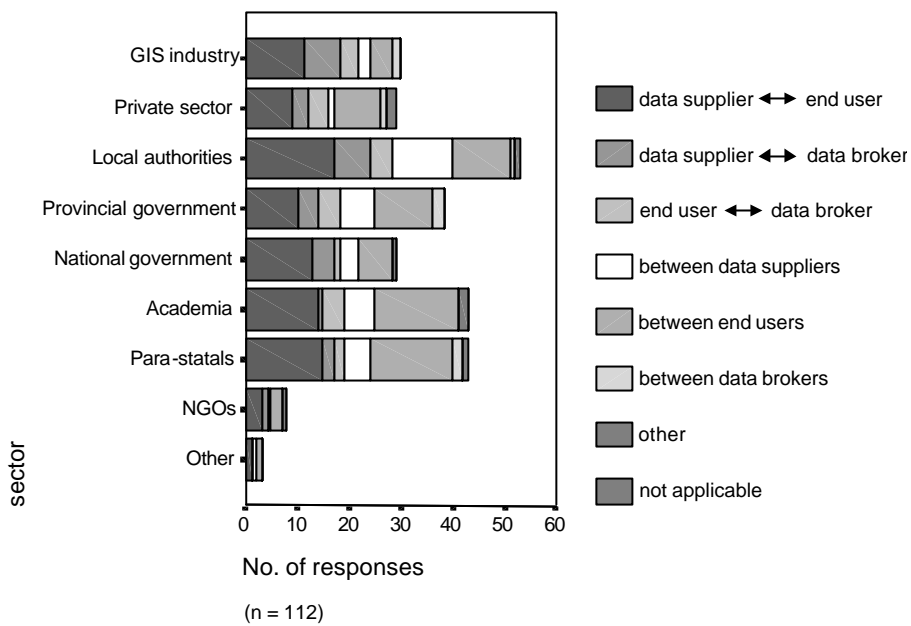
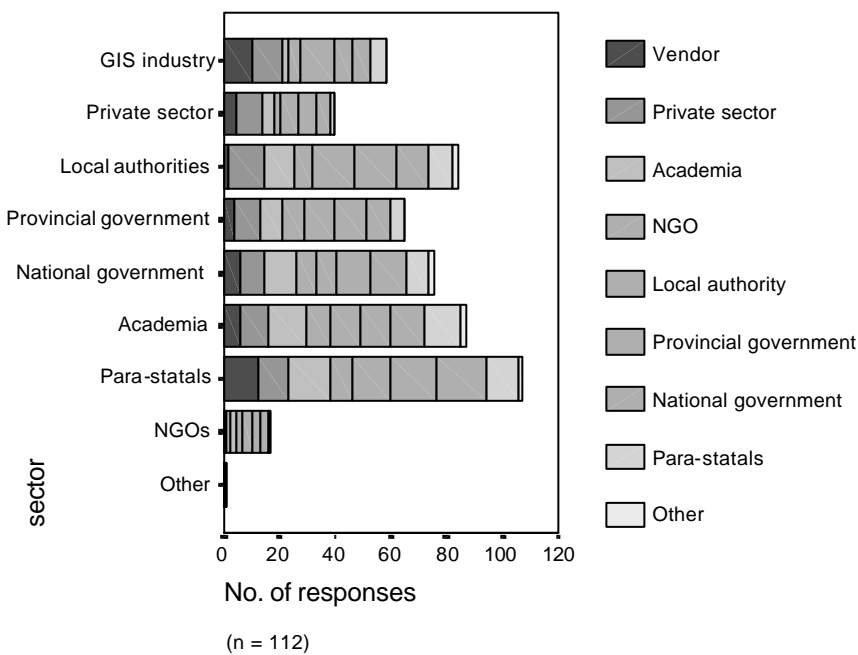


Figure 9 shows the types of sharing partners of the different GIS community sectors in the sample. At this aggregate level of the sectors (as opposed to the individual organisational level), it seems that everybody is sharing with everybody else.

Figure 9: Types of sharing partners by sector



## 5. Terms and conditions under which spatial data is shared

Both formal and informal sharing arrangements were reported frequently by the respondents (see Figure 10). Only a quarter of the respondents indicated that their organisation has an explicit mandate to share.

Figure 10: Sharing arrangements

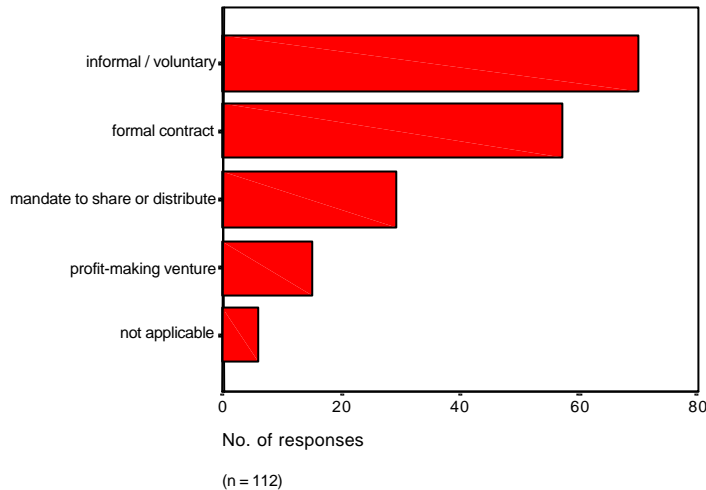
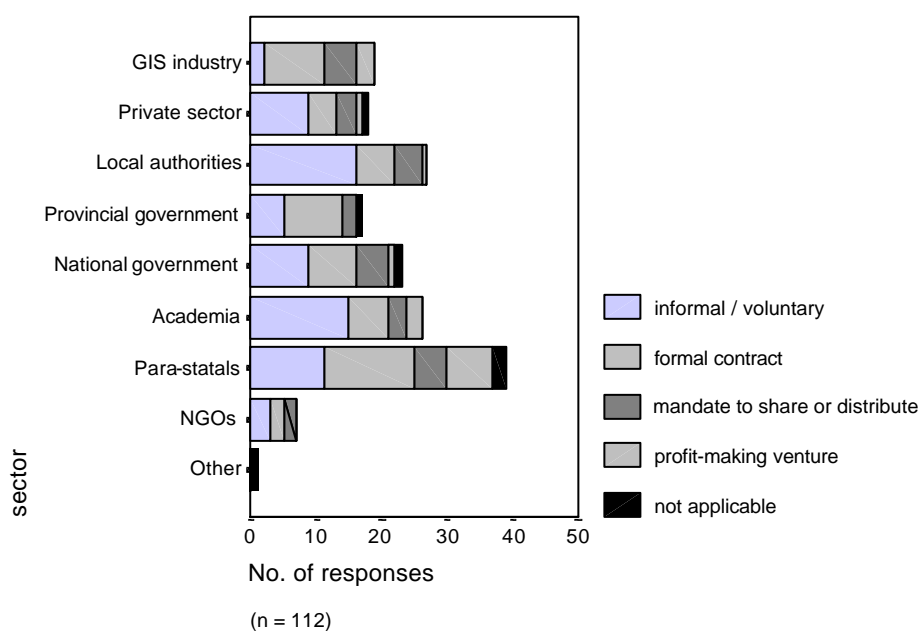


Figure 11 gives an overview of the types of sharing arrangement that the different GIS community sectors in the sample engage in. Formal and informal arrangements were reported right across all of the sectors. As can be expected, profit-making ventures were reported by the GIS industry, para-statal organisations and national government (since the Surveyor General and other data producing organisations are included in this category) but they were also being used by some local authorities and academic institutions. Sharing arrangements that are based on a mandate to share were reported by all sectors but most frequently by the GIS industry, local and national government and para-statal organisations.

Figure 11 Types of sharing arrangements by sector



The most frequent response with respect to the charges for shared spatial data (see Figure 12), whether received or supplied by the organisations, was that spatial data was shared free of charge. Other frequent terms and conditions for shared spatial data entailed full cost recovery and marginal cost of reproduction. Full cost recovery refers to making spatial data available at a price that allows the originator to recover all the costs incurred in producing the data set. Prices set at the marginal cost of reproduction entails charging only for time and the medium (e.g. CD-Rom) required for providing a copy of the spatial data (sub)set.

Figure 12: Charges for shared spatial data

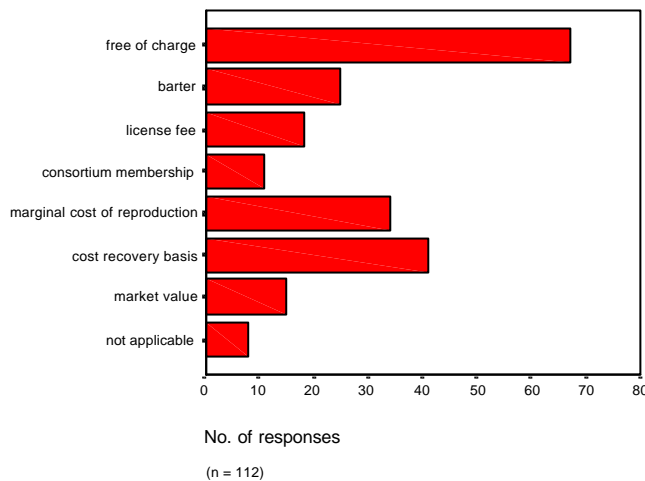
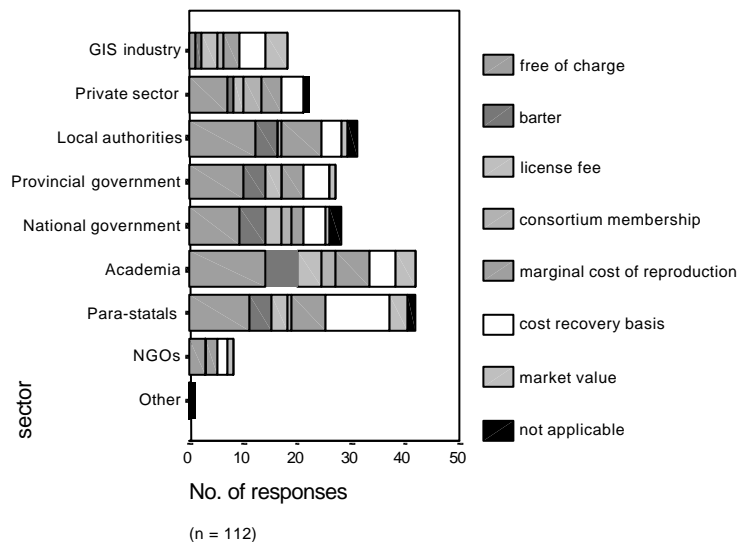


Figure 13 presents the charges for shared spatial data by the different GIS community sectors in the sample. This shows that the different types of charges are used right across all of the sectors.

Figure 13: Charges for shared spatial data by sector



## 6. Analysis and Conclusions

The scope of spatial data sharing among organisations can be categorised according to the following levels (Obermeyer & Pinto, 1994; Pinto & Onsrud, 1995): a) situation specific, project driven, non-routine, and non-recurring, to solve specific problems; b) regular sharing and exchange of information using protocols and procedures for limited sharing parties; and c) routine sharing, standardised, generalisable patterns of exchange, accessible to all parties in terms of location and format.

The empirical data presented above shows that the magnitude of spatial data sharing reported by the respondents in the sample is characterised by exchanges on demand rather than scheduled exchanges, taking place mainly on a project basis. The exchanges were reported to have taken place recently and, according to many respondents, the average quantity of spatial data exchanged by their organisation entailed the entire database, a subset or a thematic layer. Despite the recency of the reported exchanges, the self-reports of spatial data sharing of the respondents in this sample indicate that only the first level of ad hoc, non-routine level of sharing had been reached at the time of the survey. In sum, the self-reports reveal that, although most respondents indicated some involvement of their organisations in spatial data sharing across organisational boundaries, the extent of spatial data sharing activities was still very limited.

In conclusion, coupling the taxonomy of Calkins and Weatherbe (1995) with the classification of spatial data sharing by Obermeyer and Pinto (1994) and Pinto and Onsrud (1995) presents a useful means by which it is possible to gain a deeper understanding of the extent to which spatial data sharing activities are already taking place within a specific community of actors. Specifically, this approach yields results that may be of particular interest to policy makers in order to target their SDI efforts, such as identifying those sectors that engage little in sharing. Yet the motivations to engage in spatial data sharing require in-depth research in their own right and are dealt with elsewhere (Wehn de Montalvo 2002, forthcoming).

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