Gordon Institute of Business Science
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The impact of access barriers on the commercial sector's ability to derive economic value from PSI

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ABSTRACT

The public sector is the greatest producer of a wide range of information in any given country. Literature indicates that up to 80% of this data is spatial and is stored in a digital format. Access to this public sector information (PSI) has significant economic and subsequently social welfare benefits to the people in the country. Access to environmental PSGI is hindered by a number of access barriers such as prising policy and organisational operational processes to name but a few. PSGI can provide the platform for innovative development of value added products and service. .

The extent and impacts of these access barriers on the commercial sector ability to derive economic gain from PSGI is understated

The main conclusion of the study indicated a 100% correlation between the supplies and demand side requirement for the following environmental PSGI sets: Land cover, soil, vegetation, and elevation data for the creation and maintenance of value added products and services. This correlation is significant in as much as it lays the foundation for the potential profitable market for value added products and services derived from environmental PSGI. The main access barriers associate with environmental PSGI were metadata, accessibility, data maintenance programs and reliability of the data.

The main access barriers associate with environmental PSGI were metadata, accessibility, data maintenance programs and reliability of the environmental PSGI. To capitalise on the potential market for the creation and maintenance of value added products there is a strong reliance on the PSGIH to implement the SASDI Act (2003). Focused action on the side of the PSIH in conjunction with the commercial sector support will create an enabling environment to capitalise on PSGI in a sustainable manner.

KEYWORDS

Public sector information

Spatial data infrastructure

Spatial data

Geographic information systems

Value chain

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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Nicolene Fourie

10 November 2014

DEDICATION

I dedicat this reseach to my late father in law who was taken from us in my MBA tenure.

Dad, thank you for always challenging me to know more,

do more,

serve more,

and love more,

in so doing creating the change I want to see in the world.

ACKNOWLEDGMENT

LIST OF ABBREVIATIONS

EIA	Environmental impact assessments
FGDC	Federal geospatial data committee
IOR	Inter-organisational relationships
OGD	Open government data
PSI	Public sector information
PSIH	Public sector information holder
PSGI	Public sector geospatial information
SEA	Strategic environmental assessments
SDI	Spatial data infrastructure
SII	Spatial information infrastructure

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CHAPTER 1: DEFINITION OF PROBLEM AND PURPOSE

1.1 Background to research problem

The potential of deriving economic value from public sector information (PSI) is evident from the prevalence of the topic in policy development and academic research (Bates, 2012b; Janssen & Kuczerawy, 2011; Newbery, Bently & Pollock, 2008). The economic value of PSI increases along the value chain as value added product and service are development from the PSI (Loenen & Zevenbergen, 2010). The availability of PSI will induce the level of innovation in terms of value added product and service the commercial sector can offer and the product and service end user require (Bates, 2012b; Lundvall, 2009).

Spatial information and socio economic data were identified as the greatest contributors to PSI (Koski, 2011; Pollock, 2008). Pollock (2008) argued that up to 80% of all data created by the public sector has a spatial component.   Janssen further argued that the availability of public sector geospatial information (PSGI) could stimulate economic activity and thus social stability (Janssen & Kuczerawy, 2011). Notwithstanding the existence of PSGI, the inaccessibility of environmental PSGI to support activities such as environmental impact assessments (EIA) and strategic environmental assessments (SEA) was estimated at EUR 200 million in the European Market valued at EUR 1 billion (Vickery, 2011).

Figure 1: PSGI flow scenarios
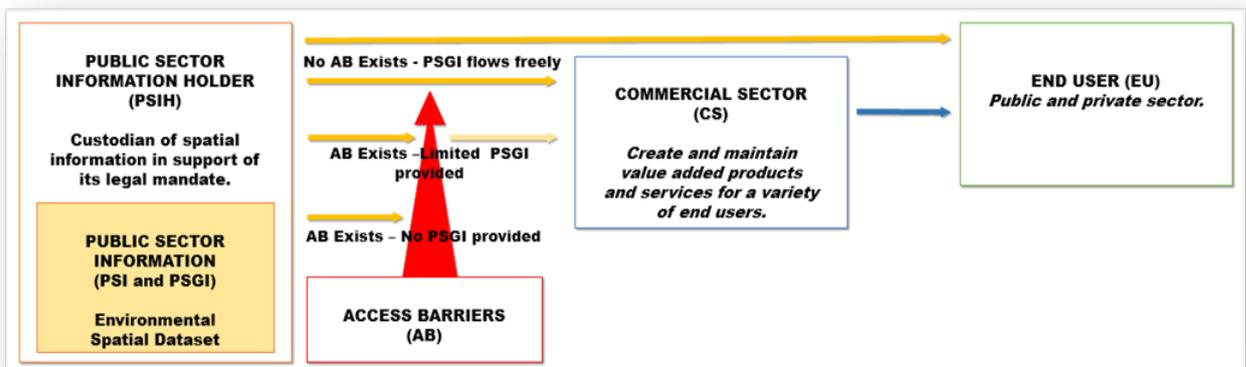
Figure 1: PSGI flow scenarios

 illustrates the flow of PSGI along the distribution chain for the development of valuated products and services. The potential of the commercial sector to capitalise on available PSI and to generate economic value by producing value added products and services is correlated to the commercial sectors ability to access the required PSI (Castelein, Bregt & Pluijmers, 2010; Koski, 2011; Newbery et al., 2008; Pollock, 2013).

Economic literature reviewing access barriers such as policy frameworks and pricing models for PSI have received considerable attention (Newbery et al., 2008; Pollock, 2008). Identification of additional access barriers to PSI is scattered over an array of literature and the associated economic impact received little attention (Bates, 2012b; Koski, 2011; Pollock, 2008).

Access barriers to PSI and in particular PSGI can be internal such as public sector information holder (PSIH) internal culture and standardisation of operational procedures are prominent themes in academic literature (Janssen & Kuczerawy, 2011; Pollock, 2008; Vries & Miscione, 2010). Outward facing access barriers such as inter-organisational relationships (IOR), lack of customer orientation and transparency of operating procedures is prevalent and exist in developed and developing countries (Janssen & Kuczerawy, 2011; Pollock, 2008; Vries & Miscione, 2010).

Not addressing these access barriers will have an impact on the potential economic exploitation of PSI in the short and long term (Bates, 2012b; Cerrillo-i-martínez, 2012; Pollock, 2008; Vickery, 2011). The extent of the economic impact, over the spectrum of access barriers requires empirical research to inform coherent action from policy makers and the commercial sector alike (Vickery, 2011).

1.2   Research motivation

Vickery (2011) highlighted the importance of PSI in economic growth of especially small economies through innovation of products and services. Information on potential development opportunities and new economic growth can only be realised if access is facilitated to the required PSGI (Pollock, 2008; Vickery, 2011).

Furthermore, Vickery highlighted the importance of addressing the lack of qualitative research into the size, growth and impact of PSI related activities (2011).   The

requirement for environmental PSGI specifically within the environmental sphere is evident but understated in the amount of empirical research (Vickery, 2011).

The uninhibited flow of PSGI throughout the value chain has at least two economic benefits a country can obtain; firstly, job creation opportunities associated with the development of the value added products and services. Secondly, the increase in tax associated with the resell of value added products and services (Joanne: Bates, 2012b; Vickery, 2011). The potential benefits can be realised by addressing the access barriers to PSGI (Pollock, 2013).

A comprehensive list of access barriers from a commercial organisation's perspective to PSGI will be compiled. The associated economic impact of the access barriers will be identified and should form the basis of remedial actions such as:

a) Prioritising access barriers for mitigating action

b) Develop and implement short, medium and long term interventions for the listed barrier

c) Monitor impact of addressing the barriers over time (Pollock, 2008).

Without a comprehensive list of access barriers to environmental PSGI as a reference document the actions described above cannot receive the required focused attention and corrective actions.

1.3   Research objective

The aim of this study is to facilitate an in-depth investigation into the existence of access barriers to environmental PSGI and determine to which extent these access barriers impact on the commercial sector ability to derive economic gain from the creation and maintenance of value added products and services.

This study will investigate the impact from a supply and demand side perspective through a two phase approach by employing the following two constructs:

Current access barrier construct derived from literature review.

Examining the creation of value added products and services based on the value chain model (Loenen & Zevenbergen, 2010; Vickery, 2011; Vries & Miscione, 2010).

The study will have the following objectives:

- **Supply side:**

Identify access barriers to environmental PSGI that the commercial sector contends with and to determine the level of constraint associate with the relevant access barriers.

- **Demand side**

Determine end-user demand for value added products and services derived from environmental PSGI.

- **Economic opportunity**

Establish if access barriers have an economic impact on the commercial sectors ability to create and maintain value added product and services.

The research approach will aim to contribute to the economic academic spheres by utilising mixed research methodology. An access barrier matrix derived from current literature in association with a value chain model for value added products and services will be used to determine the economic correlation. This academic research could be applied by any organisation that assesses the impact of PSI access constraints on the creation of value added products and services.

1.4   Research scope

The focus of the study will be limited to environmental PSGI with a national footprint that is required by commercial organisations to create and maintain value added products and services. The study will be limited to the PSIH that have a legal mandate to create and maintain environmental PSGI, whether the mandate is explicitly or implied in its legislation.

The research scope is restricted to commercial organisations that utilise or require environmental PSGI to create and maintain value added products or services. Only commercial organisations in South Africa, as a developing economy, will form part of the investigation.

1.5 Summary of introduction

PSI and in particular PSGI are very valuable commodities. For a long period, the public sector geospatial information holder (PSGIH) focussed on deriving short term financial gain by selling the PSGI through a variety of pricing models. Recent literature compared the American and European approach and policy frameworks to providing access to PSI and PSGI. These studies made a clear case to provide PSGI for free or at the most recovering a handling fee (Pollock, 2008). These studies highlighted the existence of additional access barriers.

From the aforementioned literature it is clear that PSGIH will derive an increase in funding through taxes. In addition, by stimulating the market with a constant flow of freely accessible PSGI there will be economic opportunities for the commercial sector. Furthermore, there will be economic growth for the country through job creation opportunities to support the development of value added products and services.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Traditional neo-classical economic theory holds that there is a relationship between the demand and the supply of an item and the associated value (Nilsen, 2010). Nilsen further argues that the value of the item and potential price of the item will naturally reach a general equilibrium (2010). When this equilibrium is not reached a market failure is observed (Hines, J, 1998). These market failures can be attributed to the following conditions in the market; failure of competition, public goods, externalities, incomplete markets, imperfect information, unemployment and inflation (Nilsen, 2010).

Within the provision of PSI there is a market failure due to the fact that this equilibrium is not reached based on the innate characteristics of PSI (Nilsen, 2010). From the PSI supply side perspective factors such as data creation for public goods and legislative mandated exists (Newbery et al., 2008; Nilsen, 2010; Pollock, 2008). From a demand side perspective drivers such as availability, reliability and variety play a major role (Nilsen, 2010; Pollock, 2013).

Within the context of this research, public goods refer to the creation of PSI in the national interest in a non-rivalrous and non-excludable manner (Nilsen, 2010). The PSI is created and maintained based on a legislative mandate and thus should eliminate the potential of production competition between entities (Newbery et al., 2008; Nilsen, 2010; Pollock, 2008). This is not always the case due to access barriers to the data, misalignments of mandates and lack of policy (Cooper et al., 2012; Makanga & Smit, 2010; Project & Leuven, 2012).

Three frameworks will be used as a construct against which the research will be executed. The first is the PSGI flow scenarios as discussed in section 2.6. demonstrating the vertical flow of PSGI along the value chain (Loenen & Zevenbergen, 2010; Vickery, 2011). In addition, the framework highlights the existence and impact of access barriers in the value chain (Newbery et al., 2008; Vickery, 2011).

The second construct is a framework of access barriers to PSI derived from varies empirical literature contributions as outlined in section 2.7 and Table 1. The last construct is that of Economic value derivative alignment to the PSGI value chain

(Loenen & Zevenbergen, 2010). In addition, Interconnectivity of integrated value chains was used to add a refinement dimension (Vries & Miscione, 2010). The value chain as a framework is used to deliver context to the complexity surrounding the delivery of value added products and services (Loenen & Zevenbergen, 2010; Nilsen, 2010). Each component of the value chain contends with internal and external supply and demand pressures (Nilsen, 2010).

2.2 Public sector information holder

PSIH which is responsible for geospatial information has varied operating models and organisational structure depending on the underlying political construct of the entity (Fornefeld & Boele-Keimer, 2008). The environment in which PSIH operate have come under considerable pressure from an economic, political and social perspective ( ).

These pressures range from economic constructs that promote access to PSI as an economic leaver for the information economy to a political response to the economic down turn (Fornefeld & Boele-Keimer, 2008; Newbery et al., 2008; Vickery, 2011). Ever-growing pressure for transparency in governmental administration as is evident in the range of initiatives such as formal policy changes by the Federal Geospatial Data committee (FGDC) to localised research in Pakistan (Ali & Ahmad, 2009; Bates, 2012a; Geographic & Committee, 2014).

Social pressure for PSI and in particular for PSGI is mounting due to the availability to spatial data through initiatives such as Google maps; Open Geospatial Consortium's Web Map Service (WMS) etc. (Blower et al., 2013; Fleming, 2010; Veenswijk, 2012; Vuorio, 2013). Socio-relevance and connectivity through social media is ever increasing (Bates, 2012) and the dependency on spatial location through geo-coding of images is entrenched in these communication platforms (Vuorio, 2013).

All of these technological pressures provide for an increase in demand for value added goods and services associated with PSGI (Bates, 2012a). Yalcin (2014) further argued that these technology driven pressures in turn provide for the development of additional technology platforms such as spatial data infrastructure (SDI) applications such as map services.

2.2.1   Legislation and policy

One of the key drivers for the development of national policy for SDI in Europe, Australia, New Zealand, USA and subsequently in developing countries such as South Africa is the economic pressure and opportunity due to the economic downturn in 2007 (Bates, 2014; Koski, 2011; Pollock, 2008).   Formal SDI initiatives such as Inspire a European Union SDI, Grootschalige Basiskaart Nederland (GBKN) to name a few, required amendments to legislation and implementation of enabling policies, supported by national funding (Newbery et al., 2008; Veenswijk, 2012).   National strategies such as national spatial data infrastructure strategic plan (NSDIS-plan FGDC), United Kingdom Technology Strategy in support of Inspire and Geospatial Information Strategy for New Zealand was formulated to prioritise access to PSGI and to create an enabling environment for economic growth (Mayo & Steinberg, 2007; Smart & Craemer, 2009; Spatial Infrastructure Plan, 2014).

Bates highlighted the role of data democracy in the development of policy not just the economic drivers (Bates, 2012b).   Transparency of state expenditure and associated actions alongside a requirement for privacy brings an added dimension of complexity to the development of national policy and strategies for SDI and PSGI (Cerrillo-i-martínez, 2012; Huijboom & Broek, 2011).

2.3   Public sector information

PSI can be described as information gathered or captured by a public sector organisation and its entity as part of its "public task" (Pollock, 2008; Ricolfi, et al., 2011).   Pollock (2008) found that public sector organisations have heightened prominence in the provision of data and in certain circumstances they are the only providers of core datasets. Legislation and policy play a major role in these institutionalised potential monopolisation of data generation and provision (Loenen & Zevenbergen, 2010; Pollock, 2008).

This definition of PSI is too narrow as it does not cater for information created by non-governmental public institutions (Henninger, 2013).   Henninger (2013) further argued that a definition for PSI should include information *products and services such as web portals* and offered the following generic characteristics:

- The information is dynamic and is continual creation or updated
- That the information is directly generated by the public sector. Pollock (2008) added that the high fixed cost associated with the creation and maintenance of the PSI
- The information is generated as part of function or mandate
- Useable in commercial application with little additional processing.

The dynamic and continual creation of the PSI is dependent on the funding structure of said public entity (Pollock, 2008). Pollock (2008) argued that pricing policy such as profit-maximising could lead to non-profitable information sets not receiving the required maintenance, regardless of the mandate of the public organisation.

Since 2010, countries such as Australia, Denmark, Spain, the United Kingdom and the United States have directed their countries legislative mandate and policy towards facilitating access to PSI (Huijboom & Broek, 2011). This approach was taken to encourage the re-use of PSI to stimulate the creation of value added products and thereby stimulate economic value creation (Koski, 2011; Loenen & Zevenbergen, 2010; Poplin, 2010). Movements such as open government data (OGD) and data democracy has strengthened the case of free or marginal costing of PSI (Bates, 2012b; Huijboom & Broek, 2011).

2.4 Public sector geospatial information

Public sector geospatial information (PSGI) refers to spatially enabled PSI (Crompvoets, Rajabifard & Loenen, n.d.; Loenen & Zevenbergen, 2010). Spatial information and socio economic data were identified as the greatest contributors to PSI (Koski, 2011; Pollock, 2008). Pollock (2008) estimated that up to 80% of all data held in the public sector has a spatial component.

PSGI spatial characteristics enable the dataset to be used with little additional processing in a variety of new products and services without deterring the usability (Pollock, 2008). Janssen argued that the availability of spatial data could induce economic activity and thus social stability (Janssen & Kuczerawy, 2011). The transferability of PSGI between products creates an exponential growth for uptake in product development (Cooper et al., 2013; Loenen & Zevenbergen, 2010).

2.4.1 Spatial data infrastructure as an enabler

Harnessing the economic potential and opportunities associated with spatial data holdings within the public and private sector relies on the availability of PSGI as a conduit for commercial (Makanga & Smit, 2010). To address the requirement to avail PSGI to potential users, the public and private sectors have adopted SDI initiatives approach (Infrastructures et al., n.d.).

SDI can be described as the integration of technology, people and policy as an enabling platform to promote access to the public and private sectors spatial data holdings (Infrastructures et al., n.d.). SDI initiatives can be the product of informal relationships between data producers, data users and data managers (Cooper et al., 2012; Makanga & Smit, 2010). Alternatively, the existence of a SDI can be the product of legislative and policy requirements (Paudyal, Mcdougall & Apan, 2013). Section 2.4.1.1 provides further insight in to the existence of formal SDI initiatives.

Makanga (2011) highlighted that it is essential that data, metadata, catalogues, web and map services should be integrated through the seamless interconnectivity and interoperability of the SDI (2010). Mansourian contended that the SDI environment should cater for a clearing house approach to ensure the optimal integration of the components mentioned by (2011).

The discovery and delivery of PSGI through integrated SDI platform is reliant on technology developments and infrastructure (Skoks & Steurer, 2010). The funding requirements to design build and maintain a SDI initiative is high and remains a challenges regardless of the proven economic and social benefit (Paudyal et al., 2013).

SDI initiatives can only continue if there is dedicated funding with in a formal regulatory environment (Mansourian et al., 2011; Paudyal et al., 2013.). The impact of SDI's and national spatial infrastructure (NSDI) are prevailing in current economic and technical literature since 2008 and highlights the crucial contribution to data democracy and economic growth (Cerrillo-i-martínez, 2012; Smart, 2008; Veenswijk, 2012).

2.4.1.1 SDI South African perspective

South Africa promulgated the Spatial Data Infrastructure Act 2003 (Act No.54 of 2003) to establish the South African Spatial Data Infrastructure (SASDI) and the coordinating body the Committee for Spatial Information (Rautenbach, Coetzee & Iwaniak, 2012). The main objectives of the SASDI were to facilitate access to and to promote the use of PSGI (Rautenbach et al., 2012).

Makanga analysed the status of SDI development and uptake in Africa and indicated that South Africa ranked seventh alongside Kenya and Tunisia out of the 29 participating countries (2010). Even though South Africa had a legal framework and a coordinating body with reasonable political support it had not established a clearing house for data or metadata and had little stakeholder participation (Makanga & Smit, 2010). Rautenbanbach et al. (2012) further argued that a pattern of over ambitious, very complex and the fragmented nature of the SDI initiatives contributed to the failure of SDI initiatives.

2.4.2   Environmental information

Environmental factors such as climate change and legislative requirements for EIA and SDF's played a crucial role in the creation and subsequent availability of environmental data (Fornefeld & Boele-Keimer, 2008; Poplin, 2010). Environmental data have received particular attention in national strategy development (Makanga & Smit, 2010).

Notwithstanding the focus on the creation of environmental data the availability remains a constraint (Vickery, 2011). A 2009 study indicated that between 5% to 10% of an EIA or SDF budget requirements related to the acquisition of the required data (Houghton, 2011). Vickery indicated that 73% of the required environmental data resided with PSIH (2011).

2.4.2.1 South African perspective

A discussion with Dr Clark and Mr Jenneker provided insight in the following South African context. Within a South African context, the national mapping agency National Geospatial Information (NGI), located in the Department of Rural Development and Land Reform (DRDLR) and Statistics South Africa (STATSSA) are PSIH that changed their data pricing policies for national The NGI is the custodian of spatial topographic data associated with published map such as 1:50 000 topocadastra etc. STATSSA product offering contains PSI such as tabular statistical data and PSGI

NGI's implemented changed to their data pricing policy to marginal cost pricing about 12 years ago. After the pricing policy change there was a subsequent increase of 500% in the dissemination of the PSGI. The main driver for the policy change was national approach towards establishing a Spatial data infrastructure (SDI) and their "Pro-open and Free Data" philosophy.

The estimated cost of the 1996 census was R729.5 million (data adjusted to 2001 prices) and the 2001 census R9661.1 million (May & Lehohla, 2003). With the census pricing as context and due to funding constraints STATSSA sold 219 copies of the Census 1996 flagship data product Super Cross for between R8000 and R400 000 as a cost recovery mechanism (May & Lehohla, 2003).

By 1999 the pricing policy changed and data was distributed freely (May & Lehohla, 2003). The 2001 Census received better funding and the flagship data product Super Cross was disseminated free of charge to the public sector and educational institutions bases on data dissemination policy (May & Lehohla, 2003).The change in pricing policy provided an increase of 2300 users (Africa, Sa, & Sciences, n.d.). Since 2008, 68 Census 2001 packages were purchased at R300 each. 177 Census 2011 packages were sold, at R300 each. There has been limited research into the socio and economic impact of NGI and STATSSA pricing policy changes had on the country information economy.

2.5   The economics of PSI

The departing point for the arguments that will follow is that an information economy attach economic value to information (Pollock, 2008; Smithers, 2008). The economic value can be realised by creating a market place for the exchange of value added products and services (Henninger, 2013; Smithers, 2008).

A strong case has been made against the provision of PSI at profit maximisation, average cost or cost recovery with the intent to generate income for the PSIH (Koski, 2011; Newbery et al., 2008; Ricolfi et al.,2011). Koski argues that the junction between providing information freely to facilitate openness to information and charging for this advantage of having access to the information remains cowers (Varian, 2013;.Shapiro & Varian, 2013).

Furthermore, Varian contends that policy and strategy would propagate this divide if an institution does not consider the strategic value of the decision in itself (2013). Within PSIH, the decision should be directed towards the national economic potential rather than the profitability of the institution that created the PSI (Bates, 2012a; Fioretti, 2011; Newbery et al., 2008; Pollock, 2008)

2.5.1 The economics of PSI provision

PSI is often used as a commodity to generate revenue to subsidise PSIH activities through trading funds (Newbery et al., 2008). These trading funds utilised charging policies such as profit maximisation, average cost or cost recovery, marginal cost to generate revenue (Newbery et al., 2008; Pollock, 2008). In certain instances zero cost recovery policies were successfully employed (Pollock, 2008; Ricolfi et al.,2011).

The pricing policy directive of the PSIH has a direct impact on the re-use of PSI by any component downstream of the value chain of a value added products or services derived from PSI (Newbery et al., 2008; Pollock, 2008, 2013; Ricolfi et al.,2011). Newbery further argued that the potential 'spill-overs' into additional economic opportunities should be considered in the impact assessment of pricing policy (2008). The short and long-term impact on the potential 'spill-over' effects on the knowledge economy and in particular the ITC services should be paramount (Newbery et al., 2008; Pollock, 2008). Interactions of PSGI value chain stake holders

2.6 PSI value chain

Three basic components can be associated with the creation of products and services derived from PSGI (Loenen & Zevenbergen, 2010; Pollock, 2008; Vries & Miscione, 2010). The first component is the PSGI as a dataset, secondly, the commercial sector as a service provider and, lastly, the end user (Loenen & Zevenbergen, 2010). Figure 4 illustrates the interconnectivity of the different components through the value chain associated with the creation of value added products and services derived from PSGI.

Figure 2: Interaction of PSGI value chain stake holders
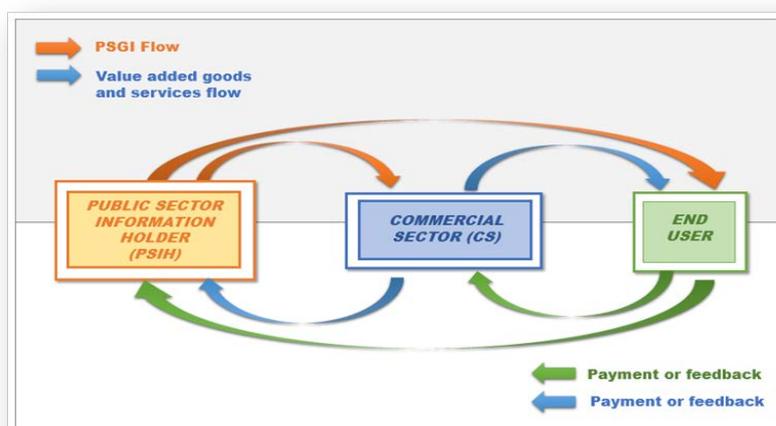
Figure 4 is adapted from current literature (Loenen & Zevenbergen, 2010; Vickery, 2011). The vertical integration of these components is crucial for the delivery of products and services to end users (Loenen & Zevenbergen, 2010; Vickery, 2011).

Vickery highlighted that the flow between the components could be bidirectional (2011). The flow of PSGI from PSIH via the commercial sector will result in product delivery to the end user (Loenen & Zevenbergen, 2010; Vickery, 2011). The flow from the end user can stop with the commercial sector or the PSHI, resulting in payment for a product or service or service or a feedback mechanism (Vickery, 2011).

Poplin highlighted that most models do not consider transactional costs in their models (Poplin, 2010). These transactional costs can vary for handling fees or media cost on a micro level (Poplin, 2010). At a macro level changes to policy that impact on the PSIH should be considered but not used for cost recovery calculations (Pollock, 2008).

2.6.1 Flow analysis

The vertical integration of PSGI into a product or a service to meet the demand of the end-users is dependent on the free or unobstructed flow of PSGI from the PSGI downstream in to the value chain (Loenen & Zevenbergen, 2010; Vickery, 2011). illustrated the complexity associated with the vertical flow of PSGI through the value chain. The flow scenarios is based a compilation of literature opinion (Koski, 2011; Loenen & Zevenbergen, 2010; Pollock, 2008; Vickery, 2011).

Figure 3: Generic PSGI value chain flow scenarios
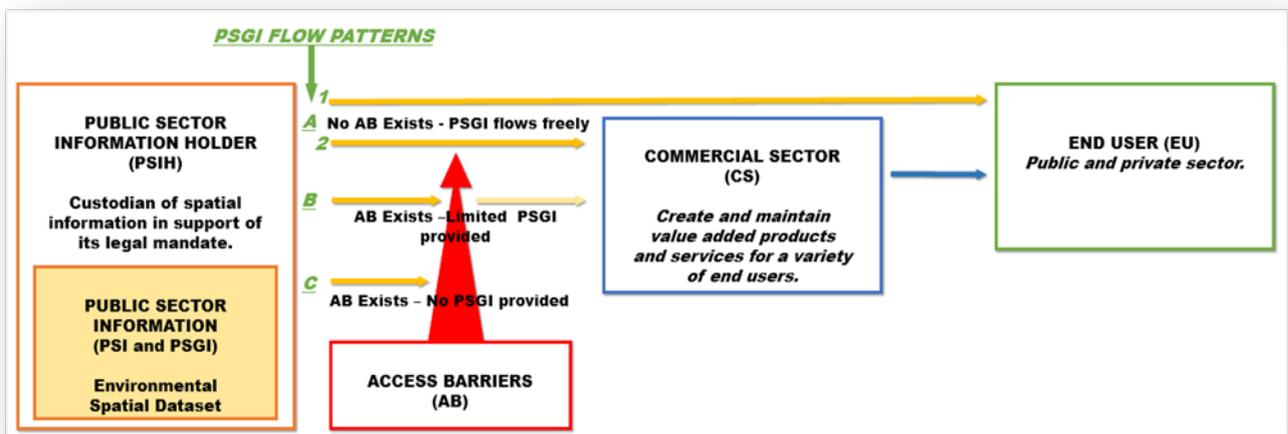
Option A: PSIH addresses commercial sector and end-user requirements.

Option A1: The supply of PSGI in its native form flows freely and addresses the end-users demand directly (Vickery, 2011). There is no barrier to access and no requirement to obtain the information by means of a value added product at this point in time. This might change as the customer demand for a more specialised or customised product increases. This scenario presents a market opportunity for the commercial sector (Vickery, 2011).

Option A2: The supply of PSGI in its native form flows freely and addresses the commercial sectors demand. There is no barrier to access and the commercial sector can use the PSGI as a raw material to develop value added products and services. This environment encourages research and development into new products and services.

Option B: PSIH addresses commercial sector requirements partially.

The supply of PSGI in its raw form addresses the consumers' demand partially. This is due to one or more barriers to entry that restricts the dissemination of the information in its original format. In this case, there is limited uptake from the private sector and thus the development of a value added product and services are inhibited. This scenario can lead to a withdrawal from the market by the commercial sector. Alternatively, a neoclassical economic adaptation where the price of the product increases with the demand, where the cost of closing the gap between the original state of the PSGI as per PSIH and the state of provision is recovered from the end-user.

Option C: PSIH addresses do not address the commercial sector requirements.

The supply of PSGI is inhibited due to the presence of one or more access barriers. The commercial sector is unable to address the consumers demand. The impact of the lack of the PSGI should be considered within the framework of a single product but also within the inter-connectivity of integrated value chains. There is little potential for substitute products or inferior goods as the base data is not available to anyone.

2.6.2 Value chain components

The activities within the value chain provides for enhancement of the native/original PSGI and thus an increase in economic value of the PSGI (Loenen & Zevenbergen, 2010; Nilsen, 2010; Vries & Miscione, 2010). Distinction can be made between six activities along the value chain (Loenen & Zevenbergen, 2010). **Error! Reference source not found.** indicates these activities and illustrates the sequential nature of these activities (Loenen & Zevenbergen, 2010). **Error! Reference source not found.** is an adaptation of work done by Loenen & Zevenbergen. Not all activities are performed or required in the development of a value added product or service (Loenen & Zevenbergen, 2010).
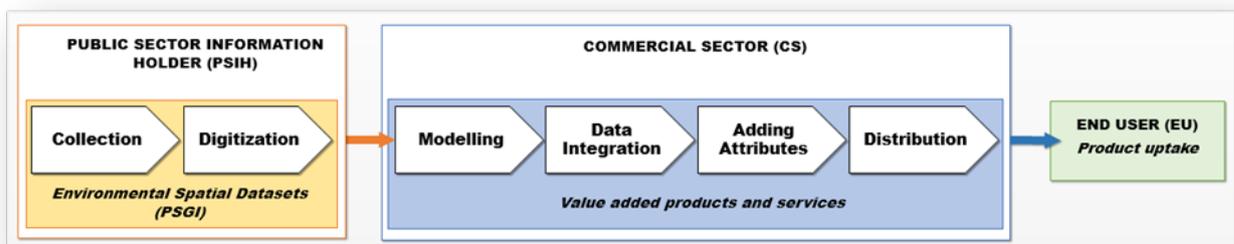
Figure 4: Basic value chain components and activities

Nilsen further argued that the value added activities performed by either the PSIH or the commercial sector is based on the PSIH legal mandate and operational requirements (2010). The maturity level of the PSIH, GIS and SDI activities contributes to an increase in value chain activities by the PSIH (Loenen & Zevenbergen, 2010). Pollock and his contemporaries highlighted the negative impact of cost structure policy, such as cost recovery, on the PSIH ability to maintain or to potentially increase their value chain activities (Bates, 2012b; Koski, 2011; Newbery et al., 2008; Pollock, 2008). There is a debate around what the extent of PSIH activities should be within the value chain (Vickery, 2011).

The integration of different value chains increases the complexity of the product development and the product delivery process (Loenen & Zevenbergen, 2010; Vries & Miscione, 2010). Vries further argued that the development stage of the individual value chain would impact on the stability of value chain and the ability to produce products through the value chain network (Vries & Miscione, 2010).

Error! Reference source not found. is an adaptation of (Vries & Miscione, 2010) - Value adding steps model. The model is used here to illustrate the interconnectivity of the components of the different value chains and highlights the added dimension of potential end users (Vries & Miscione, 2010).
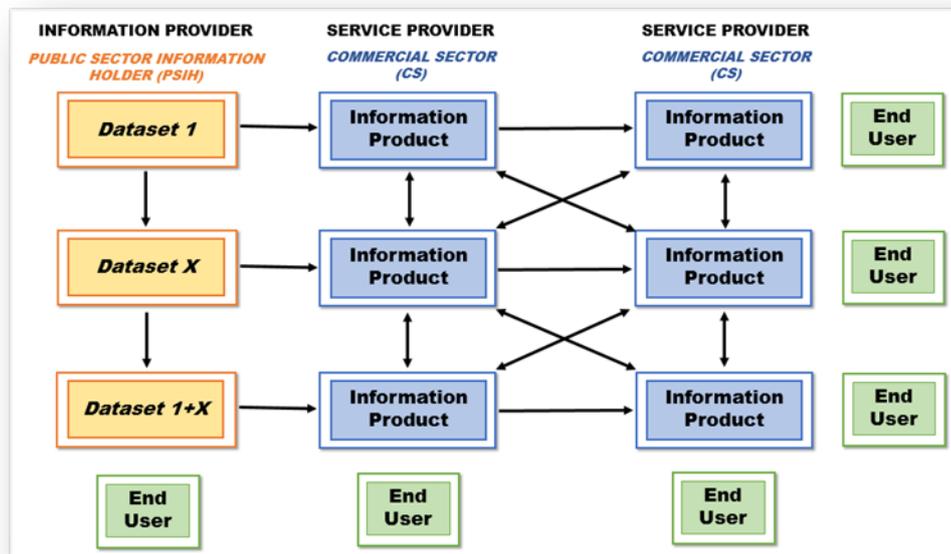
Figure 5: Interconnectivity of integrated value chains.

Each additional interconnection of a value chain provides an opportunity to increase the scale and scope of product development and delivery (Vries & Miscione, 2010; Vuorio, 2013).

2.6.3 Economic value generation along the value chain.

Loenen argued that economic value is generating through the different activities in the value chain and increases along the development chain based on additional enhancements to the data (2010). The increase in value requires an increase specialist application of the PSGI (Loenen & Zevenbergen, 2010; Vickery, 2011). Alternatively, the product should address a specific end-user requirement and differentiate itself from other products based on customisation and speciality (Pindyck & Rubinfeld, 2005).

Yalcin further argued that spatial component of PSGI is the primary driver of economic value (2014). The above mentioned factors provide the basis for end-users to attach greater value to these products and provides for value pricing of the products or services on offer (Genovese et al., 2010).

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Figure 6: Economic value derivative alignment to the PSGI value chain.
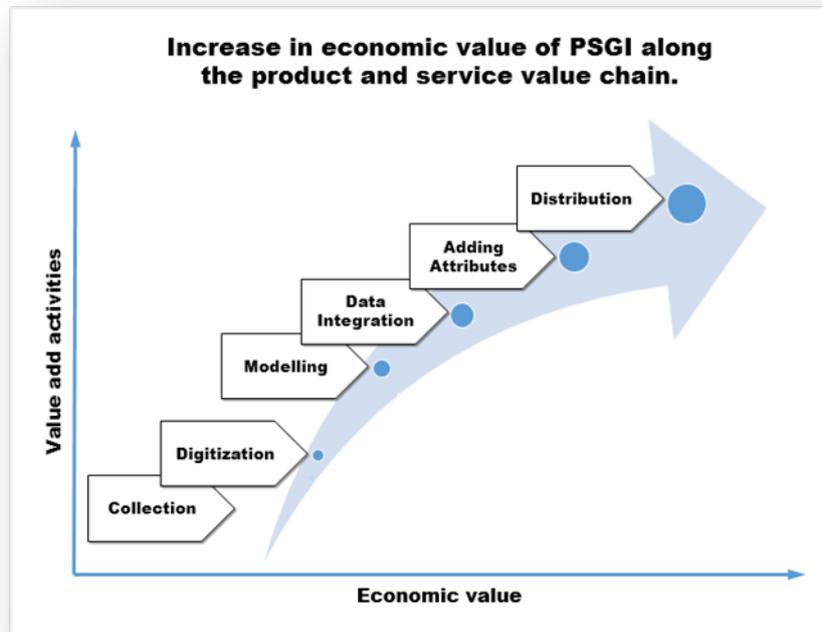
2.7   Access barriers to PSI

Access barriers can be described as any restrictive measure or action implicit or explicit in nature on the side of the PSIH that inhibits the flow of PSGI downstream (Pollock, 2008; Vickery, 2011). It is evident for the scenario description in that access barriers within the value chain can have an impact on the ability of a commercial organisation to address the end users' requirement for value added products and services (Bates, 2012b; Pollock, 2008). Furthermore, these access barriers restrict the commercial sector's ability to fully exploit the potential of economic value from PSGI (Bates, 2012b).

A systematic review of current literature provided insight into additional access barriers beyond just the populist arguments regarding prising policy. **Error! Reference source not found.** provides the results of an analysis of 18 pieces of current literature. Each of the access barriers will be defined and discussed.

2.7.1   Access

There is a wide variety of policy that informs the use, re-use and exclusive licensing practises that are being utilised to facilitate and manage access to PSGI (Bates, 2012b;

Newbery et al., 2008). The economic forces directing these policies do not facilitate accessibility (Cerrillo-i-martínez, 2012; Pollock, 2008). This approach has come under criticism from economists and data democracy activists alike (Pollock, 2008; Vickery, 2011).

2.7.2   Completeness
The completeness of a dataset in terms of its spatial footprint and descriptive attributes will define the usability of the dataset (Bates, 2012b; Huijboom & Broek, 2011; Mayo & Steinberg, 2007)

2.7.3   Usability
Usability of PSGI is defined in terms of its market value or the potential to derive market value from a product generated from it (Bates, 2012). The potential integration of the PSGI with other product value chins provides and in particular technology platforms (Bates, 2012b; Cerrillo, 2012).

Usability requires a PSIH to consider external requirements when designing and maintaining PSGI (Bates, 2012). Houghton further argued that usability had a strong correlation with the accessibility of data (2011).

2.7.4   Data accuracy
The accuracy of the data in terms of position and attribute descriptions will impact on the perceived value of the data (Loenen & Zevenbergen, 2010). PSGIH should provide a framework or standard against which the accuracy should be measured and a decision on usability can be made (Vries & Miscione, 2010). Vickery (2011) further argued that the PSGI accuracy will improve as it is used along the value chain on a granular scale.

2.7.5   Metadata
The lack of up-to-date data discovery portals or metadata describing the data holdings of PSIH is a server constraint on the side of the end user in terms of making an informed decision pertaining to availability and usable (Bates, 2012b). Poplin further argued that the unavailability of said metadata increases the transactional costs associated with the PSGI and eventually the value added product (Poplin, 2010).

Table 1: Access barrier analysis

Current literature 6reviewed.	Accessibility	Licensing policies	Completeness	Usability	Data Accuracy	Data discovery portals	Metadata	Data Formatting	Data maintenance	Data quality	Organisational structures & autonomy	Political context	Pricing policy	Regulatory compliance	Reliability	Response time	Standardised and transparent request procedures	Technological considerations
(Jo Bates, 2014)	X	X	X	X	X	X	X			X		X	X	X		X	X	X
(Cerrillo-i-martínez, 2012)	X	X	X	X		X	X				X		X			X	X	
(Fioretti, 2011)	X	X				X	X	X		X	X			X			X	X
(Henninger, 2013)	X	X	X	X	X	X	X					X				X		X
(Jasserand & Hugenholtz, 2012)	X	X	X	X	X					X					X	X		
(Janssen & Kuczerawy, 2011)	X	X				X	X			X	X		X				X	X
(Huijboom & Broek, 2011)			X	X						X			X	X			X	X
(Loenen & Zevenbergen, 2010)	X	X				X	X	X		X						X	X	
(Newbery et al., 2008)	X	X								X	X	X	X	X		X	X	X
(Nilsen, 2010)	X	X			X					X		X	X	X	X		X	X
(Pollock, 2008)	X	X								X	X		X	X			X	
(Poplin, 2010)	X	X	X	X		X	X	X		X			X			X	X	X
(Ricolfi et al., 2011)	X	X	X	X							X		X			X	X	X
(Veenswijk, 2012)	X	X									X	X	X	X		X	X	
(Vickery, 2011)	X	X			X			X		X	X		X		X	X	X	X
(Vries & Miscione, 2010)	X	X	X	X	X					X			X	X	X		X	X
(Vuorio, 2013)	X	X	X	X		X	X			X	X		X	X	X	X		X
(Yalcin, 2014)	X	X				X	X	X			X		X				X	X

2.7.6 Metadata

The lack of up-to-date data discovery portals or metadata describing the data holdings of PSIH is a server constraint on the side of the end user in terms of making an informed decision pertaining to availability and usable (Bates, 2012b). Poplin further argued that the unavailability of said metadata increases the transactional costs associated with the PSGI and eventually the value added product (Poplin, 2010).

2.7.7 Data formatting

The data transfer format impacts on the re-use of PSGI (Fioretti, 2011). Open source platforms and standardisation of protocols can improve data interoperability between different users (Fioretti, 2011; Vickery, 2011).

2.7.8 Data quality

Nilsen and Vries argued that the accuracy of the PSGI is the responsibility of the PSGIH (Nilsen, 2010; Vries & Miscione, 2010). Legal and technology platforms should be used to ensure the acceptable level of accuracy (Nilsen, 2010).

2.7.9 Organisational structures and autonomy

The traditional bureaucracy associated with the public sector is evident in the operations of PSIH and this culture impacts negatively on the competitive nature that is required for service delivery (Bates, 2012b; Huijboom & Broek, 2011). Organisational structures should also be assets against the physical representivity within the different spheres of government which adds to the complexity of providing PSGI and adds to the associated transaction cost (Poplin, 2010).

2.7.10 Pricing policy

Trading fund entities policy on costing models are directed at benefiting the public sector (Newbery et al., 2008). This approach jeopardises the commercial sectors ability to enter the market by providing value added products and services (Bates, 2012b; Koski, 2011; Pollock, 2008).

2.7.11 Political context

Vertical and horizontal flow of information through different spheres of the public sector and political alignment impact on PSGI provisioning (Bates, 2012b). (Fioretti, 2011) Fioretti argued that political context should be separated from the data and especially the decision on future data initiatives (2011).

2.7.12 Regulatory compliance and legal frameworks

The compliance with regulations by PSIH and their commercial partners could lead to monopolisation of the PSGI (Bates, 2012b; Huijboom & Broek, 2011; Vries & Miscione, 2010). These practices are inherent of cost recovery policies and the PSGIH should be transparent in applying contracts for commercial partners (Pollock, 2008).

2.7.13 Reliability

There is a perceived bias in the PSGI provided in terms of the attributes that is maintained and the revisit time as the political agendas of the PSIH dictates its work plan (Bates, 2012b).

2.7.14 Response time

The response time of PSIH to request from the commercial sector impacts the potential uptake of the PSGI in to value added products and services (Bates, 2012b). Timely and scheduled delivery of PSGI will increase the value associated with datasets (Loenen & Zevenbergen, 2010).

2.7.15 Standardised and transparent request procedures

The standardisation of processes for the acquisition or request of PSGI is required to mitigate the perception of collusion or protecting self-interest by the PSIH that operate on a trading fund model (Bates, 2012b; Cerrillo-i-martínez, 2012; Huijboom & Broek, 2011; Pollock, 2008).

2.7.16 Technological considerations

Technological constrains on the PSIH side with regards to the management of data and technology platforms for data dissemination and in the commercial sector with regards to the accessibility to PSIH dissemination platforms (geo-portals and map services (Bates, 2012b; Huijboom & Broek, 2011; Pakhus, 2010).

This analysis highlighted the prevalence of prising models as a access barrier but it is important to note that there is an array of additional constraints that require attention in order to exploit PSGI to its fullest are only the (Bates, 2012b; Fornefeld & Boele-Keimer, 2008; Pollock, 2008; Vickery, 2011).

2.8   Commercial organisations

All commercial organisations should have equal access to PSGI and, therefore, have an equal market opportunity to develop and maintain value added products and services (Huijboom & Broek, 2011; Vickery, 2011). There is a well-documented market for environmental applications such as EIA, SDF, eco-tourism etc. (Fornefeld & Boele-Keimer, 2008; Houghton, 2011). The current trend is towards digital services and advanced solutions such as hand held device apps (Huijboom & Broek, 2011). Location based and navigation services linked to geo-marketing is widely used (Koski, 2011).

Koski highlighted the potential impact of regional and country specific characteristics and approach to business development of innovation, regardless of the accessibility to PSGI (Koski, 2011). Empirical evidence holds that smaller SME's with limited resources have a greater barrier to entry for the development of value added products and services (Koski, 2011). Larger firms are in a better position to innovate and produce value added products and services from PSGI (Koski, 2011).

Vickery further argued that the commercial sector will have to change their business model and strategically positioning to harness economic growth from accessible PSGI (Vickery, 2011). The contextual nature in which the business sector operates is another limiting factor especially in developing economies(Veenswijk, 2012).

2.9   Conclusion of literature review

The availability of current and divers literature assisted greatly in the analysis of the current terms associated with the provisioning, use and the associated economic potential (Pollock, 2008; Vickery, 2011). Within the provision of PSI there is a market failure due to the fact that this equilibrium is not reached based on the innate characteristics of PSI (Nilsen, 2010).

Three frameworks will be used as a construct against which the research will be executed. The first is the PSGI flow scenarios as discussed in section 2.4.1. demonstrating the vertical flow of PSGI along the value chain (Loenen & Zevenbergen, 2010; Vickery, 2011). The second construct is a framework of access barriers to PSI derived from varies empirical literature contributions as outlined in section 2.7 and Table 1 The last construct is that of Economic value derivative alignment to the PSGI value chain (Loenen & Zevenbergen, 2010).

CHAPTER 3:   RESEARCH PROPOSITION

3.1   The purpose of this research

The purpose of this research is to define accesses barriers to environmental PSGI that commercial sector contend with and to establish the impact of these accesses barriers on the development of value added products and services within the South African context.

3.2   Research proposition

3.2.1   Supply side - Research proposition 1

Identify access barriers to environmental PSGI that the commercial sector contend with.

1.1. Identify the environmental PSGI that is required by the commercial sector to create value added products and services.

1.2. Identify the access barriers associated with the environmental PSGI.

1.3. Determine the level of constraint associated with these access barriers.

1.4. Determine the commercial sector strategic positioning of the value added products and services derived from environmental PSGI.

3.2.2   Demand side - Research proposition 2

Determine end-user demand for innovative value added products and service derived from environmental PSGI. The following input data will be collected to inform the impact assessment.

2.1 How do 'end-users' access environmental PSGI? And what is the motivating reason for 'end-users' access environmental PSGI in a certain way?

2.2 Why do 'end-users' have specific preferences for value added products and services? And how do 'end-users' access these value added products and services?

2.3 What environmental PSGI do 'end-users' access through the value added products and services?

3.2.3   Economic opportunity - Research proposition 3

Establish if access barriers have an economic impact on the commercial sectors ability to create and maintain value added product and services.

3.1 Link the supply-side conceptual framework for access barriers to environmental PSGI with the prevalence of end-user requirements for value added products and services derived from environmental PSGI.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

Data gathering for the research was conducted in two phases using a mixed methodology. The main aim of the research was to investigate the existence of access barriers to environmental PSGI and investigate the impact on the on the commercial sectors ability to create and maintain value added product and services as defines the research propositions that were investigated.

The first phase was qualitative in nature and investigated the supply side of the delivery of value added products and services. The results of the first phase were used as a construct for the quantitative investigation in to the demand side in phase two. The final proposition was addressed thru the triangulation of the phase one and two results.

Table 2: Research propositions

Supply side Research proposition 1	Demand side Research proposition 2
Outcome of proposition 1: Validate list of access barriers to PSGI and evaluate the impact of the access barriers. 1.1 Identify the access barriers to environmental PSGI that the commercial sector contends with. The following input data will be collected: *A list of access barriers will be compiled from a sample of commercial organisations that provide value added products and services based on spatial environmental PSGI obtained from PSIH.* 1.2 Determine the level of constraint associated with these access barriers. *A sample of commercial organisations will rate the level of impact that the access barriers have on their operations.* 1.3 Determine the commercial sector strategic positioning of the value added products and services derived from environmental PSGI.	Outcome of proposition 2: The demand for innovative value added products and services by end users. 2.1 Determine end-user demand for innovative value added products and service derived from environmental PSGI. *Potential for economic growth is fuelled by demand for a product or a basket of products.* 2.2 How do 'end-users' access value added products and services? 2.3 Why do 'end-users' have specific preferences for value added products and services? 2.4 What environmental PSGI do 'end-users' access through the value added products and services?

Economic opportunity Research proposition 3
Outcome from research proposition 3: Establish if access barriers have an economic impact on the commercial sectors ability to create and maintain value added product and services. 3.1. Link the supply-side conceptual framework for access barriers to environmental PSGI with the prevalence of end-user requirements for value added products and services derived from environmental PSGI.

4.2   Choice of methodology

A pragmatic research philosophy formed the basis of the research due to the study's requirement for practical adaptation in an operational environment and not just in social theory (Denscombe, 2007). The study had a cross sectional time horizon due to the time constraints associated with this level of study and design (Denscombe, 2007). Saunders, Lewis & Thornhill, 2009)

A mixed methodology approach was used to provide for alternative perspectives and to triangulated the results for improved accuracy (Denscombe, 2007.; Saunders et al., 2009). The research approach delivered a platform to investigate the links between the different economic contributors in the value added product and service development and uptake (Denscombe, 2007).

A mixed methodology approach provided for a phased approach whereby one phase generated information that informed the subsequent phases at a micro and macro level (Denscombe, 2007). The order of the research execution was sequential in nature as illustrated in **Error! Reference source not found.**9.   The last component of the research, where the findings were triangulated to the participants of the qualitative study and provided for a pragmatism approach for the research (Denscombe, 2007; Saunders et al., 2009).

MULTILEVEL SEQUENTIAL STUDY

COMMERCIAL SECTOR (CS) Qualitative study *Interviews* Micro Level	→	END USER (EU) *Public and private sector.* Quantitative study *Online self-administered survey* Macro level	→	COMMERCIAL SECTOR (CS) Qualitative study *Interviews* Triangulate results Micro Level
Dominant Counter Balance		Subsidiary Counter Balance		Dominant Counter Balance
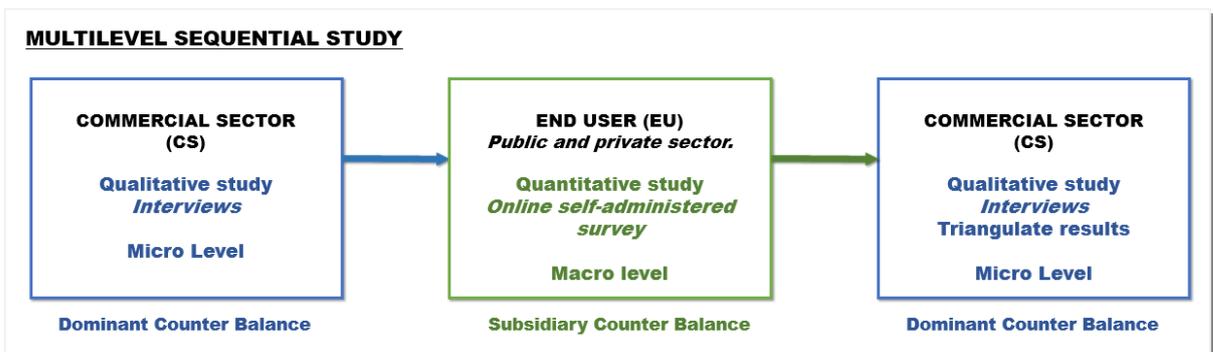
Figure 7: Research design and approach.

The components of this research design differed in dominance and the quantitative study acted as a subsidiary counterbalance for the data triangulation. Mixed methodology provides for differentiation in the weighting assigned to the different research components due to the scale of the research component and the significance in the triangulation (Denscombe, 2007).

4.3   Qualitative component

Vickery (2011) highlighted the importance of addressing the lack of qualitative research into the size, growth and impact of PSI related activities. The qualitative component focused on obtaining primary data that would provide contextual information from the commercial sector regarding the development and maintenance of value added products and services that rely on environmental PSGI. Face to face semi structured interviews was used as this approach is best suited to obtain credible unobstructed in-depth contextual data from participants (Denscombe, 2007; Saunders et al., 2009).

The semi-structured interviews provided the framework for the questions used in the survey in phase two of the data gathering process. The semi-structured approach of the interview was used to enable the collection of additional contextual data within the framework of the different themes and was especially useful in exploring the different strategic approaches (Saunders et al., n.d.).

4.3.1   Population

The population of the study was defined as commercial entities that require environmental PSGI to provide value added product and services. The universe is not formally documented and the most appropriate method would require selection based on known activity.

The population was divided into four categories based on the size of the organisation. The UNIDO classification system for SME's in developing countries was used (Abor & Quartey, 2010). This approach was used to ensure that any underlying parents in a specific group were identified.

UNIDO classification system for SME's in developing countries:

- Organisation with less than 5 workers - Small
- Organisation with 5-19 workers - Micro
- Organisation with 20-99 workers - Medium
- Organisation with 100 or more workers – Large.

4.3.2 Sampling method and sampling size

Non-Probability sampling – Purposive sampling and in particular a heterogeneous sample variety was used to identify commercial organisations over the spectrum of population classes. This approach was used due to the small number of participants and to obtain the maximum variety characteristics (Denscombe, 2007; Saunders et al., 2009).

The sample consisted of 12 commercial organisations with equal represented for each of the four categories based on the size of the organisation. The sample size was sufficient based on the data collection method and the potential for saturation even though a heterogeneous sample variety was used due to the nature of the debate (Denscombe, 2007; Saunders et al., 2009).

4.3.3 Unit of analysis

The unit of analysis was commercial organisations that developed and maintained value added products or services that require environmental PSGI.

4.3.4 Data collection tool

Primary data was collected through face to face, semi-structured interviews with each of the sampled participants. The interview guide and the associated questionnaire was reviewed by a demographer in the industry to eliminate any terminology bias and ambiguity associated with questionnaire. Thereafter, it was pre-tested by three industry specialists who were not associated with the sample group of commercial organisations.

Finally, two pre interviews was held with two large commercial organisations that provided value added products based on PSGI but not necessarily environmental PSGI. The interview was done to pre-test the research approach and to obtain strategic insight that was used to triangulate some of the comments from the interview with the sample group at a later stage.

The original interview guide and the associated questionnaire were provided as a survey monkey product. After the tests the interview guide and the associated questionnaire was reviewed. Subsequently the documentation was provided as a MS Word document to facilitate ease of use and formatting potential to the participants.

4.3.4.1 Data collection method

The interview relied on both technical and strategic contributions from the participants. The interview guide consisted of four themes and used a combination of question. **Error! Reference source not found.**3 indicates the themes covered in the interview and the associated question structures.

The interview guide containing all the questions was provided to the participants prior to the interview. The questions that focused on the technical aspects could be completed by technical experts in the organisation prior to the interview. The majority of participants were senior managers in the organisations and provided in-depth contributions to the questions pertaining to the organisation overview and strategy.

The structure of the interview guide was used to facilitate independence in the feedback and to provide for an in-depth and focused discussion (Denscombe, 2007; Saunders et al., 2009). Annexure A provides an example of the interview guideline with the four main themes and the associated questionnaire.

Table 3: Qualitative interview guide

Interview themes	Question construct	Description
Organisation Overview	A combination of list and category questions.	This theme provided a general overview of the size, industry and core business of the organisation. *Option to complete before interview.*
Value added products and services overview	Open ended questions.	This theme investigated the organisations revenue streams and the value added products and services. *This section was completed in the interview.*
Barrier analysis	A combination of open tabular questions drawing from a predefined list of headings. In conjunction with ranking options. The last question was open ended to solicit any additional insights and opinions.	This theme forms the basis of the research analysis. *Option to complete before interview but the content was discussed in the interview to afford the respondents an opportunity to expand on their observations*
Data acquisition analysis	A combination of list and open ended questions.	This theme investigated the strategically approach and

		operational procedure to access barriers. *This section was completed in the interview.*

4.3.5   Preparation of data

All interviews were audio-recorded and subsequently transcribed by an external contractor. The transcription document was prepared prior to analysis in ATLAS.ti by indicating the different contributors in the interview, specifying any emotional associations to certain sections of the text and indicating any significant pauses in the conversation (Saunders et al., 2009). All transcriptions were reviewed to eliminate any typographical errors.

4.3.6   Data analysis method

A deductive analysis approach was used to constructing a conceptual framework based on current literature (Saunders et al., 2009). The framework drew upon the literature outlining access constraints to PSI and the development of value added products and services (Loenen & Zevenbergen, 2010; Newbery et al., 2008; Vries & Miscione, 2010). The framework and analysis was refined throughout the interview phase (Saunders et al., 2009).

The data was coded and categorised in accordance with the conceptual framework. The underlying themes and relationships within the codes and categories were identified. The conceptual framework was updated after every processed transcript.

A content analysis was used to identify the current environmental PSGI used and the type of value added products and services derived from the preceding information. Particular attention was given to the level of development along the value chain. The result of the analysis was used as the base construct of the survey in the second phase.

In addition the access barrier framework was refined through a frequency analysis that indicated the occurrence of established and new access barriers. This data will inform the correlation analysis to address proposition three.

4.3.7   Limitations

There were three limitations envisaged and subsequent actions were taken to mitigate the potential impact on the quality and integrity of the primary data.

1. This researcher's potential confirmation bias to the subject under investigation. The potential bias was mitigated by not providing the access barrier framework to the respondents and affording them the opportunity to identify their own construct.

2. The complexity of the content under investigation in the interview. The potential impact of the complexity of the interview that relied on technical and strategic contributions from participants was mitigated by A) providing the interview guide containing all the questions to the participants prior to the interview. B) The technical components could be completed prior to the interview.

3. The researcher's association bias to potential commercial organisations over the spectrum of population classes. This bias was mitigated by selecting the initial seven respondents based on the fact that there was no professional association with the commercial organisations. The subsequent organisations were selected based on comments from the initial group pertaining to current projects and constraints in the industry.

The original research design required a sample of three commercial organisations from each of the UNIDO classification systems for SME's in developing countries. Access to the required number of organisation with 5-19 workers – Micro and organisation with 20-99 workers – Medium was not obtained.

4.3.8   Research method conclusion

The deductive approach to the qualitative component of this research led to a formalised and structure method of obtaining meaning from the narration of the open ended questions in the interviews. Technical data was obtained from the questionnaire component of the interview guide. A combination of the preceding data was used as the conceptual framework in the second phase of the research thru a quantitative component.

4.4   Qualitative component

The second phase of the data gathering exercise employed a self-administered online survey data collection method to facilitate contributions on a macro scale from a variety of potential end-users (Saunders et al., 2009).

4.4.1   Population

The population of the survey was defined as end-users of value added products and services that required environmental PSGI that could be contacted through standardised contact databases such as PLATO, GISA and IAIA. The motivation for using standardised contact databases was to insure the credibility of the responses and to obtain access to a variety of potential end-user applications.

4.4.2   Sampling method and sampling size

Non-probability sampling using a quota sampling method was used. The sample size was 120; allocated as 60 over all spheres of government, 30 from the private sector, 15 academic and statutory bodies and lastly 15 from NGOs. The allocation was based on current representation in formal structures such as PLATO, GISA and IAIA.

4.4.3   Unit of analysis

The unit of analysis is the end-user demand for value added products and services that require environmental PSGI.

4.4.4   Data collection tool

The data was collected through a self-administered online survey. The survey was compiled and pretested by seven individuals of who four were active users of GIS products and three were non-technical end-users. Modifications were made to the terminology that was used and the logical flow of the survey.

The survey consisted of four logical components. **Error! Reference source not found.**4 indicates the themes covered in the interview and the associated question structures.   The conceptual framework that was derived through the qualitative investigation informed the structure of the product preference and environmental PSGI themes.   The majority of the questions used dropdown selections to facilitate standardised and ease of use.   Open ended questions were used in the product preference, environmental PSSGI and additional comments themes to solicit any additional insights and opinions.

Table 4: Quantitative survey structure

Interview themes	Question construct	Description
End-user	A combination of list and category	This theme provided a

background information	questions.	general overview of the size, industry and core business of the end-user.
Product and services. Product preference with additional descriptive information.	A combination of open tabular questions drawing from a predefined list of headings. In conjunction with open-ended contextual questions. The last question was open ended to solicit any additional insights and opinions.	This theme provided insight in to the use of value added products and services.
Environmental PSGI used in the preferred product platform	A combination of open tabular questions drawing from a predefined list of headings. In conjunction with open-ended contextual questions. The last question was open ended to solicit any additional insights and opinions.	This theme provided an over view of the Environmental PSGI that the end-users access.
Additional comments	The last question was open ended to solicit any additional insights and opinions.	The theme provided for additional contextual information.

4.4.4.1 Data collection method

The different end-user groups as described in 4.4.1 Population were provided with a customised universal resource locator (URL) through which they could access and complete the online survey. **Error! Reference source not found.** provides an overview of the different end-users that were targeted and the distribution method. Annexure B provides the online survey.

Table 5: Online survey distribution list

Institution	URL link	Distribution
GISSA	Spatial_Environmental_Data _Demandside_GISSA	GISSA distributed the survey request to its members
PLATO	Spatial_Environmental_Data _Demandside_PLATO	Researcher obtain contact list from PLATO and distributed the survey.
IAIA	Spatial_Environmental_Data _Demandside	IAIA could not distribute or supply the member contact details. A request to complete the survey was posted on the IAIA South African Affiliate and Environmental Consultants in South Africa LinkedIn profiles.
Environmental consultants	Spatial_Environmental_Data _Demandside_Environmental _Sector	Contact list of environmental consultants was obtain from DEA EIA unit and distributed the survey.

Survey monkey was used for the following reasons:

- Customisable and user friendly interface
- Survey data could be provided in a range of formats that was compatible with the statistical software SPSS
- The ability to create customised URL's for different institutions
- Secure data environment
- It is a commercial application to which the researcher had access.

4.4.5 Data analysis method

The research component aimed to provide contextual information on a macro scale pertaining to the patterns of use of value added products and services that are reliant on environmental PSGI. This section provided insight into the '*what, how and why'* of end-user patterns. **Error! Reference source not found.**6 provides the framework for data analysis and illustrates the inter connectivity of the survey questions.

Table 6: Statistical tests

Description	Statistical tool	Distribution
Proposition 2. Determine end-user demand for innovative value added products and service derived from environmental PSGI.		
Evaluate current access platforms.	Frequency and constabulary analysis.	This section provided context pertaining to how end-users access value added products and services and why.
Evaluate data used through the different access platforms.	Frequency and cross tabular analysis.	This section focused on the "what" component by providing a list of environmental PSGI and indicating the frequency of use.

Figure 8: Inter connectivity of survey questions for data analysis.
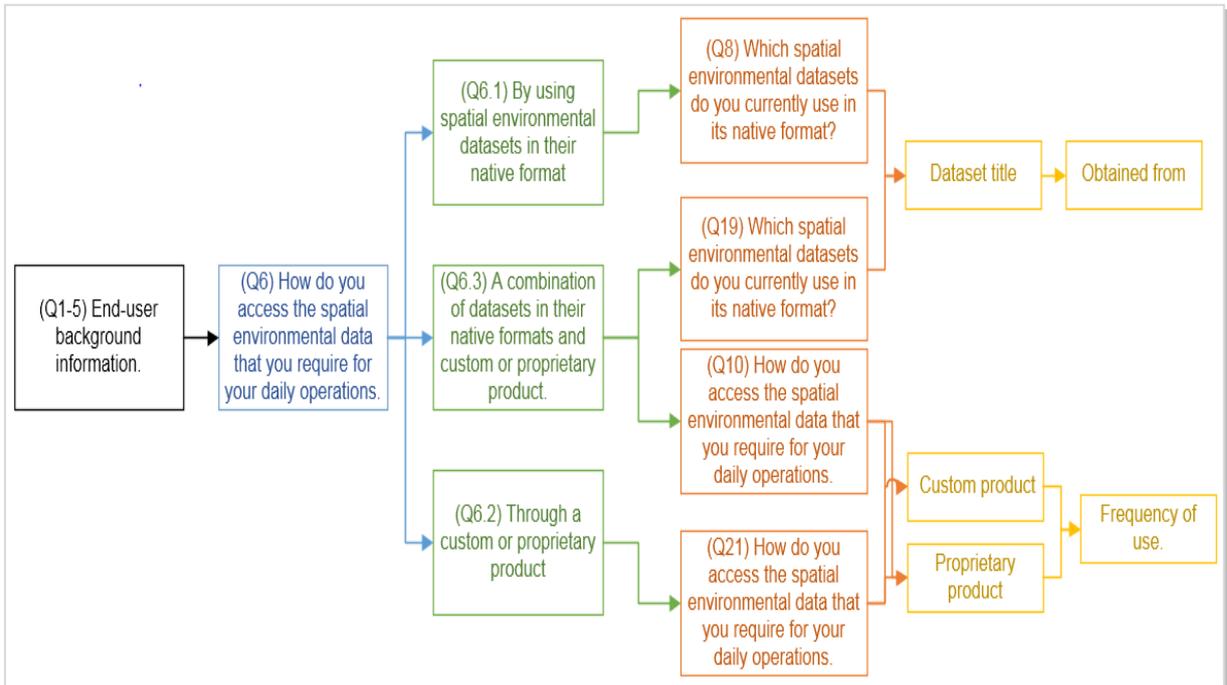
4.4.6   Preparation of data

The data obtained from the survey was extracted from the data capturing tool (Survey monkey). The data was transferred to statistical software -SPSS. SPSS was used to combine, edit, code and run gross tabular analysis on the data (Babbie, 2008).

4.4.7   Limitations

This component of the research faced two constraints. The first was the unavailability of the IAIA contact list for survey distribution. The IAIA body represents a significant part of the population that is associated with EIA in South Africa. An attempt was made to mitigate the limitation by posting a request to complete the survey on the IAIA South African Affiliate and Environmental Consultants in South Africa LinkedIn profiles.

The last limitation was the complexity of the survey data. The complete conceptual framework for environmental PSGI that was derived in the first phase of the study was used. This resulted in a very large and complex database of results. The data was grouped under the different assess platforms to ensure that meaningful results were obtained.

4.5 Conclusion research methodology

Data gathering for the research was conducted in two phases using a mixed methodology. The main aim of the research was to investigate the existence of access barriers to environmental PSGI and investigate the impact on the on the commercial sectors ability to create and maintain value added product and services as defines the research propositions that were investigated.

The first phase was qualitative in nature and investigated the supply side of the delivery of value added products and services. The results of the first phase were used as a construct for the quantitative investigation in to the demand side in phase two. The final proposition was addressed thru the triangulation of the phase one and two results.

The second phase of the data gathering exercise employed a self-administered online survey data collection method to facilitate contributions on a macro scale from a variety of potential end-users (Saunders et al., 2009).

CHAPTER 5:   RESEARCH RESULTS

5.1 Introduction

This chapter provides the results obtained from the two phases, mixed methodology research. The research investigated the existence of access barriers to environmental PSGI and attempt to determine the extent to which these access barriers impact on the commercial sector ability to derive economic gain from the creation and maintenance of value added products and services.

Phase one as described in section 4.3 investigates, in a qualitative manner the access barriers commercial organisation contend with in obtaining environmental PSGI to create and maintained value added products and services. This phase consists of four sequential steps:

- Identify the environmental PSGI that is required by the commercial sector to create value added products and services
- Identify the access barriers associated with the environmental PSGI
- Determine the level of constraint associated with these access barriers.
- Determine the commercial sector strategic positioning of the value added products and services derived from environmental PSGI

The second phase of the research, as described in section 4.4, employed a quantitative approach to investigate the demand for value added products and services that are reliant on environmental PSI. The following constructs were used to define the end user demand:

- How do 'end-users' access environmental PSGI? And what is the motivating reason for 'end-users' access environmental PSGI in a certain way?
- Why do 'end-users' have specific preferences for value added products and services? And how do 'end-users' access these value added products and services?
- What environmental PSGI do 'end-users' access through the value added products and services?

Lastly the results from the preseding components will be used to Establish if access barriers have an economic impact on the commercial sectors ability to create and maintain value added product and services.

- Link the supply-side conceptual framework for access barriers to environmental PSGI with the prevalence of end-user requirements for value added products and services derived from environmental PSGI.

5.2   Phase one supply side analysis

The non-probability sampling – purposive sampling and, in particular, a heterogeneous sample variety was done by selecting commercial organisations known to be actively associated with environmental products and services. The sample of the first seven commercial organisations was selected from a list of environmental practisioners obtained from the Department of Environmental Affairs. The selection was based on the following criteria:

- Size of the organisation
- Period which the commercial organisation has been actively creating and maintaining value added products and services derived from environmental PSGI.

The additional five commercial organisations were selected based on the feedback of the initial interviews.

5.2.1   Sample results and descriptive statistics

Nine commercial organisations were initially approached for an interview. Seven accepted. The remaining two companies were unable to assist due to the fact that the first organisation's managing director was ill and the second organisation sited current work pressures and stated that it would be available in October 2014. The last five commercial organisations all accepted the invitation.

From a geographic perspective there was one organisation from Pietermaritzburg, three from Cape Town and eight from the Pretoria - Johannesburg area. Appendix provides an overview of the commercial organisations that contributed to phase one's interviews**.**

5.2.1.1 Geographic operational footprint

The commercial organisations geographic operation footprint was distribution ranged between national, SADC and international. Table 7 correlates the sizes of the organisations interviewed with their geographic operation footprint.

Table 7: Interview sample – size of organisations and geographic operation footprint.

	Small <5 *(n)*	Micro 5-19 *(n)*	Medium 20-99 *(n)*	Large 100 > *(n)*
Municipal level	-	-	-	-
Provincial	-	-	-	-
National	2	1	-	1
SADC Africa	2	1	1	-
International	-	1	-	3

5.2.1.2 Industries that are serviced

The majority of the respondents selected more than one industry in which they operate in. Table 8 represents the top 10 industries in which the respondents operate in. This phenomena relates to the variety of core business activities identified by the interviewees.

Table 8: Industries that are serviced

	Industry	**Occurrence *(n)***
1	Environmental management	6
2	Minerals / Mining	5
3	Water resource management	5
4	Agriculture, including food security	3
5	Civil Engineering	3
6	Energy	3
7	Communication (Telecommunication)	2
8	Conservation	2
9	Disaster and Emergency Management	2
10	Forestry	2

5.2.1.3 Core business activities

Half (50%) of interviewees was involved in the development of specialised reports such as EIA, but there was no representivity in the marketing and communication or software development areas. Table 9 provides a listing of the organisations core business.

Table 9: Core business activities of the commercial sector sample.

Core business of the organisation.	Occurrence (n)
Development and reporting of EIA, EMF, SDF, specialist reports etc.	*6*
Data analysis and interpretation	5
Data acquisition / collection / collation	4
Data management	4
Project management	4
Spatial products development	4
Visualisation and mapping	3
Data vendor	2
Planning	2
Policy development and governance	2
Data warehousing	1
Database administration	1
System analysis	1
Training	1
Marketing and communication	*0*
Software development	*0*

5.2.1.4 Client base

All the respondents provided services and eight interviewees provided products to the private sector. The respondents selectively had the public sector as a client and governmental statutory bodies was least represented. Table 10 provides an overview of the current client base of the sample organisations based on information obtained in personal in-depth interviews.

Table 10: Client base of the sample organisations.

Client base	Selection occurrence *(n)*
Private companies	12
National departments	10
Provincial department	10
Local authority level	9
Government parastatal	6
Academic and research institutions	5
Statutory body	5

5.3   Supply side - Research proposition 1

The objective of research proposition was to identify access barriers to PSGI that the commercial sector contended with.   Table 11 provides the structure for the data gathering and reporting in this section.

Table 11: Qualitative data gathering framework.

Sub-propositions	Interview questions
1.1. Identify the environmental PSGI that is required by the commercial sector to create value added products and services.	Q18 - List spatial environmental datasets (PSGI) that you use to develop and maintain value added products and services. Q19 - Indicate the *importance of the datasets.*
1.2. Identify the access barriers associated with the environmental PSGI	Q20.1. - What are the *access barriers that impact* on your ability to access PSGI.
1.3. Determine the level of constraint associated with these access barriers.	*Q20.2. Indicate the level of constraint associated with each access barrier*
1.4. Determine the commercial sector strategic positioning of the value added products and services derived from environmental PSGI.	Q9. - What revenue streams does your organisation use to generate income? Q10 - 13. - Supply of value added products to end users. Q14 - 17. - Supply of services to end users.

5.4 Environmental PSGI

The interviewees identified a variety of environmental PSGI sets that are currently used to develop value added products and services. Table 13 provides the 17 environmental PSGI datasets that was prioritised based on a frequency analysis done on the results of the interviews. Annexure D provides all the environmental PSGI datasets identified in the interviews. Furthermore, the interviewees indicated the level of importance associated with these datasets and the results was incorporated in to Figure to illustrate the relationship.

Table 12: Priority environmental PSGI

	Environmental PSGI	Number of times identified		Environmental PSGI	Number of times identified
1	Land cover data	12	10	Degraded land	5
2	Soil data	12	11	Estuaries data	5
3	Vegetation data	12	12	Forestry data	5
4	Elevation data	11	13	Geology data	5
5	Mine data	7	14	Land capacity data	5
6	River course data	7	15	Slope data	5
7	Dams / water bodies	6	16	Wetlands data	5
8	Protected areas data	6	17	Conservation data	4
9	Critical biodiversity area data	5	-	-	-

5.4.1 Ranking of environmental PSGI

The environmental PSGI was ranked on relevance and importance. Where relevance refers to the frequency (prevalence) of the dataset in the analysis of the interviews results and the survey data. Importance ranking refers to the importance level allocated to the environmental PSGI derived from the interview data.

Table 13: Ranking analysis

	Environmental PSGI (Importance)	Environmental PSGI (Relevance)
1	Land cover	Land cover
2	Soil	Soil
3	Vegetation	Vegetation
4	Elevation	Elevation
5	Mine	Estuaries
6	River course	Critical biodiversity
7	Dams / water bodies	Protected areas
8	Protected areas	Dams / water bodies
9	Geology	Geology
10	Critical biodiversity	River course
11	Estuaries	Mine
12	Forestry	Forestry
13	Slope	Conservation
14	Wetlands	Wetlands
15	Land capacity	Slope
16	Degraded	Land capacity
17	Conservation	Degraded

Table 12 provides for a graphical representation of the correlation between the importance and relevance categories as a ranking mechanism. The datasets had a 41% correlation in ranking.

Figure 9: Environmental PSGI required for value added products and services.
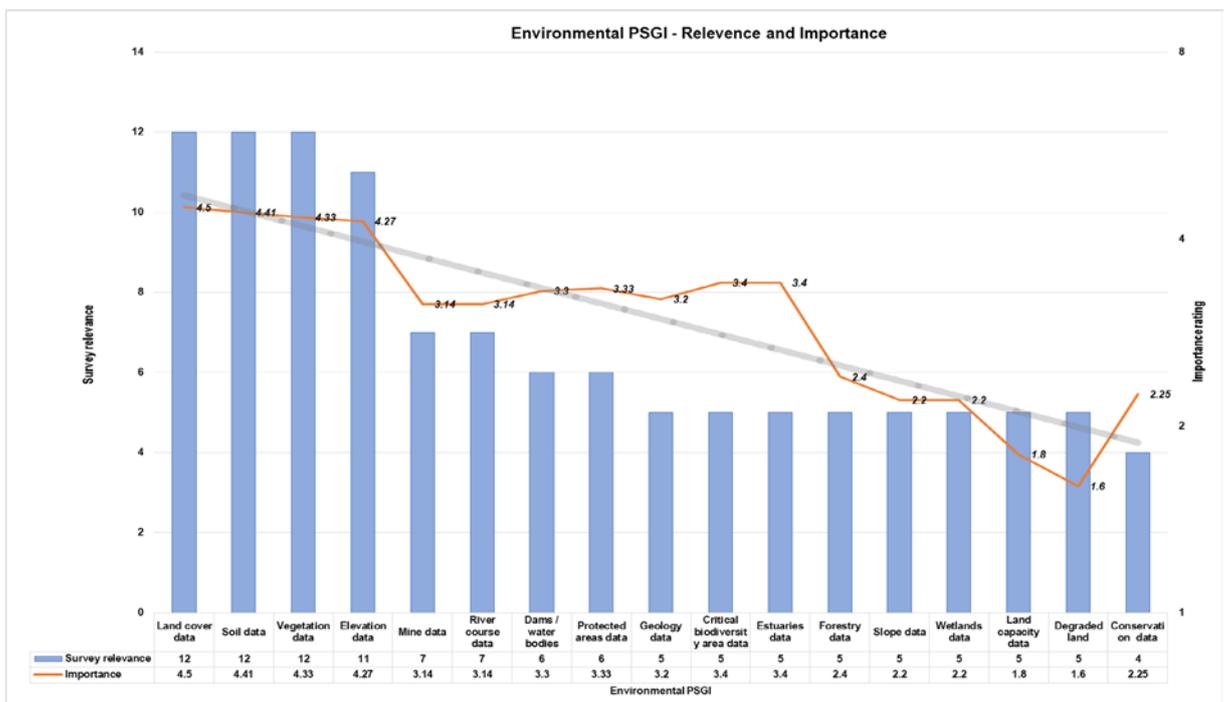
5.4.1.1 Additional PSGI requirements

The interviewees indicated additional PSGI that they required. Thes datasets are not considerd as pure environmental datasets but are used to enhance the value added products and services derived from environmental PSGI. Thes datasets were grouped as Associated Environmental PSGI and Additional PSGI and Table 14 provides a ranked list of these datasets.

Table 14: Additional PSGI

PSGI - Dataset	Occurrence	Constraints
Associated Environmental PSGI		
Aerial photography	8 (66%)	Technology platforms (size of datasets and geographical distance from the PSGIH)
Topographic data	7 (58%)	Technology platforms (size of datasets and geographical distance from the PSGIH)
Satellite imagery	6 (50%)	Pricing policy and technology constraints
Fire potential	1 (8%)	Data accessibility
Additional PSGI		
Cadastral	8 (66%)	Data quality, Data maintenance, usability and reliability
Census	6 (50%)	Accessibility good. Usability in terms of scale / resolution of data and updates
Deeds data	4 (33%	Pricing policy
Roads	3 (25%)	Standardisation and accessibility
Spot building count	2 (16%)	Accessibility – non PSIH is custodian
Former homelands	1 (8%)	Accessibility, metadata
Networks (Roads, Railways, Electrical, etc.)	1 (8%)	Accessibility, metadata and data quality
Waste treatment facilities	1 (8%)	Accessibility, metadata
Alternate energy sources	1 (8%)	Accessibility, metadata
Infrastructure data	1 (8%)	Accessibility, metadata and data quality

5.4.2 Access barriers

The first step was to identify the access barriers to environmental PSGI commercial sector contends with. 163 incidences of accesses barriers were reported over the 12 interviews. These incidences were refined by aggregating reported access barriers to

align to the framework as described in Table 13. After this process 119 incidences of access barriers remained. Annexure c provides an extensive list of the access barriers associated with the relevant environmental PSGI. Figure 13 provides an overview of the prevalence and type of access barriers that was identified. The access barriers were aligned to the access barrier framework outlined in Table 15.

Figure 10: Access barriers prevalence.
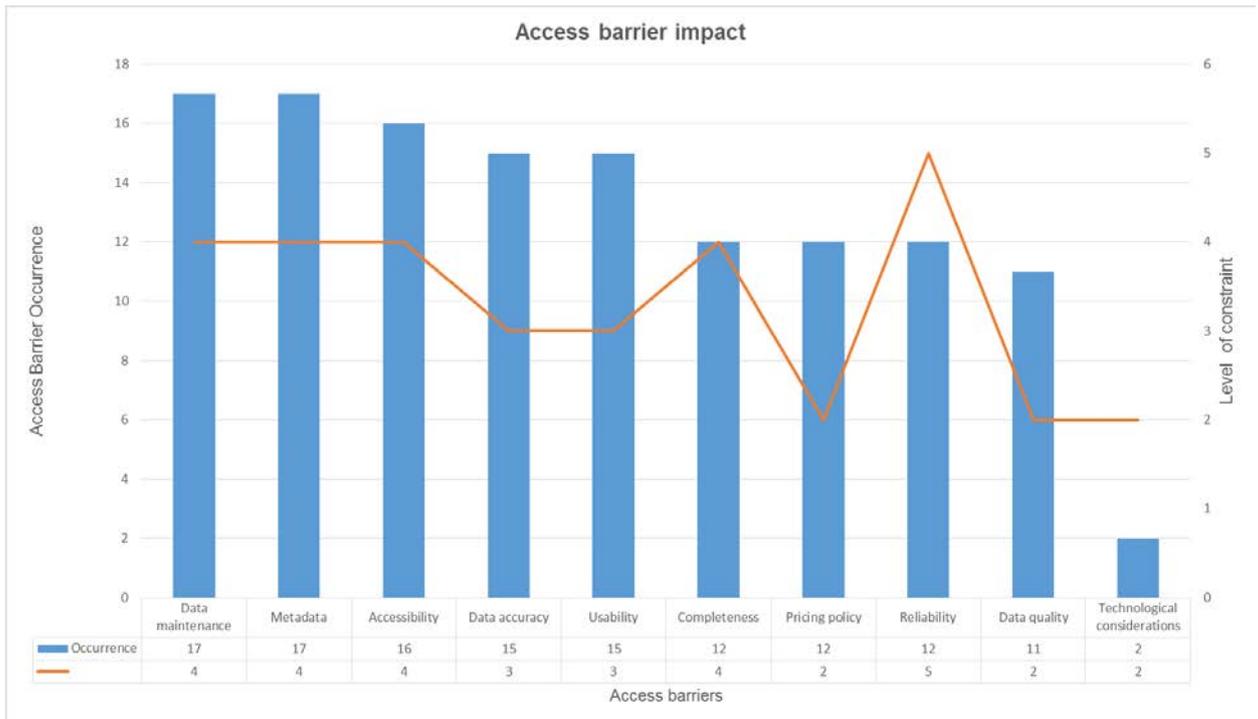
5.4.3   Level of constraint

The level of constraint associated with these access barriers was identified based on feedback from the interviewees. Annexure W provides a Table indicating the level of constraint per environmental PSGI dataset as indicated by the interviewees. Figure provides a quick reference to the level of constraint per access barrier for the 17 priority environmental PSGI. All access barriers types were not associated with the prioritised environmental PSGI.

Figure 11: Constraint analysis per access barrier.

Commercial sector data matrix: Cross tabular analysis of constraint levels and access barriers.

Commercial sector data matrix: Cross tabular analysis of constraint levels and access barriers.

Priority 7 - Dams / water bodies data

Priority 8 - Protected areas data

Priority 9 - Geology data

Priority 10 - Critical biodiversity area data

Priority 11 - Estuaries data

Priority 12 - Forestry data

Priority 13 - Slope data

Priority 14 - Slope data

Commercial sector data matrix: Cross tabular analysis of constraint levels and access barriers.

Priority 15 - Land capacity data

Priority 16 - Degraded land

Priority 17 - Conservation data
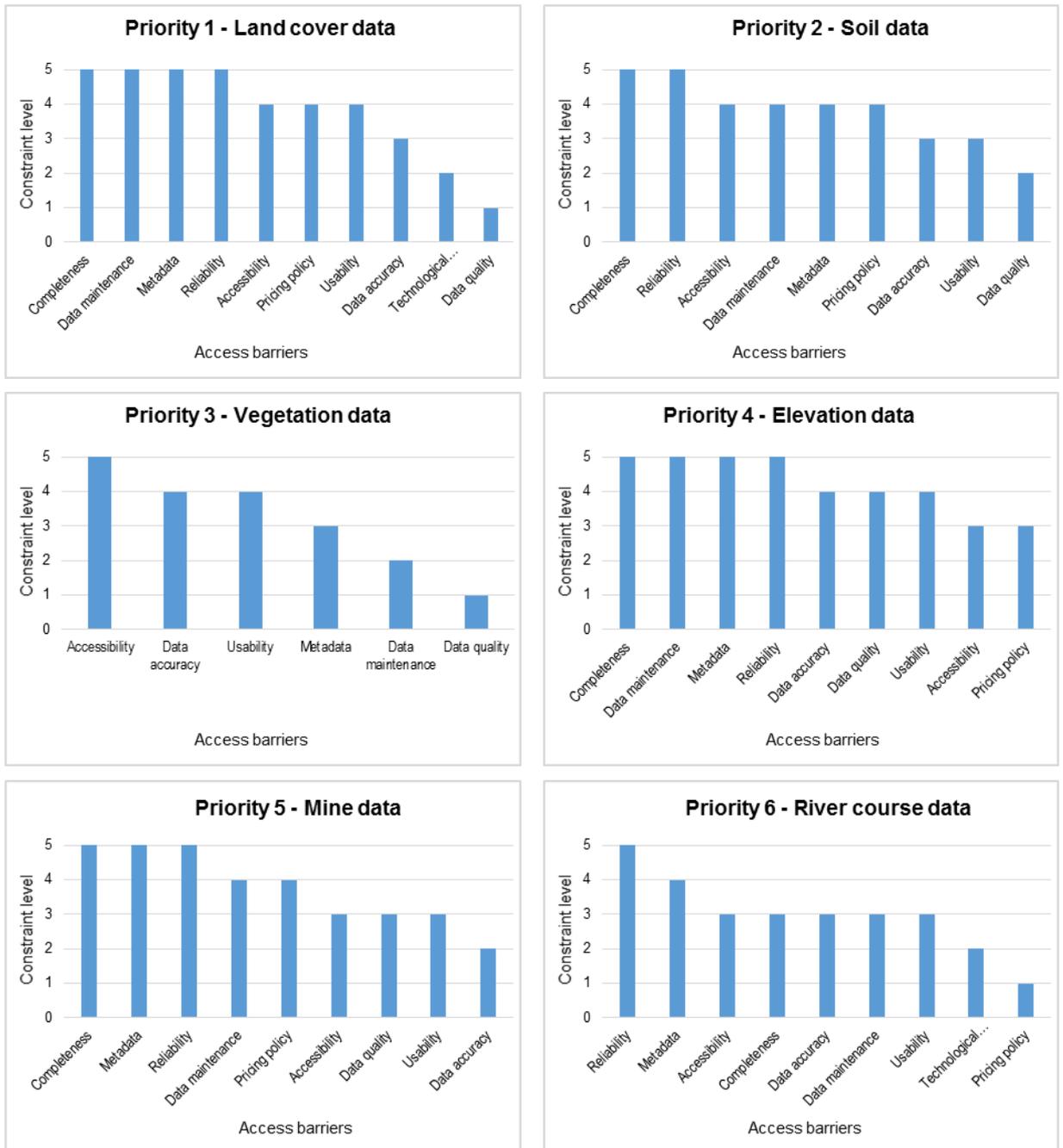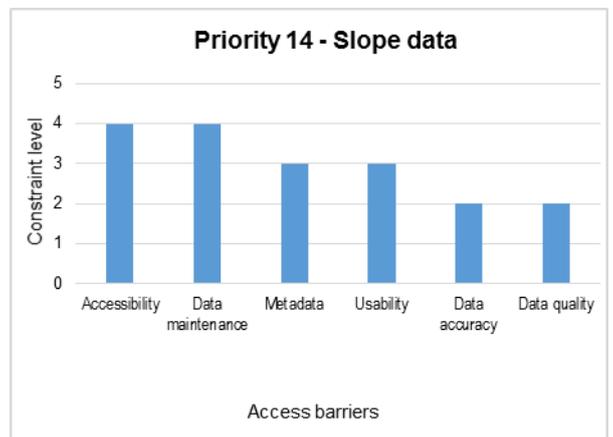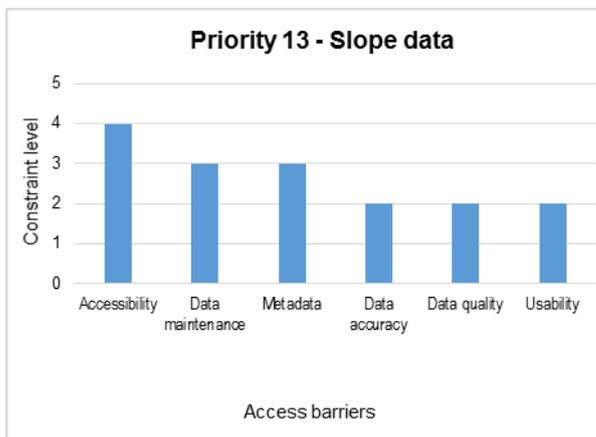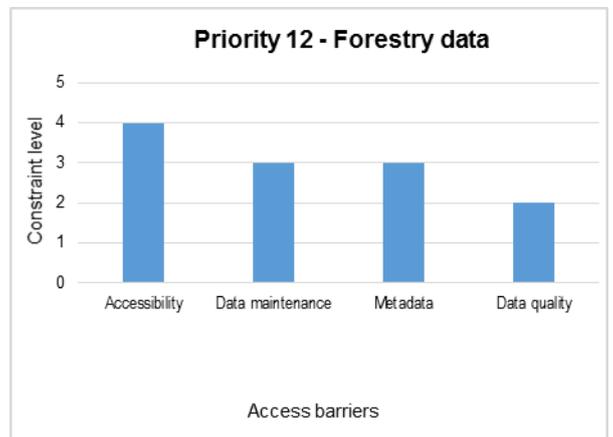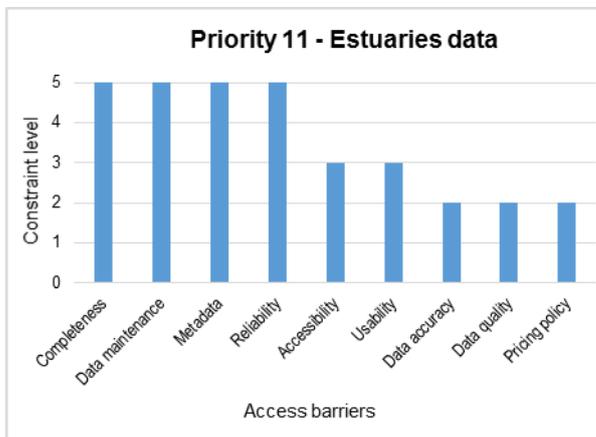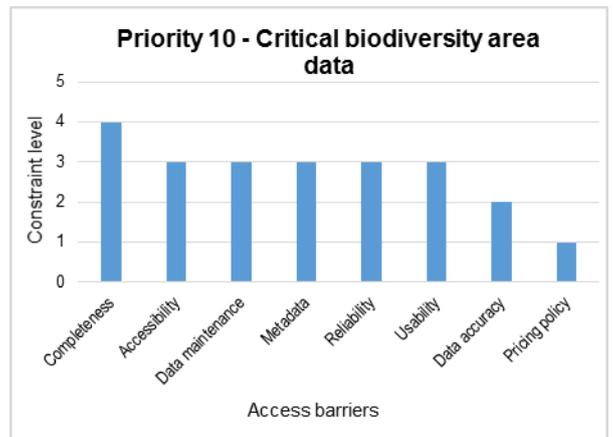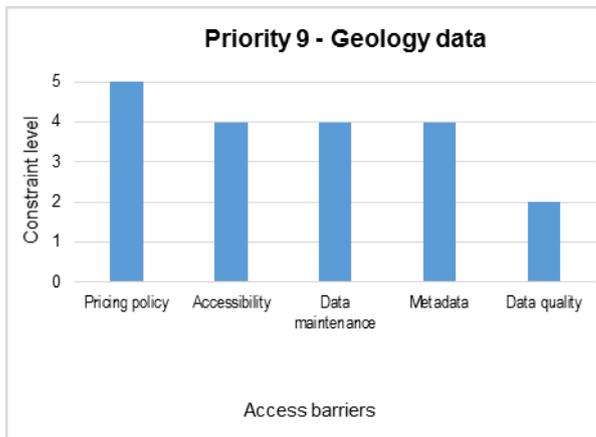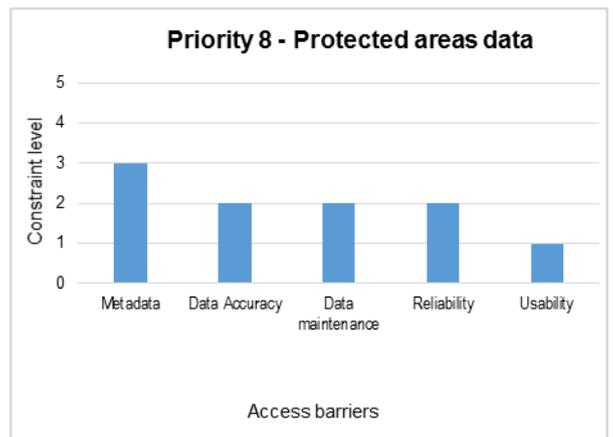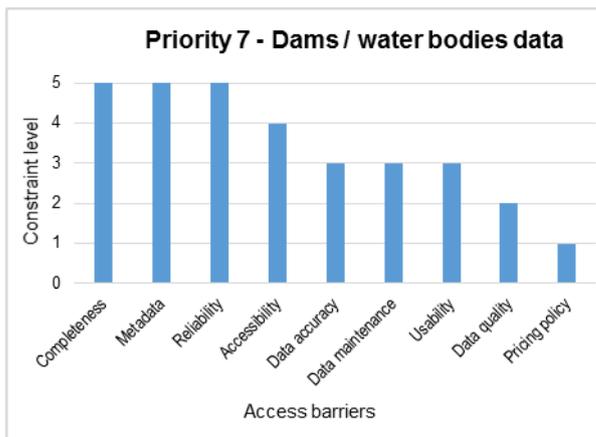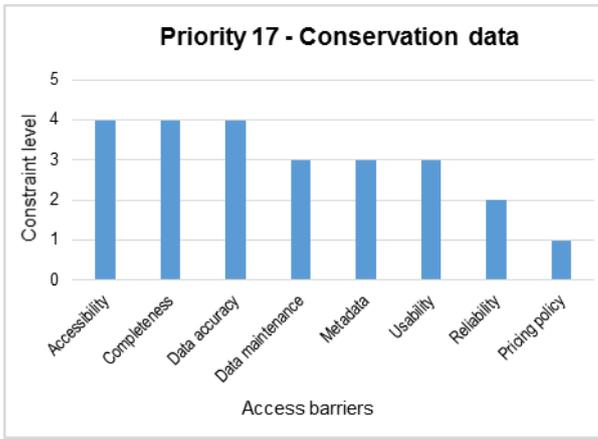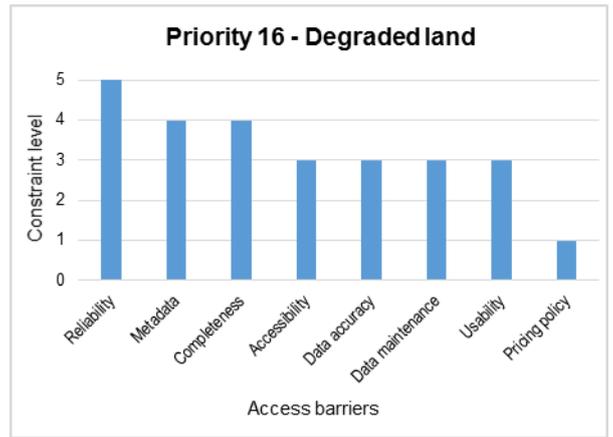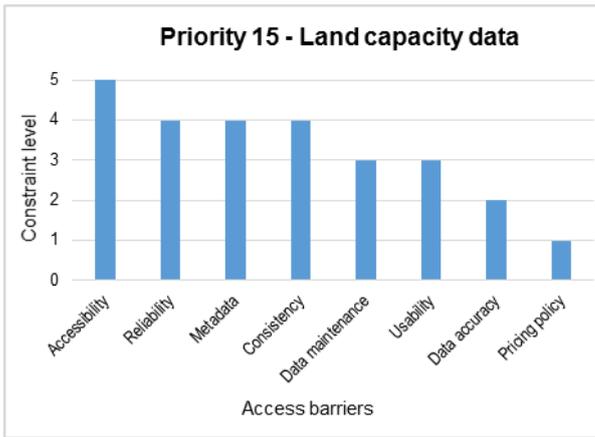
Table 15: Indicates the systematic delineation of the allocated constraint level for each access barrier for the prioritised environmental PSGI dataset.

Table 15: Environmental PSGI constraint level analysis

	Access Barrier	Occurrence per PSGI	Range	Mean	Median	Allocated constraint level
1	Metadata	17	5-3	3.9	4	3.9
2	Accessibility	16	5-3	3.8	4	3.6
3	Data maintenance	17	5-3	3.4	3.5	3.4
4	Reliability	12	5-2	4.2	5	3.0
5	Completeness	11	5-1	4.2	4.5	2.7
6	Usability	15	3	3	3	2.6
7	Data accuracy	15	4-2	2.7	3	2.4
8	Pricing policy	12	5-1	2.3	1.5	1.6
9	Data quality	11	1-4	2.1	2	1.4
10	Technological considerations	2	2	2	2	0.2

5.4.4 Commercial sector strategic positioning

The strategic positioning of the commercial sector towards the development of value added products and services derived from environmental PSGI was assessed. The interviews indicated that they followed different approaches towards their product and service with regards to the scope and client base.

Figure 15 illustrates the variance in the strategic approach within the different size groupings of the interviewees in relation to both the product and service deliver. In addition there is a differential based on their customer base.

Figure 12: Product and service strategic positioning
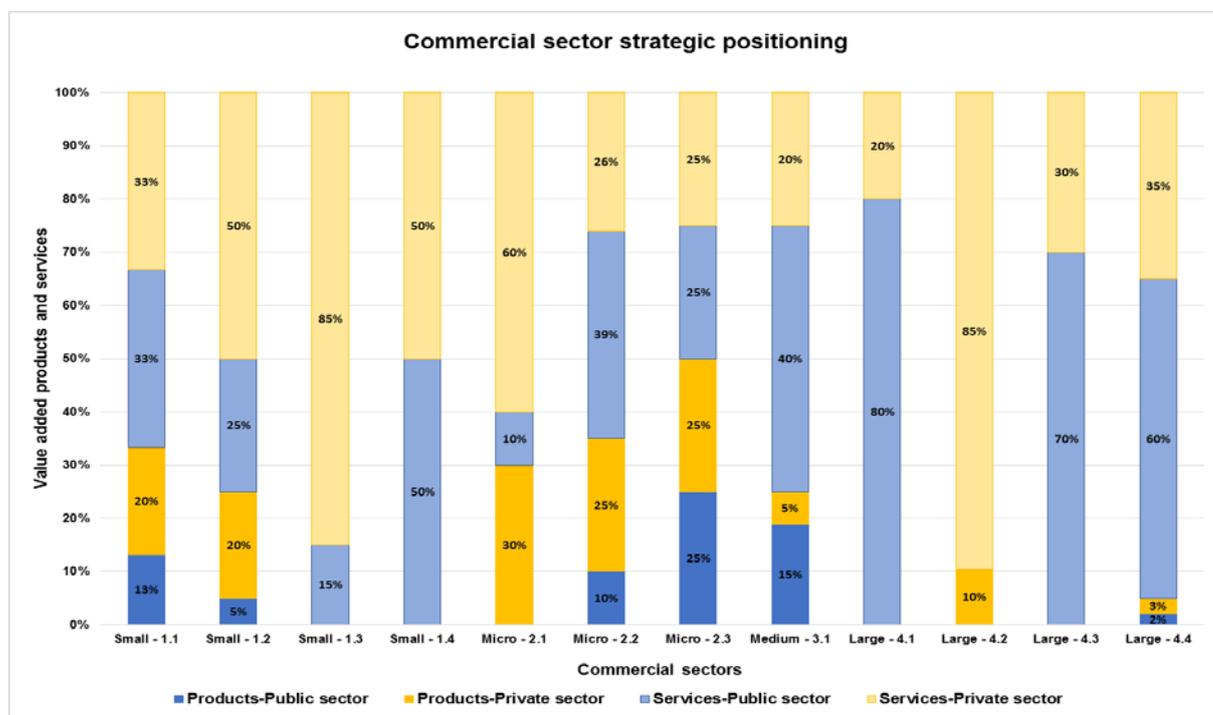
Additional strategic considerations was identified. Table 16 provides a list of internal and external strategic considerations.

Table 16: additional strategic considerations

Internal strategic considerations	External strategic considerations
Professional registration – council requirements	Reliance on public sector renders and contracts
Organizational cultural approach to value added products and services	Procurement processes
Financial constraints and lack of investment in R&D for new products	End user willingness to pay for value added products and services

5.5 Phase two demand side analysis

The second phase of the research relied on qualitative data obtained from end users of environmental PSGI. This section determined the end-user demand for innovative value added products and service derived from environmental PSGI.

5.5.1 Sample results and descriptive statistics

The second phase of the data gathering exercise employed a self-administered online survey data collection method to facilitate contributions on a macro scale from a variety of potential end-users. 273 responses were received and 263 were used for this analysis as 5 responses were incomplete.

5.5.1.1 Geographic operating area

The user base was divided according to public and private users. Further refinement of the public sector was incorporated to provide differentiation of needs based on mandates and geographical footprints of authority. Figure 16 indicates the geographical operating area for the different sectors. The data integrity was confirmed in this group as there was no public sector entities the indicated there activity beyond their legal geographical mandate. Thus there was no local authorities that indicated activity on a international level.

The sample of respondents from national departments did not indicate any activity on a international level. This is due to the sample as there is international activity from national departments such as Department of Environmental Affairs that is responsible for environmental treaties such as Millennium development goals.

Figure 13: Geographic operating area
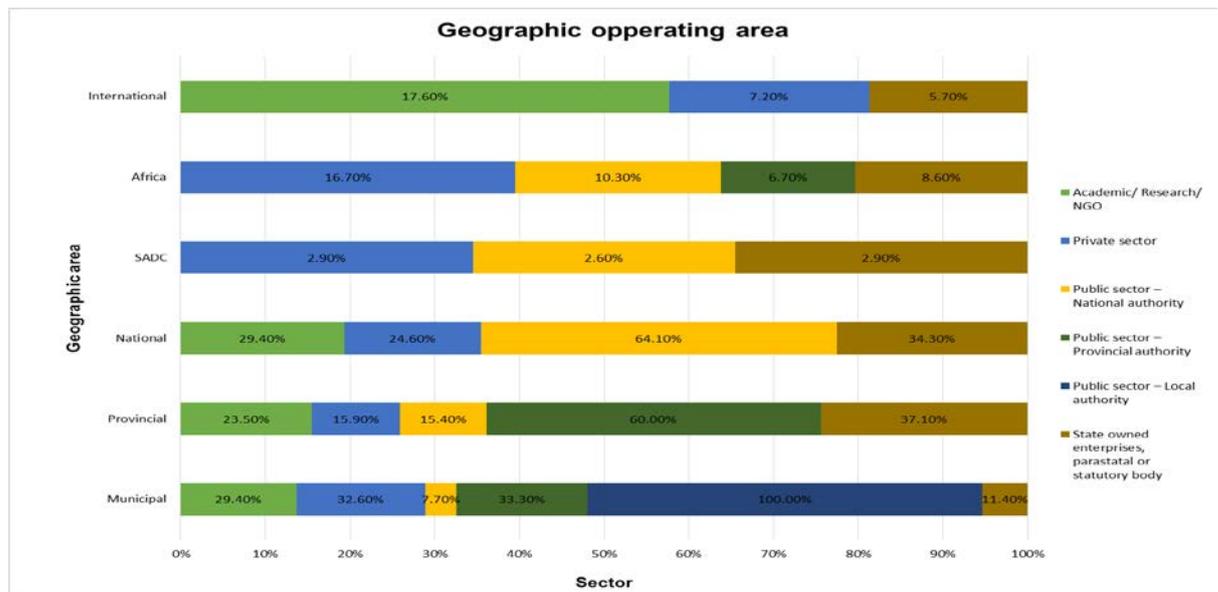
5.5.1.2 Area of operation

Table 17 provides an overview of the top six areas of operation in which the respondents operate in. Annexure E provides a full account of the 263 respondent's multi selections in descending order.

Table 17: Industry in which respondents operate in.

Areas of operation.	Academic Research NGO	Private sector	Public sector			State owned enterprises, parastatal or statutory body	Total
			National authority	Provincial authority	Local authority		
Environmental management	*7*	*71*	*11*	*5*	*9*	*8*	*111*
Surveying	1	*41*	*8*	*3*	*7*	*10*	*70*
Civil Engineering	1	*40*	1	1	*6*	*7*	*56*
Spatial planning and information (urban and regional planning)	2	*30*	*6*	*5*	*10*	1	*54*
Other	*3*	*28*	*7*	1	*7*	*5*	*51*
Land Administration and/or Land information systems	1	*20*	*9*	*6*	*7*	*5*	*48*

5.5.1.3 Core business activities

The top four core business activities over all respondents are highlighted in Figure 17. The primary activity of the respondents relates to engagements such as data acquisition, collection and collation. The full account of business activities is available in Annexure F.

Figure 14: Respondents core business activities.

Data access platform	Academic Research NGO	Private sector	Public sector			State owned enterprises, parastatal or statutory body
			National authority	Provincial authority	Local authority	
Data acquisition / collection / collation	41.20%	49.30%	51.30%	73.30%	66.70%	57.10%
Data analysis and interpretation	52.90%	48.60%	41.00%	73.30%	66.70%	45.70%
Data management	23.50%	38.40%	33.30%	73.30%	62.50%	42.90%
Visualisation and mapping	29.40%	39.10%	41.00%	33.30%	50.00%	45.70%

5.6   Demand side - Research proposition 2

The objective of the proposition is to determine the end-user demand for innovative value added products and service derived from environmental PSGI. This component focused on how "end-user" access environmental PSGI, why the preference, how often and, lastly, what environmental PSGI do they access.

Sub-propositions	Survey questions
1.1. How do 'end-users' access environmental PSGI? And what is the motivating reason for 'end-users' access environmental PSGI in a certain way?	Question 6 - How do you access the spatial environmental data that you require for your daily operations? Question 7 Indicate the reason/s for using spatial datasets.
1.2. Why do 'end-users' have specific preferences for value added products and services? And how do 'end-users' access these value added products and services?	Question 10 - How do you access the spatial environmental data that you require for your daily operations? Question 11 - List the custom or proprietary product/s you use. Question 12 - Motivation for using the custom or proprietary product/s. Question 13 - How often do you use the custom / proprietary products or services? Question 14 - What benefits do you derive from using the custom / proprietary products or services? Question 15 - What constraints / drawbacks do you associate with the custom / proprietary products or services?
1.3. What environmental PSGI do 'end-users' access through the value added products and services?	Question 8, 17 and 19 - Which spatial environmental datasets do you currently access through a custom / proprietary product or service? Question 9, 17 and 20 - Do you require access to any _additional_ spatial environmental datasets through a custom / proprietary product or service?

5.6.1.1 How do 'end-users' access value-added products and services?

This component of the research assesses the current and future requirements to spatial environmental PSI. Data can be used in its native format such as Shape file, Geodatabase, CAD files etc. Alternatively, spatial environmental data can be accessed through technology platforms such as map services or web services as custom products or proprietary product.

For the purpose of the survey the following distinction was made:

- Environmental PSGI in its native format
- Custom or proprietary technology products
- A combination of environmental PSGI native format and custom or proprietary technology products.

Question six of the online survey requested respondents to indicate their current data access platform. 263 responses were received for this section of the survey. 35.7% of respondents worked only with data in its native format. 10.6% of respondents exclusively used custom or proprietary product and 53.6% relied on a combination of data in its native format and custom or proprietary products. Figure 18 provides an overview of the preference for the different access platforms per organisation type.

Figure 15: Access platform preference for PSGI
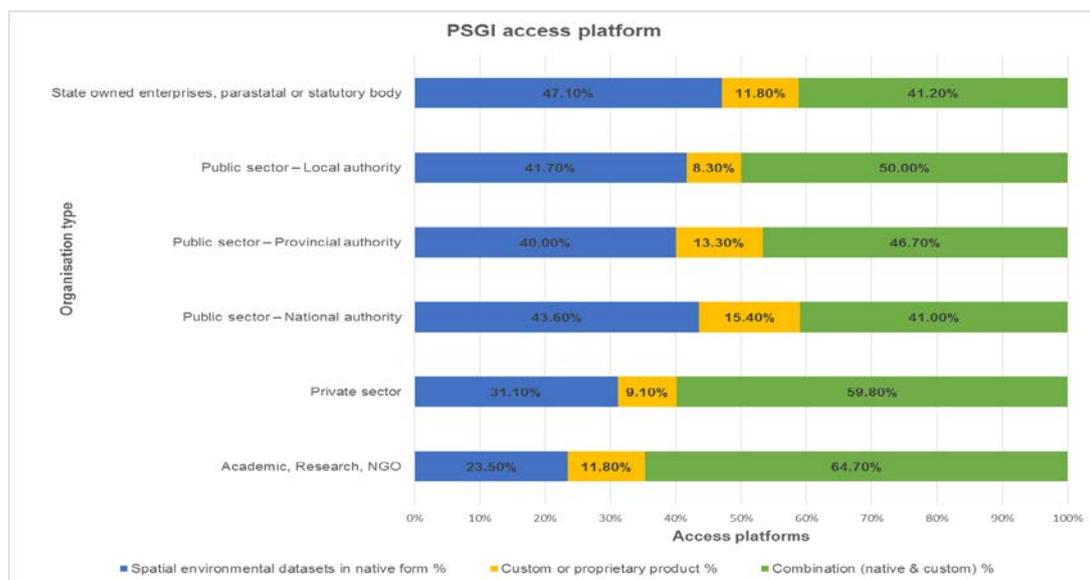
Significance testing:

Question 3. Type of organisation that you are affiliated to		
6. How do you access the spatial environmental data that you require for your daily operations?	Chi-square	8.772
	Df	10
	Sig.	.554[a]
Results are based on nonempty rows and columns in each innermost suitable. Pearson Chi-Square Tests indicated a chi-square level of 8.772 indicating an acceptable level for analysis for this component.		

For the purpose of this analysis there is a grouping of responses per platform preference as described in section 4.4.5 - Data analysis method and illustrated in Figure 18: Inter-connectivity of survey questions for data analysis.

5.6.1.2 End-users preferences for value-added products and services
Question 7 and 18 of the online survey analysed the respondents' rationale for selecting the different access platforms.

Option 1: Data in its native format rationale:

35.7% of respondents accessed environmental PSGI in its native format. Table 7 indicates the selection rational. It is evident from the cumulative results that 88% of the respondents identified the following three reasons as their main selection drivers:

- Personal preference 37%
- System requirements 28%
- *(Un)* availability of products 23%.

In Annexure F section 1, an overview per organisational type is provided. The preference rational related to organisational structures correlates with the results as a total, with provincial authority as an exception. Provincial authority indicated system requirements as its major consideration and there after sited user preference.

The other respondents provided additional reasons for using environmental PSGI in its native format. Comments such as technical requirements for attribute construction and validation procedures for data integrity can be grouped under internal system requirements. Motivations such strategic approaches to data management by means of a data warehousing initiatives was sited and could not be grouped with any of the predefined options due to the strategic rational.

Figure 20 provides an overview of the different response levels for each rational that contributes to the choice of using environmental PSGI in its native format. The information provides insight from both the access scenarios. 37% of users prefer to work with data in a raw format and 27% indicated their internal system requirements as a contributing factor. Technology contributes the least as a factor to consider and only contributes 6%.

Figure 16: Choice rational for environmental PSGI in native format.
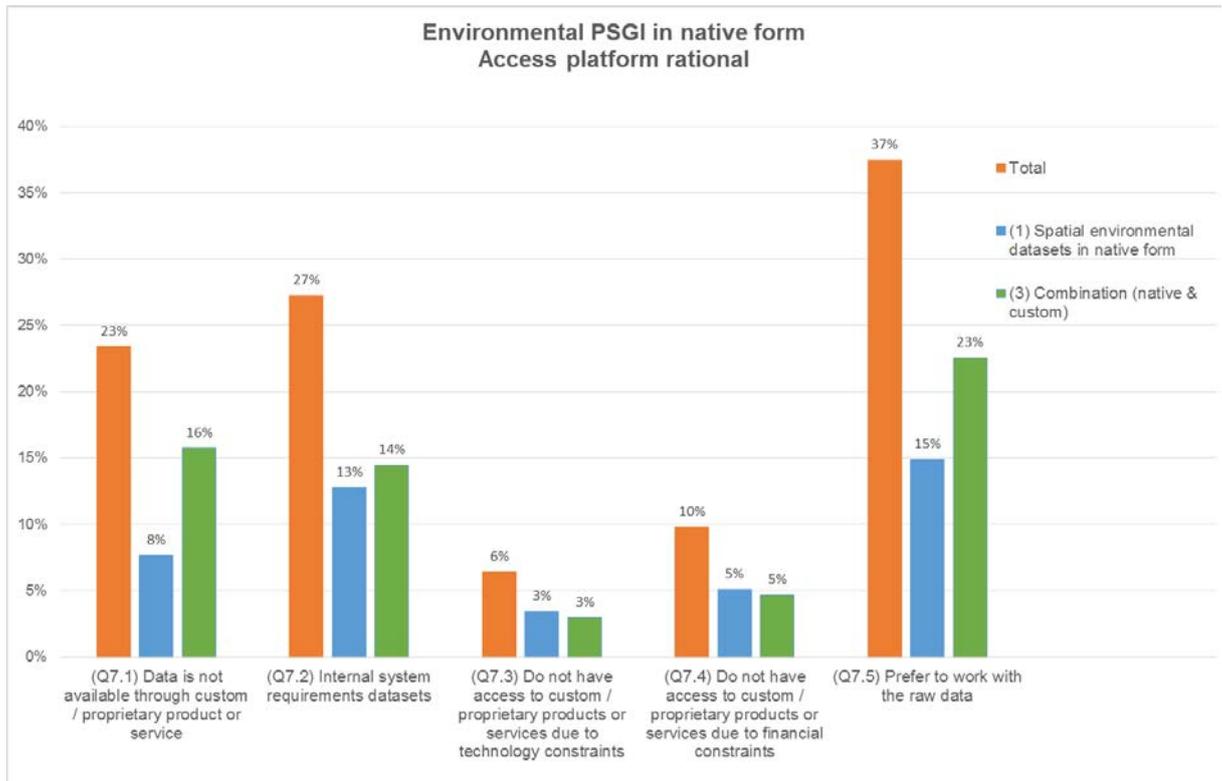
Option 2: Data is accessed through a custom or proprietary product such as BGIS, SPISYS, ArcGIS online or Google Big maps etc.

In this survey, custom and proprietary product refers to the following scenarios:

- Custom product refers to custom made platforms (systems) such as BGIS and SPISYS. These services provide access to a variety of spatial data. These services are normally designed for a specific user base

- Proprietary product or service refers to proprietary platforms such as ArcGIS online, 1map, SAEON, Google Big maps etc. These services provide access to a variety of spatial data and have a variety interests and applications. These platforms are normally commercial products.

Figure 21 indicates the preference in access platforms. The analysis provides a cumulative response for question 10 and 21 expressed per organisational type. The private sector was the strongest users of these platforms with 44 users. The combined uptake over all public sector organisations equates to 31 users.

Figure 17: Custom and proprietary access platforms
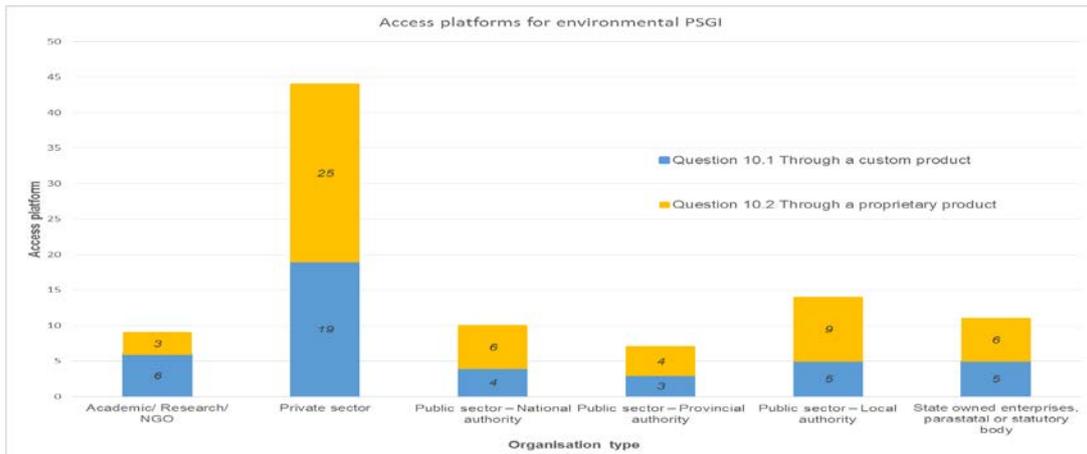
Table 18 represents the response per class for custom and proprietary products. Nine respondents misinterpreted the question and indicated proprietary software in their responses. These respondents did however indicate at least one custom or proprietary products and the responses were still valid.

Table 18: Results table of custom and proprietary

Platform description	*n*	Custom products	Platform description	*n*	Proprietary products
SANBI BGIS	16	DEA - SANBI Free	Google Earth	11	Licenced
In-house database and web services	7	Access restricted - internal use. E.g. City of Cape town, ISIS intranet viewer, Eskom - Spaceman	ArcGIS Online	8	ESRI - licenced
			Google Maps	8	Free of charge
			Bing maps	6	Free of charge
AGIS	4	DAFF - Free	1MAP	3	1Map - licenced
National Geo-Spatial Information	2	NGI - Free	WinDeed	3	Deeds information - licences
CIS Project Launcher	1	Free	AFIS	1	Licenced
CSIR	1	Project specific	Open Street Maps	1	Free of charge
DWA Maps	1	DWA - Free	SAEcplorerClimate	1	Licenced
Genome	1	Free	SPISYS	1	Licenced
Nitrogen maps	1	National Atmospheric Deposition Program			
SANBI Red list & Species maps	2	DEA - SANBI Free			

5.6.1.3 Environmental PSGI accessed through the value-added products and services

Table 19 provides an overview of the top ten environmental PSGI per access platform based on the following analysis criteria: "Question 6. How do you access the spatial environmental data that you require for your daily operations? Cross tabulated with Question 8. Which spatial environmental datasets do you currently use in its native format?" The sequence of the significance level between the two questions per dataset is the same. Annexure

Table 19: Environmental PSGI comparison and access platforms analysis

Question 6. How do you access the spatial environmental data that you require for your daily operations? Cross tabulated with Question 8. Which spatial environmental datasets do you currently use in its native format?			
Environmental PSGI	(1) Spatial environmental datasets in native form	(3) Combination (native & custom)	Total
Land Cover data	32	38	*70*
Elevation data	26	37	*63*
Dams / water body data	13	34	*47*
Conserved areas data	13	31	*44*
Protected areas data	21	21	*42*
Critical biodiversity areas data	12	29	*41*
Vegetation data	13	23	*36*
Wetlands data	10	24	*34*
Rivers course data	11	21	*32*
Geology data	8	19	*27*

Annexure G: Environmental PSGI per access platform contains the entire analysis sheet including a comparison with "Question 9. Do you require any additional spatial environmental datasets? ". The following environmental PSGI appeared in both of the question results:

- Critical biodiversity areas data
- Elevation data
- Geology data
- Land Cover data
- Protected areas data
- Rivers course data
- Vegetation data
- Wetlands data.

Table 20 indicates the use of environmental PSGI per organisation type. Land cover remains the most important environmental PSGI for the public sector and its state owned enterprises, parastatal or statutory body. The private sector, academic, research and NGO identified elevation data.

Table 20: Environmental PSGI comparison and organisation type analysis

Question 8. Which spatial environmental datasets do you *currently use* in its native format? Cross tabulated with Question 3. Type of organisation that you are affiliated to.			Public sector			State owned enterprises, parastatal or statutory body	Total
Environmental PSGI	Academic/ Research/ NGO	Private sector	National authority	Provincial authority	Local authority		
Land Cover data	3	28	14	8	5	12	*70*
Elevation data	7	34	6	3	4	9	*63*
Dams / water body data	6	18	8	2	3	10	*47*
Conserved areas data	2	27	4	2	3	6	*44*
Protected areas data	4	15	7	4	3	9	*42*
Critical biodiversity areas data	1	22	4	4	4	6	*41*
Vegetation data	5	15	3	4	1	8	*36*
Wetlands data	1	18	1	3	3	8	*34*
Rivers course data	3	18	3	2	1	5	*32*
Geology data	2	17	2	2	1	3	*27*

5.7 Economic opportunity - Research proposition 3

The economic opportunity related to environmental PSGI was derived through a correlating analysis of the supply side constraint and demand side requirements. The objective was to delineate the correlation trend to establish if access barriers have an economic impact on the commercial sectors ability to create and maintain value added product and services

5.7.1 Environmental PSGI supply and demand correlation analysis

The correlation analysis utilised the results of the supply side analysis indicating the environmental PSGI datasets required for added products and services in descending order of importance. The demand side reflects the prevalence of environmental PSGI

obtained from the online survey data analysis. The final contribution is the trend line indicating the level of constraint associated with each environmental PSGI. Figure 22 illustrates the linier correlation between the demand sides for environmental PSGI.

5.8 Conclusion of research results

This chapter provides the results obtained from the two phases, mixed methodology research. The research investigated the existence of access barriers to environmental PSGI and attempt to determine the extent to which these access barriers impact on the commercial sector ability to derive economic gain from the creation and maintenance of value added products and services.

Phase one as described in section 4.3 investigates, in a qualitative manner the access barriers commercial organisation contend with in obtaining environmental PSGI to create and maintained value added products and services. This phase consists of four sequential steps:

- Land cover, soil, vegetation, and elevation data was identify as the main environmental PSGI that is required by the commercial sector to create value added products and services:
- The main access barriers associate with environmental PSGI were metadata, accessibility, data maintenance programs and reliability of the environmental PSGI
- The level of constraint associated with these access barriers was calculated.
- The commercial sector strategic positioning of the value added products and services derived from environmental PSGI suggest a differentiated approach with a focus on value added services.

Figure 18: Correlation analysis of supply and demand requirements

Environmental PSGI - Supply and demand correlation analysis
(Commercial organisations - Importance ranking)

	Land cover	Soil	Vegetation	Elevation	Estuaries	Critical biodiversity	Protected areas	Dams / water bodies	Geology	River course	Mine	Forestry	Conservation	Wetlands	Slope	Land capacity	Degraded
SS - Interview relevance	100%	100%	100%	92%	42%	42%	50%	50%	42%	58%	58%	42%	33%	42%	42%	42%	42%
DS - Survey requierment	27%	24%	18%	17%	7%	10%	13%	14%	12%	16%	16%	6%	1%	4%	5%	2%	1%
SS - Importance	4.5	4.41	4.33	4.27	3.4	3.4	3.33	3.3	3.2	3.14	3.14	2.4	2.25	2.2	2.2	1.8	1.6
SS - Cumelitive level of constraint	3.8	3.8	3.2	4.2	3.6	2.8	2.0	3.4	3.8	3.0	3.8	3.0	3.0	3.0	2.7	3.3	3.3

Environmental PSGI importance ranking (Supply side)

CHAPTER 6: DISCUSSION OF RESULTS

6.1 Introduction

This chapter provides a discussion and interpretation of the results obtained from the two phases, mixed methodology research in chapter 5. The research investigated the existence of access barriers to environmental PSGI and determine the extent to which these access barriers impact on the commercial sector ability to derive economic gain from the creation and maintenance of value added products and services.

The supply side consist of commercial organisations actively engaged in the creation and maintenance of value added products and services. The demand side is represented by the following entities all levels of government, private sector, NGO's, academia research institutions, parastatals, statutory bodies and state owned enterprises.

6.2 Supply side - Research proposition 1

Access barriers to environmental PSGI that the commercial sector contend with.

6.2.1 Background

Phase one as described in section 4.3, investigates in a qualitative manner the access barriers commercial organisation contend with in obtaining environmental PSGI to create and maintained value added products and services. This phase consists of four sequential steps:

- Identify the environmental PSGI that is required by the commercial sector to create value added products and services
- Identify the access barriers associated with the environmental PSGI
- Determine the level of constraint associated with these access barriers.
- Determine the commercial sector strategic positioning of the value added products and services derived from environmental PSGI

The commercial organisations operate in a variety of industries ranging from Minerals / Mining, Civil Engineering and Forestry. Half (50%) of interviewees was involved in the

development of specialised reports such as EIA, but there was no representivity in the marketing and communication or software development areas.

All the respondents provided services and eight interviewees provided products to the private sector. The respondents selectively had the public sector as a client and governmental statutory bodies was least represented. Table 9 provides an overview of the current client base of the sample organisations based on information obtained in personal in-depth interviews.

6.2.2 Environmental PSGI

Identify the environmental PSGI that is required by the commercial sector to create value added products and services

The interviewees identified a variety of environmental PSGI sets that are currently used to develop value added products and services. Environmental PSGI sets was prioritised based on a frequency analysis done on the results of the aggregated comments obtained through the in-depth semi structured interviews.

There was a 100% relevance correlation over all environmental PSGI sets, between the supply side and demand side ranking of environmental PSGI sets based. This is significant as the respondents to the online survey represented represent a variety of potential end users based on their organisational type

The "importance category" as a ranking mechanism provided for a change in the ranking order. The top four environmental PSGI rankings remained the same.

Table 21: Correlation of environmental PSGI

	Environmental PSGI (Importance)	Environmental PSGI (Relevance)
1	Land cover	Land cover
2	Soil	Soil
3	Vegetation	Vegetation
4	Elevation	Elevation

The alignment of the environmental PSGI sets as indicted in Table 21 (land cover data, soil data, vegetation data and elevation data) based on relevance and importance will assist in prioritising the access barriers that effect the commercial sector will.

6.2.2.1 Additional PSGI requirements

The interviewees indicated additional PSGI that they required. Thes datasets are not considerd as pure environmental datasets but are used to enhance the value added products and services derived from environmental PSGI. Thes datasets were grouped as Associated Environmental PSGI and Additional PSGI and Table 22 provides a ranked list of these datasets. From the interviews PSGI

Table 22: Additional PSGI

PSGI - Dataset	Occurrence	Constraints
Associated Environmental PSGI		
Aerial photography	8 (66%)	Technology platforms (size of datasets and geographical distance from the PSGIH)
Topographic data	7 (58%)	Technology platforms (size of datasets and geographical distance from the PSGIH)
Satellite imagery	6 (50%)	Pricing policy and technology constraints
Fire potential	1 (8%)	Data accessibility

The additional PSGI is required to increase the economies of scope for the value added products and services. Interconnectedness of different PSGI value change provides an added dimension of potential end users (Vries & Miscione, 2010).

An access barrier analysis was not performed on these PSGI sets but the interviewees provided some insight into the application of the datasets and the constraints associated with this PSGI sets. The majority of PSGI that is associated with environmental PSGI are vector raster datasets that inherently higher level of technology requirements.

The satellite images and in particular the Spot 6 and 7 images had a high prevalence and exhibits great potential to assist in the development of value added products and service. Satellite images such as Spot 6 and 7 are commercial datasets and the public sector licensing policy excludes the private sector.

6.2.3 Access barriers

Identify the access barriers associated with the environmental PSGI

Only 10 of the constraint identified in the access barrier analysis Table 23 was identifies. Vickery indicated that different markets have different development stages and thus will have to content with constraints (2011).

Table 23: Access barrier analysis comparison

Access barriers	Environmental PSGI Application	Relevance n (17)
Accessibility	Yes	16 (84%)
Licensing policies	Not identified	
Completeness	Yes	11 (58%)
Usability	Yes	15 (79%)
Data Accuracy	Yes	15 (79%)
Data discovery portals	Not identified	
Metadata	Yes	17 (100%)
Data Formatting	Not identified	
Data maintenance	Yes	17 (100%)
Data quality	Yes	11 (58%)
Organisational structures & autonomy	Not identified	
Political context	Not identified	
Pricing policy	Yes	12 (63%)
Regulatory compliance	Not identified	
Reliability	Yes	12 (63%)
Response time	Not identified	
Standardised and transparent request procedures	Not identified	
Technological considerations	Yes	2 (11%)
Usability	Yes	15 (79%)

6.2.3.1 Cross cutting access barriers
Metadata

Certain access barriers constraints was identified over all the environmental PSGI. The first was the unavailability of metadata for PSGI in particular for environmental PSGI. The constraint level of the access barrier ranged between 3 and 5. Comments pertaining to the legislative frameworks such as the SASDI Act highlighted the

perceived apathy by the public sectors regarding its responsibility for the maintenance of metadata.

Even though South Africa had a legal framework and a coordinating body with reasonable political support it had not established a clearing house for data or metadata and had little stakeholder participation (Makanga & Smit, 2010). Rautenbanbach et al. (2012) further argued that a pattern of over ambitious, very complex and the fragmented nature of the SDI initiatives contributed to the failure of SDI initiatives.

Data maintenance and reliability

Data maintenance of environmental PSGI was identified as a considerable barrier to the development of value added products and services. Data maintenance relates to a formal program of updating and maintaining an environmental PSGI. The level of uncertainty increases if there are political or funding pressures.

There is a perceived bias in the PSGI provided in terms of the attributes that is maintained and the revisit time as the political agendas of the PSIH dictates its work plan (Bates, 2012b).

If there is an increase in transparency pertaining to the maintenance program of an environment PSGI the reliability will increase and the potential innovate and to create value added products and services.

Usability

The potential usability of the data is determined by the application of the environmental PDGI. Usability requires a PSIH to consider external requirements when designing and maintaining PSGI (Bates, 2012). The commercial sector indicated that this concept is foreign to the current custodians of PSGI and to certain extent to environmental PSGI.

Platforms such as SANBI's BGIS data portal and DEA's release of the ENPAT data in was an attempt to bridge the usability gap. Bit usability of PSGI is defined in terms of its market value or the potential to derive market value from a product generated from it (Bates, 2012). The potential integration of the PSGI with other product value chins provides and in particular technology platforms (Bates, 2012b; Cerrillo, 2012).

BGIS data portal provides for inter action with the data bur access to the underlying data is restricted. Houghton further argued that usability had a strong correlation with the accessibility of data (2011).

Accessibility

There is a wide variety of policy that informs the use, re-use and exclusive licensing practises that are being utilised to facilitate and manage access to PSGI (Bates, 2012b; Newbery et al., 2008).

"Except that we do not necessarily know that a dataset exists my ability to get hold of it is sometimes the biggest constraint. There is no standard way we can get hold of the data. So if you get hold of the right person, …. it does not mean that you will get the data."

The economic forces directing these policies do not facilitate accessibility (Cerrillo-i-martínez, 2012; Pollock, 2008). This approach has come under criticism from economists and data democracy activists alike (Pollock, 2008; Vickery, 2011).

6.2.4 Level of constraint
- Determine the level of constraint associated with these access barriers.

The level of constraint associated with these access barriers was identified based on feedback from the interviewees. Annexure G and H provides a tables indicating the level of constraint per environmental PSGI dataset. All access berries types were not associated with the prioritised environmental PSGI.

Figure 19: Constraint correlation with environmental PSGI

Environmental PSGI - Supply and demand correlation analysis
(Commercial organisations - Relevance ranking)
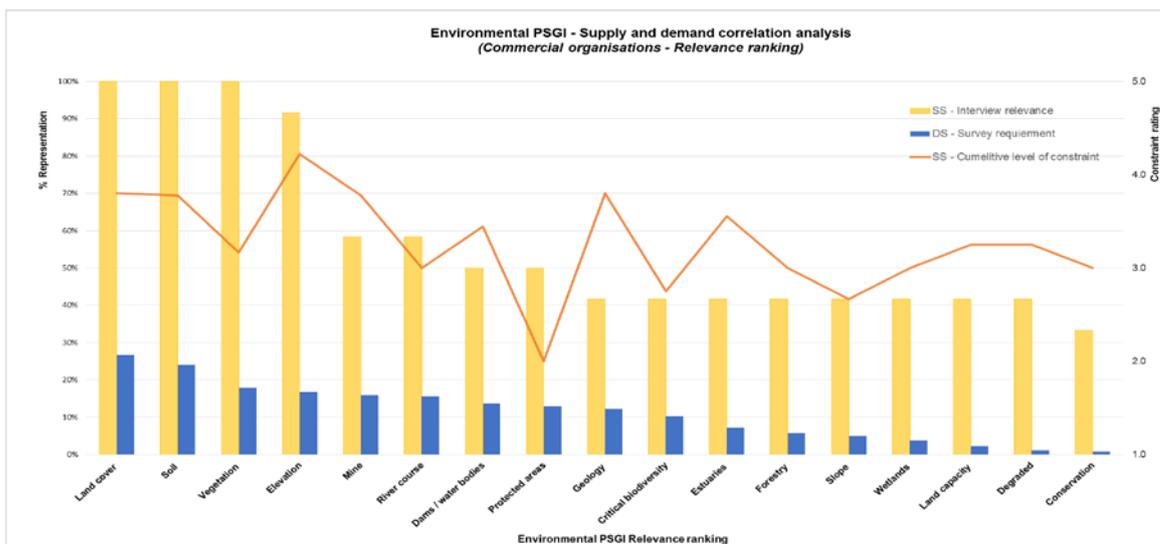
The level of constraint associated with the environmental PSGI provided an opportunity to triangulate the comments with current PSGIH initiatives. The results of the constraints analysis aligned to the current activity in the industry.

Table 24 provides feedback from the PSGI associated with the environmental PSGI under review. DAFF agricultural and forestry components, SANBI, CD:NGI and DEA provided feedback.

Table 24: PSIH initiatives

Environmental PSGI	Constraint level	PSIH initiatives
Land cover	3.8	Last national data set 2001. PSIH generates section of South Africa per year. Data maintenance is dependent on budget allocation
Soil	3.8	The PSGI has a statutory body that provides the data to all end users at a profit maximisation pricing policy. No national dataset.
Vegetation	3.2	This environmental PSGI set is maintained and accessible. The constraint relates to the usability due to the scale and additional attribute data such as red-species.
Elevation	4.2	The unavailability of a national dataset is the biggest contributor to this high level of constraint. The PSGIH is currently investigating potential commercial datasets to address the user requiems.
Mine	3.8	The PSGI has a statutory body that provides the data to all end users at a profit maximisation pricing policy.
River course	3.0	Custodianship is divided between two national public entities.
Dams / water bodies	3.4	Custodianship is divided between two national public entities.
Protected areas	2.0	The PSIH demonstrated a willingness to ensure the

Environmental PSGI	Constraint level	PSIH initiatives
		dataset is accessible and usable.
Geology	3.8	The PSGI has a statutory body that provides the data to all end users at a profit maximisation pricing policy.
Critical biodiversity	2.8	Dataset is available from a data portal but factors of usability was raised
Estuaries	3.6	The PSIH responsible for this dataset is not well known and data and associated metadata is scares.
Forestry	3.0	The PSIH is a small operational unit and even though the data usability is strong the problem of access still remains
Slope	2.7	Slope dataset is associated with the generation of elevation data. Thus the constraint correlation is expected. The constraint is exasperates by the fact that slope data is a legal requirement for EIA.
Wetlands	3.p	The ENFEPA dataset provides good quality hydrological data on a 1:500 000 scale. This relates to the requirements to address constraints such as data maintenance and usability.
Land capacity	3.3	The PSIH is currently addressing the requirement for increased accessibility and data maintenance. The data is currently under review. The usability remains a constraint due to the inherent complexity of the dataset.
Degraded	3.3	Degraded land dataset is associated with the generation of land cover data. Thus the constraint correlation is expected. An alternative dataset is available from the PSGIH. Unfortunately knowlige regarding the existence of this dataset is dependent on inter organisational relationships. This illustrates the requirement for metadata posted on an open platform
Conservation	3.o	The completeness of the dataset on a national level is a reality. Components of the dataset is compiled on a provincial level and requires dedicated coordination. The lack of metadata exasperates the problem.

6.2.5 Commercial sector strategic positioning

Determine the commercial sector strategic positioning of the value added products and services derived from environmental PSGI.

The strategic positioning of the commercial sector towards the development of value added products and services derived from environmental PSGI was assessed. The interviewees indicated that they followed different approaches towards their product and service with regards to the scope and client base.

There is a variance in the strategic approach within the different size groupings of the interviewees in relation to both the product and service deliver. In addition there is a differentiation based on their customer base. Only two of the commercial organisations created an independent value added product. Five additional commercial organisations created products as a support function when they provide value added services to end users.

Two organisations indicated that they are investing capital in to research and development of value added products. The organisations indicated the economies of scope and scale associated with value added products is higher and this is the driving forces for the investment. The remaining five commercial organisations considered themselves as service provider and focused on this market.

This pattern of servicing markets with specific products is the result of internal operational culture. Table provides additional strategic factors that impacts on the product and service offering. Internal cultural constraints such Professional registration of council requirements. The Geometrics Act. Restricts the association of registries professionals with in the stricter of the organisation. Table 25 illustrates the impact of association. This is evident from the lack of uptake of software development / programing and marketing and communication.

6.3   Demand side - Research proposition 2

End-user demand for innovative value added products and service derived from environmental PSGI.

The second phase of the research, as described in section 4.4, employed a quantitative approach to investigate the demand for value added products and services that are reliant on environmental PSI. The following constructs were used to define the end user demand:

- How do 'end-users' access environmental PSGI? And what is the motivating reason for 'end-users' access environmental PSGI in a certain way?
- Why do 'end-users' have specific preferences for value added products and services? And how do 'end-users' access these value added products and services?

- What environmental PSGI do 'end-users' access through the value added products and services?

The objective of the proposition is to determine the end-user demand for innovative value added products and service derived from environmental PSGI. This component focused on how "end-user" access environmental PSGI, why the preference, how often and, lastly, what environmental PSGI do they access.

Figure 18 indicates the market segments for the provision of products and internet based services to end-user. Question six of the online survey requested respondents to indicate their current data access platform. 263 responses were received for this section of the survey. 35.7% of respondents worked only with data in its native format. 10.6% of respondents exclusively used custom or proprietary product and 53.6% relied on a combination of data in its native format and custom or proprietary products.

Section 6.4.1.Environmental PSGI indicated that there is a 100% relevance correlation between the supply side and demand side ranking of environmental PSGI sets based.

6.3.1 Value-added products and services
- How do 'end-users' access value-added products and services??

35.7% of respondents accessed environmental PSGI in its native format. Table 26 indicates the selection rational. It is evident from the cumulative results that 88% of the respondents identified the following three reasons as their main selection drivers:

- Personal preference 37%
- System requirements 28%
- *(Un)* availability of products 23%.

Table 26: response rational – data in its native format

Access rational	Total Responses
Prefer to work with the raw data	37%
Internal system requirements datasets	28%
Data is not available through custom / proprietary product or service	23%
Do not have access to custom / proprietary products or services due to financial constraints	10%
Do not have access to custom / proprietary products or services due to technology constraints	6%
Other	3%

Figure 20: Choice rational organisational level
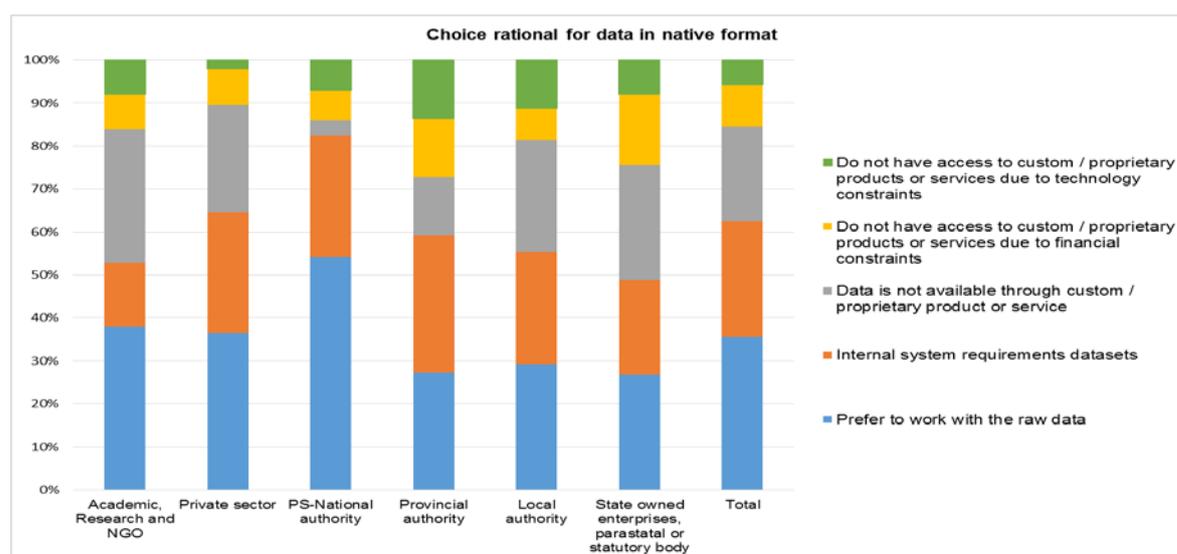
Table 24 and figure 24 provides insight in to the organisational approach to platform selection and in particular motivating factors for data in its native format. A requirement to work with data in its native format due to personal preference is the leading rational over all organisational types. This is a significant consideration when designing new value added products and associated services.

Personal preference as a motivating factor will inpact on the scope of usability and potential integration of products in subsequent stages of the product and service value chain (Bates, 2012b; Vickery, 2011).

6.3.2 Custom or proprietary technology products

- How do 'end-users' access environmental PSGI? And what is the motivating reason for 'end-users' access environmental PSGI in a certain way?

The current market that exclusively access environmental PSGI thru a custom or proprietary technology products is 10.6%. This is an under represented portion of the potential market. There is a 53% user base that prefers a combination of data and custom or proprietary product. Of the 53% user base only 20% are using custom products and the remaining 80% relies on proprietary products.

This pattern of activity suggests that a conservative estimation of the potential market would be there is a potential grout in the market of

- An increase from 20% to 42 % of the segment of combination platform users that constitutes 53% of the overall market. This increase can be realised though insuring the availability of prioritised environmental PSGI.
- 10.6% currently market that exclusively use environmental PSGI thru a custom or proprietary technology products is captured and should be maintained.

Interviewees indicated that end-users are reluctant to pay for products as their price elasticity of demand is high due to the lack of availability of commercial environment products. Furthermore the availability of free products such as Bing maps increases this price sensitivity of the general users. If the high level of specialisation of the potential end-users is considered (Table 16 and 17) it is evident that a market for specialised environmental products exists.

The alignment of products to increase in speciality will require a different approach to product development (Loenen & Zevenbergen, 2010). Current developments is concentrated on the collection, digitising and to a lesser extent modelling before it is release as a product on the custom or proprietary technology products. Figure 25 and 26 illustrate the activity levels required for custom and proprietary products

Figure 21: Value chain activities for custom products
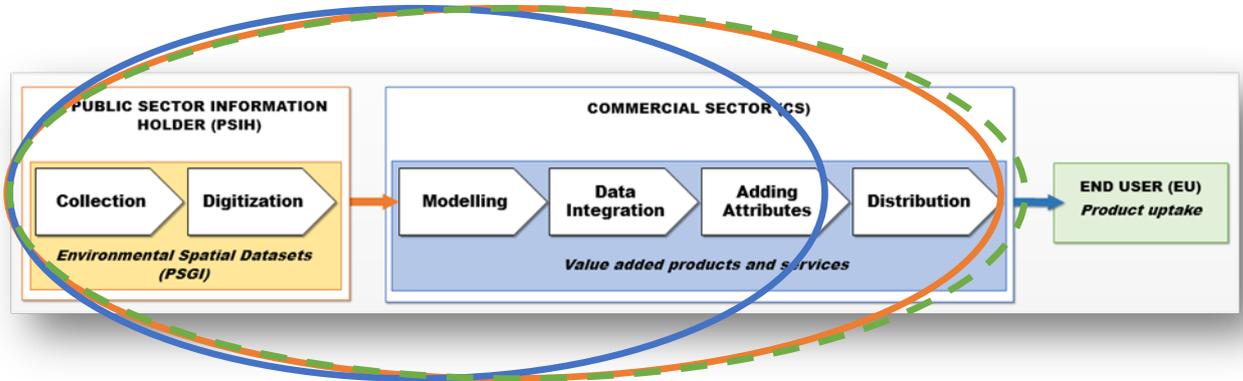
Platform description	*n*	Development level
SANBI BGIS	16	C,D, - M, GI, AA, D
AGIS	4	C,D, - M, GI, AA,
DWA Maps	1	C, D, M, D

Figure 22: Value chain activities for proprietary products
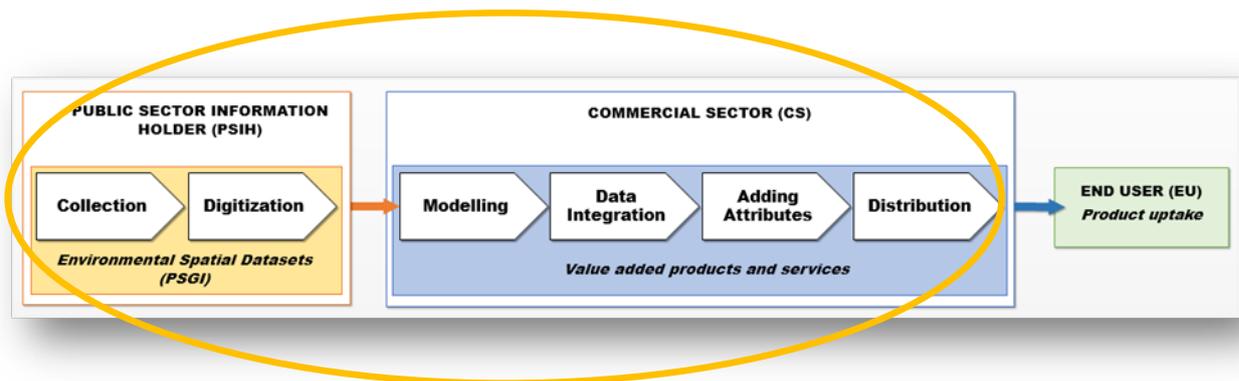
Platform description	*n*	Proprietary products
Google Earth	11	C,D, - M, GI, AA, D
ArcGIS Online	8	C,D, - M, GI, AA, D
SPISYS	1	C,D, - M, GI, AA, D

6.4　Economic opportunity - Research proposition 3

Establish if access barriers have an economic impact on the commercial sectors ability to create and maintain value added product and services.

The correlation analysis utilised the results of the supply side analysis indicating the environmental PSGI datasets required for added products and services in descending order of importance.　The demand side reflects the prevalence of environmental PSGI obtained from the online survey data analysis.　The final contribution is the trend line indicating the level of constraint associated with each environmental PSGI

Link the supply-side conceptual framework for access barriers to environmental PSGI with the prevalence of end-user requirements for value added products and services derived from environmental PSGI.　Figure 27 indicates the correlation between the requirement for environmental PSGI and the current level of constraint.　Section 6.3 provided evidence that predict a potential market opportunity for value added products and service derived from environmental PSGI.　It is crucial that the access constraints with the different environmental PSGI be addressed from the PSGIH side.

Figure 23: Supply and demand correlation
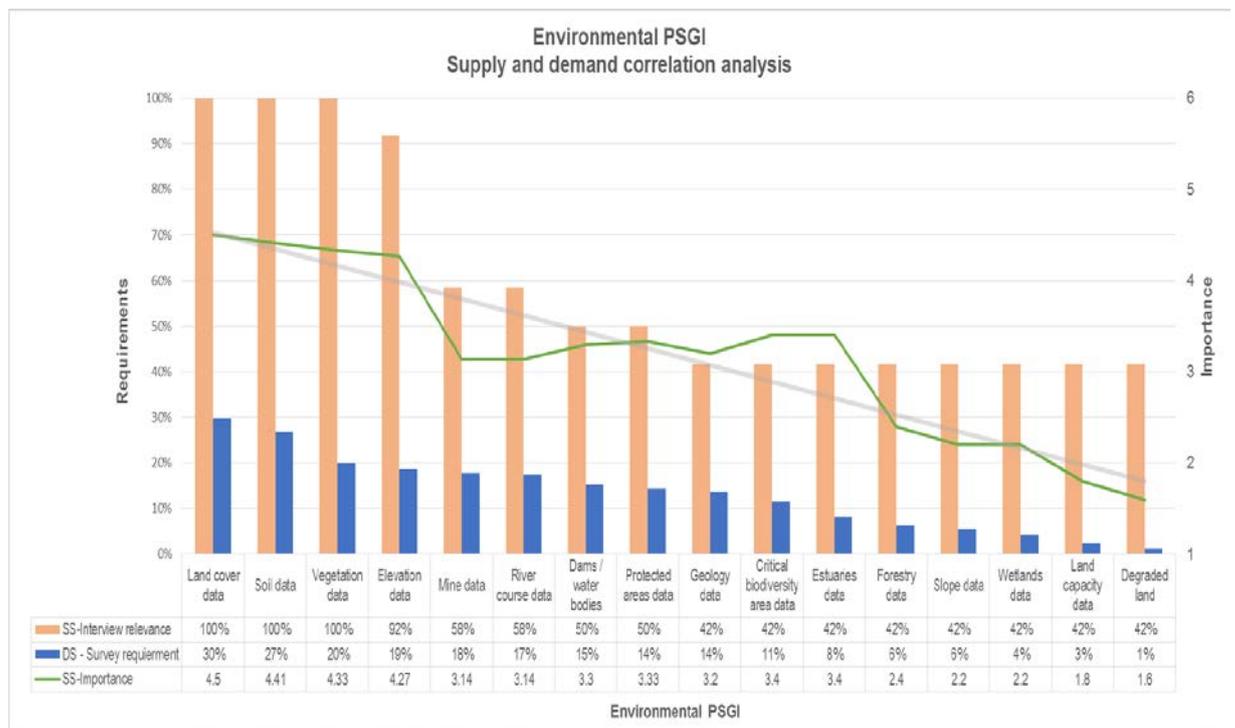
To ensure a sustainable market and maximise the opportunity to derive economic value from the environmental PSGI the principals of derivative alignment to PSGI value chain. Figure 8 provides clarity of the sequential process. Yalcin further argued that spatial component of PSGI is the primary driver of economic value (2014). The above mentioned factors provide the basis for end-users to attach greater value to these products and provides for value pricing of the products or services on offer (Genovese et al., 2010).

6.5   Conclusion of discussion of results:

The research provide for an integrated approach to validating the constraints associated with access barriers to environmental PSGI.

In reviewing the data characteristics the following key relations are evident:

There is a linear correlation between the relevance classification of the commercial organisations and end user requirement to access of environmental PSGI. Furthermore if the commercial organisations impotence criteria is used in conjunction with the end user requirements is still a 48% correlation of the environmental PSGI and in particular the top four datasets remains the same.

There is at least a potential market growth of 42% for custom technology products that require environmental PSGI. It would be adventurous if for the sustainability of the value added products or related services f these platforms provide a platform to access the data in its native format for download.

There is a high level of access barrier association with the significant environmental PSGI sets. In particular access barriers such as metadata and improved maintenance programs. Addressing these constraints will improve the perceived reliability of the datasets and potential uptake in to value added products and services.

In Europe, Australia, and the USA policy decision makers have unequivocally proven that pricing policy such as cost recover and profit maximisation have detrimental effects in the economy, the private sector and most importantly on the PSGI sets itself.

CHAPTER 7:   CONCLUSION

7.1 Introduction

The availability of PSI will induce the level of innovation in terms of value added product and service the commercial sector can offer and the product and service end user require. Notwithstanding the existence of PSGI, the inaccessibility of environmental PSGI to support activities such as environmental impact assessments (EIA) and strategic environmental assessments (SEA) was estimated will continue to exasperate the cost associated with these activities.

PSI important for economic growth of especially small economies through innovation of products and services. Information on potential development opportunities and new economic growth can only be realised if access is facilitated to the required PSGI. Develop opportunities have a duel benefit as it will create employment opportunities and additional tax revenue for the state.

Access barriers to PSI and in particular PSGI can be internal such as public sector information holder (PSIH) internal culture and standardisation of operational procedures are prominent themes in academic literature (Janssen & Kuczerawy, 2011; Pollock, 2008; Vries & Miscione, 2010). Outward facing access barriers such as inter-organisational relationships (IOR), lack of customer orientation and transparency of operating procedures is prevalent and exist in developed and developing countries.

7.2 Major findings

The research into environmental PSGI and the associated access barriers delivered the following major findings:

1. There is a linear correlation between the relevance classification of the commercial organisations and end user requirement to access of environmental PSGI. Furthermore if the commercial organisations importance criteria is used in conjunction with the end user requirements is still a 48% correlation of the environmental PSGI and in particular the top four datasets remains the same.

	Environmental PSGI (Importance)	Environmental PSGI (Relevance)
1	Land cover	Land cover
2	Soil	Soil
3	Vegetation	Vegetation
4	Elevation	Elevation

2. Access barriers associated with environmental SPGI have different constraint levels associated with the different environmental PSGI. But Metadata, data maintenance and accessibility is the most debilitating factors. (Extraction from Table 27: Environmental PSGI constraint level analysis)

	Access Barrier	Occurrence per PSGI	Range	Allocated constraint level
1	Metadata	17	5-3	3.9
2	Accessibility	16	5-3	3.6
3	Data maintenance	17	5-3	3.4
4	Reliability	12	5-2	3.0
5	Completeness	11	5-1	2.7
6	Usability	15	3	2.6
7	Data accuracy	15	4-2	2.4
8	Pricing policy	12	5-1	1.6
9	Data quality	11	1-4	1.4
10	Technological considerations	2	2	0.2

3. There is at least a potential market growth of 42% for custom technology products that require environmental PSGI. It would be adventurous if for the sustainability of the value added products or related services for these platforms provide a platform to access the data in its native format for download.

4. There is a high level of access barrier association with the significant environmental PSGI sets. In particular access barriers such as metadata and improved maintenance programs. Addressing these constraints will improve the perceived reliability of the datasets and potential uptake in to value added products and services.

7.3 Recommendations for PSIH

The SASDI act makes provision for the establishment of a metadata portal. By establishing the metadata portal it will invariable change the face of PSGI provisioning. In addition if the custodian prescript of the act is implemented and monitor the constraint associated with data maintenances issues will be minimised. This in turn will address the access barrier associated with the usability of PSGI.

The requirement for PSGI and in particular environmental PSGI is promenade feature in strategic developments such as the NDP. Without dedicated interventions the country will be unable to deliver on the citizens development requirements in a sustainable manner.

Harmonising of PSI and in particular PSGI information policies is required to ensure the pragmatic and sustainable delivery on the capital investment for PSGI. Initiatives such as the SASDI should be approached in a phased approached linking existing infrastructure rather than creating a new platform. The development of a SDI policy for the environmental sector will ensure a strategic and coherent approach to environmental PSGI management.

7.4 Recommendations for commercial sector

The commercial sector can position itself to derive substantial economic value from the available environmental PSGI. The current industry in South Africa is services orientated. Capital investment in research and development for potential products will be require. The economic potential cannot be realised if there is not a significant culture shift in the provisioning of value added products and services that require PSGI

7.5 Recommendation for future research

The focus of the study was limited to environmental PSGI. The study identified additional PSGI sets that contributes to the interconnected and integration of value chains. It would be adventurous to test the access barriers identified in this study in a broader sphere of PSGI sets. In addition an investigation in to the organisation's cultural approach to product delivery would provide insight in to externalities to the development of value added products and services derived from PSGI.

7.6 Conclusion

There exist unlimited opportunity to derive economic value from PSGI. This economic opportunity can only be realised if the economic benefits are acknowledged and act upon the opportunity by the PSIH that are responsible for PSGI. Measure such as legislation is in place and required the implementation and maintenance there off

By prioritising the environmental PSGI and a dedicated action plan for the associated access barriers as the basis for policy and an associated mitigating action plan. This approach will enable the PSIH to develop and implement short, medium and long term interventions for the listed barrier. It will be possible to monitor the impact of the access barriers to environmental PSGI over time.

The potential for job creation and creating a culture of innovation can be realise if the suggested approach of open PSI is adopted. Such an approach will benefit the country not only financially but also by developing an open culture to PSI provisioning.

REFERENCE LIST

Abor, J., & Quartey, P. (2010). Issues in SME Development in Ghana and South Africa. *International Research Journal of Finance and Economics*, *39*(39).

Ali, A., & Ahmad, M. (2009). Geospatial Data Sharing in Pakistan : Possibilities and Problems.

Bates, J. (2012a). Of the united kingdom' s open government data initiative. *Open Government Data Initiative*, (December).

Bates, J. (2012b). The politics of open government data: a neo-gramscian analysis of the united kingdom's open government data initiative. Manchester Metropolitan University.

Bates, J. (2014). The strategic importance of information policy for the contemporary neoliberal state: The case of Open Government Data in the United Kingdom. *Government Information Quarterly*.

Bank, E. (2004). Importance of open spatial data infrastructure for data sharing

Blower, J. D., Gemmell, A. L., Grif, G. H., Haines, K., Santokhee, A., & Yang, X. (2013). Environmental Modelling & Software Short communication A Web Map Service implementation for the visualization of multidimensional gridded environmental data q, *47*, 218–224. doi:10.1016/j.envsoft.2013.04.002

Castelein, W. T., Bregt, A. K., & Pluijmers, Y. (2010). The economic value of the Dutch geo-information sector ∗, *5*, 58–76. doi:10.2902/1725-0463.2010.05.art2

Cerrillo-i-martínez, A. (2012). The Reuse of Public Sector Information in Europe and Its Impact on Transparency Public Sector Information : The Evolution of Regulations Concerning Public Sector Information in Europe **, *18*(6), 770–792.

Cooper, A., Coetzee, S., Kourie, D., & Kaczmarek, I. (2012). Volunteered geographical information – the challenges. *PoPositionIT*, 34–38.

Cooper, S. A., Rautenbach, V., Owusu-banahene, W., Tewolde, N., Harvey, F., Iwaniak, A., … Kubik, T. (2013). Volunteered geographical information (VGI) for

spatial data infrastructures (SDIs) and geoportals Publications :, (January 2012), 2012. doi:10.1016/j.csi.2011.02.004.Iwona

Crompvoets, J., Rajabifard, A., & Loenen, B. Van. (2008.). *A Multi-View Framework to Assess SDIs.*

Denscombe, M. (2007). The Good Research Guide. Berkshire.

Fioretti, M. (2011). *Open Data : Emerging trends , issues and best practices. A research project about openness of public data in EU local administration* (pp. 1–34). Sant'Anna, Pisa.

Fleming, A. (2010). Geospatial data portals : librarians add expertise in the development of gis metadata catalogs.

Fornefeld, M., & Boele-Keimer, G. (2008). Assessment of the Re-use of Public Sector Information (PSI) in the Geographical information, Meteorological Information and Legal Information Sectors. *2011-12-20]. Http:// …, 49*(0). Retrieved from http://www.epsiplatform.eu/sites/default/files/ezpublish_media/micus_report_december2008.pdf

Genovese, E., Roche, S., Caron, C., Feick, R., Géomatiques, S., & Laval, U. (2010). The EcoGeo Cookbook for the assessment of Geographic Information value ∗, *5*, 120–144. doi:10.2902/1725-0463.2010.05.art5

Geographic, F., & Committee, D. (2014). National Spatial Data Infrastructure Strategic Plan, (December 2013).

Henninger, M. (2013). The value and challenges of public sector information. *Cosmopolitan Civil Societies: An Interdisciplinary Journal*, *5*(3), 75–96. doi:10.5130/ccs.v5i3.3429

Hines, J, R. (1998). *Three Sides of Harberger Triangles*.

Houghton, J. (2011). Costs and Benefits of Data Provision, (September).

Huijboom, N., & Broek, T. Van Den. (2011). Open data: an international comparison of strategies. *European Journal of ePractice*, (April), 1–13. Retrieved from http://www.epractice.eu/files/European Journal epractice Volume 12_1.pdf

Janssen, K., & Kuczerawy, A. (2011). Increasing the Availability of Spatial Data Held by Public Sector Bodies: Some Experiences and Guidelines. *ICRI Research Paper*, *7*, 249–276. doi:10.2902/1725-0463.2012.07.art13

Jasserand, C., Ll, M., & Hugenholtz, P. B. (2012). Using Copyright to Promote Access to Public Sector Information : A Comparative Survey by, (June).

Koski, H. (2011). Does marginal cost pricing of public sector information spur firm growth? Retrieved from http://www.econstor.eu/handle/10419/87764

Loenen, B. Van, & Zevenbergen, J. (2010). AAAssessing Geographic Information Enhancement. *International Journal Od Spatial Data Infrastructure Research*, *5*, 244–266. doi:10.2902/1725-0463.2010.05.art10

Lundvall, B.-A. (2009). Innovation as an Iteractive Process: User-Producer Interaction to the National System of Inovation. *African Journal of Science, Technology Inovation and Development (AJSTID)*, *1*(2), 10–34.

Makanga, P., & Smit, J. (2010). A Review of the Status of Spatial Data Infrastructure Implementation in Africa, (45), 18–25.

Mansourian, A., Omidi, E., Toomanian, A., & Harrie, L. (2011). Computers , Environment and Urban Systems Expert system to enhance the functionality of clearinghouse services. *Computers, Environment and Urban Systems*, *35*(2), 159–172. doi:10.1016/j.compenvurbsys.2010.06.003

May, J., & Lehohla, P. (2003). Counting the Costs of a 21 st Century Census : South Africa ' s Census 2001, (October).

Mayo, E., & Steinberg, T. (2007). The Power of Information : An independent review by, (June).

Newbery, D., Bently, L., & Pollock, R. (2008). Models of Public Sector Information Provision via Trading Funds Acknowledgments.

Nilsen, K. (2010). Economic theory as it applies to public sector information. *Annual Review of Information Science and Technology*, *44*(1), 419–489. doi:10.1002/aris.2010.1440440117

Pakhus, D. (2010). *The value of Danish address data* (pp. 1–8). Copenhagen, Denmark.

Paudyal, D. R., McDougall, K., & Apan, A. (2013). Developing spatial information sharing strategies across natural resource management communities.

Pollock, R. (2008). *The economics of public sector information* (pp. 1–50). Cambridge.

Pollock, R. (2013). Welfare gains from opening up Public Sector Information in the UK. *University of Cambridge, Undated, Accessed*, *0*(2009), 3–6. Retrieved from http://rufuspollock.org/papers/psi_openness_gains.pdf

Poplin, A. (2010). Methodology for Measuring the Demand Geo-information Transaction Costs: Based on Experiments in Berlin, Vienna and Zurich ∗, *5*, 168–193. doi:10.2902/1725-0463.2010.05.art7

Project, O., & Leuven, I. K. U. (2012). Increasing the Availability of Spatial Data held by Public Sector Bodies : Some Experiences and Guidelines from the, *7*, 249–276. doi:10.2902/1725-0463.2012.07.art13

Rautenbach, V., Coetzee, S., & Iwaniak, A. (2012). Orchestrating OGC web services to produce thematic maps in a spatial information infrastructure, 1–25.

Ricolfi, M., Drexl, J., Van Eechoud, M., Janssen, K., Maggiolino, M., Morando, F., ... & De Vries, M. (2011). The "Principles Governing Charging" for Re-Use of Public Sector Information. *European Thematic Network on Legal Aspects of Public Sector Information*, (105), 0–15.

Saunders, M., Lewis, P., & Thornhill, A. (2009). Reaserch methods for business students*, fifth edition*.

Shapiro, C., Varian, H. R., & Becker, W. E. (1999). Information rules: a strategic guide to the network economy. *Journal Of Economic Education*, *30*, 189-190.

Skoks, V., & Steurer, C. (2010). An Overview of the Use of GML in Modern Spatial Data Infrastructures, *44*, 60–67.

Smart, A. (2008). The Value of Spatial Information, (March).

Smart, A., & Craemer, R. (2009). Spatial information in the New Zealand economy Please contact :, (August).

Smithers, C. (2008). Managing geographic data as an asset : A case study in large scale data management by.

Spatial, N., Infrastructure, D., & Plan, S. (2014). National Spatial Data Infrastructure Strategic Plan, (December 2013).

Veenswijk, M. (2012). Unravelling Organizational Consequences of PSI Reform An In-depth Study of the Organizational Impact, (June).

Vickery, G. (2011). Review of recent studies on PSI re-use and related market developments. *Information Economics, Paris*. Retrieved from http://www.umic.pt/images/stories/publicacoes6/psi_final_version_formatted-1.pdf

Vries, W. T. De, & Miscione, G. (2010). Relationality in Geo-Information value . Price as product of. *International Journal of Spatial Data Infrastructure Research*, *5*, 77–95. doi:10.2902/1725-0463.2010.05.art3

Vuorio, R. (2013). *Use of public sector ' s open spatial data in commercial applications*. University of Oulu.

ANNEXURE A: SUPPLY SIDE INTERVIEW GUIDE AND QUESTIONNAIRE.

Gordon Institute of Business Science
University of Pretoria

Introduction

Good day, I am Nicolene Fourie and I am currently studying towards a Master of Business Administration degree at the Gordon Institute of Business Science (GIBS), Pretoria University. The focus of my study is to identify what access barriers exist and inhibit the ability of the commercial sector to create and maintain value added products and services by using public sector geospatial information (PSGI). This research will focus on the South African context and specifically on environmental data. The title of my research is: **The impact of access barriers on the commercial sector's ability to derive economic value from PSI.**

Our interview is expected to last about an hour and will assist in obtaining primary data on access barriers and will evaluate the level of constraint associated with these access barriers. To ensure that the interview time is used optimally I have compiled a survey to capture the generic questions. The interpretive sections (Qualitative investigation) of the research will be the focus of the interview.

Your participation is voluntary and you can withdraw at any time without penalty. All data will be kept confidential. By accepting this invitation, you indicate that you voluntarily participate in this research. If you have any concerns, please contact my supervisor or myself. Herewith are our contact details.

Researcher Name: Nicolene Fourie
Email: nfourie@environment.gov.za
Phone: 082 335 5689

Research Supervisor Name: Mike Holland
Email: mholland@pricemetrics.co.za
Phone: 082 495 1283

Signature of Participant:
Date:

Signature of Researcher:
Date:

A. Organisation overview:

Please provide the following information as an overview of your organisation.

1. **The size of organisation.**
    - ☐ Organisation with less than 5 workers
    - ☐ Organisation with 5-19 workers
    - ☐ Organisation with 20-99 workers
    - ☐ Organisation with 100 or more workers

2. **In which industry do you operate?**
    - ☐ Agriculture, including food security
    - ☐ Arts and culture
    - ☐ Civil Engineering
    - ☐ Climate change
    - ☐ Communication (Telecommunication)
    - ☐ Conservation
    - ☐ Construction
    - ☐ Defence and Intelligence
    - ☐ Disaster and Emergency Management
    - ☐ Economic development
    - ☐ Education
    - ☐ Energy
    - ☐ Environmental management
    - ☐ Financial
    - ☐ Forestry
    - ☐ Health Services
    - ☐ Heritage management
    - ☐ Housing
    - ☐ Labour
    - ☐ Land Administration and/or Land information systems
    - ☐ Law enforcement
    - ☐ Marketing
    - ☐ Minerals / Mining
    - ☐ Public works
    - ☐ Real Estate / Valuations
    - ☐ Science and technology
    - ☐ Social Welfare
    - ☐ Spatial planning and information (Urban and regional planning)
    - ☐ Sport and recreation
    - ☐ Statistics
    - ☐ Surveying
    - ☐ Tourism and recreation
    - ☐ Trade and industry
    - ☐ Transportation (road, rail, water and air)
    - ☐ Water resource management
    - ☐ Weather and Meteorology

3. **In which geographic area do you mainly operate?**
    - ☐ Municipal level

- ☐ Provincial
- ☐ National
- ☐ SADC Africa
- ☐ International

4. Indicate the core business of the organisation.
- ☐ Data analysis and interpretation
- ☐ Data acquisition / collection / collation
- ☐ Data management
- ☐ Data vendor
- ☐ Data warehousing
- ☐ Database administration
- ☐ Marketing and communication
- ☐ Planning
- ☐ Policy development and governance
- ☐ Project management
- ☐ Software development
- ☐ Spatial products development
- ☐ System analysis
- ☐ Training
- ☐ Visualization and mapping
- ☐ Development and reporting of EIA, EMF, SDF, specialist reports etc.
  Please provide details:
- ☐ Other. *Please indicate:*

This section should be completed by the component or line function that focuses on the provision of value added products and services that require spatial environmental PSI.

5. What is the size of component involved in creating and maintaining value added products and services derived from spatial environmental PSI.
- ☐ Component with less than 5 workers
- ☐ Component with 5-19 workers
- ☐ Component with 20-99 workers
- ☐ Component with 100 or more workers

6. What is the core business of the component?
- ☐ Data analysis and interpretation
- ☐ Data acquisition / collection / collation
- ☐ Data management
- ☐ Data vendor
- ☐ Data warehousing
- ☐ Database administration
- ☐ Marketing and communication
- ☐ Planning
- ☐ Policy development and governance
- ☐ Project management
- ☐ Software development
- ☐ Spatial products development
- ☐ System analysis
- ☐ Training
- ☐ Visualization and mapping
- ☐ Development and reporting of EIA, EMF, SDF, specialist reports etc.
  Please provide details:

☐   Other. *Please indicate:*

7. In which geographic area do you mainly operate?
☐   Municipal level
☐   Provincial
☐   National
☐   SADC
☐   Africa
☐   International

8. Indicate your client base.
☐   Private companies
☐   Academic and research institutions
☐   National departments
☐   Provincial department
☐   Local authority level
☐   Statutory body
☐   Government/para-statal
☐   Other. Please indicate:

B. Value added products and services overview:
SECTIONS IN PINK SHADING - The interpretive sections (Qualitative investigation) of the research will be the focus of the interview.

9. What revenue streams does your organisation use to generate income?
(E.g. tenders from private or public entities, SLA or customise products etc.)

Supply of value added products to end users.
10. What value added products *do you currently provide* that require spatial environmental PSI?
11. What constraints *do you currently face* in the provision of these value added products?
12. What *additional value added products* does your client base require that will use spatial environmental PSI?
13. What constraints *do you anticipate* in the provision of additional or new value added products?

Supply of services to end users.
14. What services *do you currently provide* that require spatial environmental PSI?
15. What constraints *do you currently face* in the provision of these services?
16. What *additional services* does your client base require that will use spatial environmental PSI?
17. What constraints *do you anticipate* in the provision of additional / new services?

C. Barrier analysis:

18. List at least 5 spatial environmental datasets (in order of importance) that you use to develop and maintain value added products and services.

	Dataset Title	Description	Scale	Extent (National, provincial etc.)	Sourced from
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

All datasets listed above will be evaluated using the process outlined below.

Data Set - 1 (1-10)	Title:				
19. Indicate the *importance of the datasets* you require to create and maintain value added products and services	Require the dataset 0 -20% of the time	Require the dataset 21% - 40% of the time	Require the dataset 41% - 60% of the time	Require the dataset 61% - 80% of the time	Require the dataset 81% - 100% of the time
20. The *following access barriers impact* on my ability to access PSI.	*Level of constraint associated with each access barrier*				
	Constraint level 1 0% -20%	Constraint level 2 21% - 40%	Constraint level 3 41% - 60%	Constraint level 4 60% - 80%	Constraint level 5 81% - 100%

21. Please provide context for the access barriers described above.

22. Do you have any other comments pertaining to access barriers that impact on your ability to obtain spatial environmental PSI?

D. Data acquisition analysis

23. What mechanisms do you use to inform you about old, current or new spatial environmental PSI?

24. What mechanisms do you use to obtain the required spatial environmental PSI?

25. When you obtain spatial environmental data from a PSIH, the data:
☐ Is ready for use in a value added product or service,
☐ Requires minimal intervention before you can use it in a value added product or service,
☐ Requires major intervention before you can use it in a value added product or service,
☐ Needs to be recaptured for use in a value added product or service (If so please complete question 26).

26. How do you recover the costs associated with the data capturing process?

ANNEXURE B: DEMAND SIDE END USER SURVEY.

Gordon Institute of Business Science
University of Pretoria

Introduction

Good day, I am Nicolene Fourie and I am currently studying towards a Master of Business Administration degree at the Gordon Institute of Business Science (GIBS) - Pretoria University. I am currently conducting research into spatial environmental data. The research will be limited to spatial environmental data in the South African context.

This component of the research assesses the current use and future requirement for spatial environmental Public Sector Information (PSI). Furthermore the survey aims to identify access constraints associated with spatial environmental PSI.

I would like to invite you to participate in this survey. The survey will take you no more than 15 minutes to complete and there are no costs to you. Your participation is voluntary and you can withdraw at any time without penalty. Of course, all data will be kept confidential. By completing the survey, you indicate that you voluntarily participate in this research. If you have any concerns, please contact myself or my supervisor. Herewith our contact details.

Researcher Name: Nicolene Fourie
Email: nfourie@environment.gov.za
Phone: 082 335 5689

Research Supervisor Name: Mike Holland
Email: mholland@pricemetrics.co.za
Phone: 082 495 1283

Please provide the following information as an overview.

1. **Indicate the size of the organisation you are associated with?** *(Please select 1 option)*

    ☐ Organisation with less than 5 workers
    ☐ Organisation with 5-19 workers
    ☐ Organisation with 20-99 workers
    ☐ Organisation with 100 or more workers

2. **In which industry / ies do you operate?** *(Please select all relevant options)*

    ☐ Agriculture, including food security
    ☐ Arts and culture
    ☐ Civil Engineering
    ☐ Climate change
    ☐ Communication (Telecommunication)
    ☐ Conservation
    ☐ Construction
    ☐ Defense and Intelligence
    ☐ Disaster and Emergency Management
    ☐ Economic development
    ☐ Education
    ☐ Energy
    ☐ Environmental management
    ☐ Financial
    ☐ Forestry
    ☐ Health Services
    ☐ Heritage management
    ☐ Housing
    ☐ Labour
    ☐ Land Administration and/or Land information systems
    ☐ Law enforcement
    ☐ Marketing
    ☐ Minerals / Mining
    ☐ Public works
    ☐ Real Estate / Valuations
    ☐ Science and technology

- ☐ Social Welfare
- ☐ Spatial planning and information (Urban and regional planning)
- ☐ Sport and recreation
- ☐ Statistics
- ☐ Surveying
- ☐ Tourism and recreation
- ☐ Trade and industry
- ☐ Transportation (road, rail, water and air)
- ☐ Water resource management
- ☐ Weather and Meteorology

3. Type of organisation that you work for. *(Please select 1 option)*

- ☐ Academic institutions
- ☐ Non-governmental organisation (NGO)
- ☐ Private sector
- ☐ Public sector – National authority
- ☐ Public sector – Provincial authority
- ☐ Public sector – Local authority
- ☐ Research institutions
- ☐ State owned enterprises, parastatal or statutory body *(E.g. ARC, DBSA, ESKOM, HSRC etc.)*.
- ☐ Other. Please indicate:

4. In which geographic extent do you mainly operate? *(Please select all relevant options)*

- ☐ Municipal level
- ☐ Provincial
- ☐ National
- ☐ SADC
- ☐ Africa
- ☐ International

5. Indicate your core business. *(Please select all relevant options)*

- ☐ Data analysis and interpretation
- ☐ Data acquisition / collection / collation
- ☐ Data management

- ☐ Data vendor
- ☐ Data warehousing
- ☐ Database administration
- ☐ Marketing and communication
- ☐ Planning
- ☐ Policy development and governance
- ☐ Project management
- ☐ Software development
- ☐ Spatial products development
- ☐ System analysis
- ☐ Training
- ☐ Visualization and mapping
- ☐ Environmental Impact assessments (EIA)
- ☐ Environmental management Frameworks (EMF)
- ☐ Spatial Development Frameworks (SDF)
- ☐ Other. *Please indicate:*

B. ACCESS PLATFORMS - Product and service.

This component of the research assesses the current and future requirements to spatial environmental PSI. Data can be used in its native format such as Shape file, Geodatabase, CAD files etc. Alternatively, spatial environmental data can be accessed through technology platforms such as map services or web services as custom products or proprietary product.

In this survey custom and proprietary product refer to the following scenarios:
- Custom product refers to custom made platforms (systems) such as BGIS and SPISYS. These services provide access to a variety of spatial data. These services are normally designed for a specific user base
- Proprietary product or service refers to proprietary platforms such as ArcGIS online, 1map, SAEON, Google Big maps etc. These services provide access to a variety of spatial data and have a variety interests and applications. These platforms are normally commercial products.

6. **How do you access the spatial environmental data that you require for your daily operations:**

   6.1

   - ☐ By using spatial environmental datasets in their native format (e.g. Shape file, Geodatabase, cad files etc.).
   6.2

☐ Through a custom or proprietary product (e.g. BGIS, SPISYS, ArcGIS online or Google Big maps etc.).

6.3

☐ A combination of datasets in their native formats and custom or proprietary product.

ACCESS PLATFORMS – Q6.1: DATA IN ITS NATIVE FORMAT

7. **Indicate the reason/s for using spatial datasets.**

☐ The data I require is not available through a custom / proprietary product or service.

☐ My internal system/s require access to datasets in their native format.

☐ I do not have access to custom / proprietary products or services due to ***technology constraints.***

☐ I do not have access to custom / proprietary products or services due to ***financial constraints.***

☐ I prefer to work with the raw data.

☐ Other – please indicate.

8. **Which spatial environmental datasets do you _currently_ use in its native format?** *If possible, please list at least 5 spatial environmental datasets.*

Dataset Title	Scale	Extent (National, provincial etc.)	How often would you use the dataset	How important is the dataset to your operations	Obtained from
☐ Conserved areas data ☐ Critical biodiversity areas data ☐ Dams / water body data ☐ Degraded land data ☐ Elevation data ☐ Estuaries data ☐ Forestry data ☐ Geology data ☐ Land capability data ☐ Land Cover data ☐ Mine data ☐ Protected areas data ☐ Rivers course data ☐ Slope data ☐ Soil type data ☐ Vegetation data ☐ Wetlands data	☐ 1:2 000 ☐ 1:10 000 ☐ 1:20 000 ☐ 1:50 000 ☐ 1:250 000 ☐ 1:500 000 ☐ 1:1 000 000	☐ Study area ☐ Municipal ☐ Provincial ☐ National	☐ Daily ☐ Weekly ☐ Monthly	☐ Limited importance (0 -20%) ☐ Moderately importance (21% - 40%) ☐ Important dataset (41% - 60%) ☐ Very important (61% - 80%) ☐ Crucial (81% - 100%)	☐ Custodian ☐ Vendor ☐ Personal network connection

9. **Do you require any _additional_ spatial environmental datasets?**

Dataset Title	Scale	Extent (National, provincial etc.)	How often would you use the dataset	How important is the dataset to your operations	Obtained from
☐ Conserved areas data ☐ Critical biodiversity areas data ☐ Dams / water body data ☐ Degraded land data ☐ Elevation data ☐ Estuaries data ☐ Forestry data ☐ Geology data ☐ Land capability data ☐ Land Cover data ☐ Mine data	☐ 1:2 000 ☐ 1:10 000 ☐ 1:20 000 ☐ 1:50 000 ☐ 1:250 000 ☐ 1:500 000 ☐ 1:1 000 000	☐ Study area ☐ Municipal ☐ Provincial ☐ National	☐ Daily ☐ Weekly ☐ Monthly	☐ Limited importance (0 -20%) ☐ Moderately importance (21% - 40%) ☐ Important dataset (41% - 60%) ☐ Very important (61% - 80%) ☐ Crucial (81% - 100%)	☐ Custodian ☐ Vendor ☐ Personal network connection

Dataset Title	Scale	Extent (National, provincial etc.)	How often would you use the dataset	How important is the dataset to your operations	Obtained from
☐ Protected areas data ☐ Rivers course data ☐ Slope data ☐ Soil type data ☐ Vegetation data ☐ Wetlands data					

10. How do you access the spatial environmental data that you require for your daily operations? (Please select the relevant option/s)

☐ Through a custom product (e.g. Internet services, BGIS, SPISYS etc.)

☐ Through a proprietary product (e.g. ArcGIS online, 1map, SAEON, Google Big maps etc.)

☐ Other (please specify)

11. List the custom or proprietary product/s you use.
12. Motivation for using the custom or proprietary product/s.
13. How often do you use the custom / proprietary products or services?

☐ Daily

☐ Weekly

☐ Monthly

14. What benefits do you derive from using the custom / proprietary products or services?
15. What constraints / drawbacks do you associate with the custom / proprietary products or services?
16. Which spatial environmental datasets do you <u>currently</u> access through a custom / proprietary product or service? Please list at least 5 spatial environmental datasets.

Dataset Title	Scale	Extent (National, provincial etc.)	How often would you use the dataset	How important is the dataset to your operations	Obtained from
☐ Conserved areas data ☐ Critical biodiversity areas data ☐ Dams / water body data ☐ Degraded land data	☐ 1:2 000 ☐ 1:10 000 ☐ 1:20 000 ☐ 1:50 000 ☐ 1:250 000 ☐ 1:500 000 ☐ 1:1 000 000	☐ Study area ☐ Municipal ☐ Provincial ☐ National	☐ Daily ☐ Weekly ☐ Monthly	☐ Limited importance (0 -20%) ☐ Moderately importance (21% - 40%) ☐ Important dataset (41% - 60%)	☐ Custodian ☐ Vendor ☐ Personal network connection

☐ Elevation data ☐ Estuaries data ☐ Forestry data ☐ Geology data ☐ Land capability data ☐ Land Cover data ☐ Mine data ☐ Protected areas data ☐ Rivers course data ☐ Slope data ☐ Soil type data ☐ Vegetation data ☐ Wetlands data				☐ Very important (61% - 80%) ☐ Crucial (81% - 100%)	

17. Do you require access to any _additional_ spatial environmental datasets through a custom / proprietary product or service? _Please select the relevant options._

Dataset Title	Scale	Extent (National, provincial etc.)	How often would you use the dataset	How important is the dataset to your operations	Obtained from
☐ Conserved areas data ☐ Critical biodiversity areas data ☐ Dams / water body data ☐ Degraded land data ☐ Elevation data ☐ Estuaries data ☐ Forestry data ☐ Geology data ☐ Land capability data ☐ Land Cover data ☐ Mine data ☐ Protected areas data ☐ Rivers course data ☐ Slope data ☐ Soil type data ☐ Vegetation data ☐ Wetlands data	☐ 1:2 000 ☐ 1:10 000 ☐ 1:20 000 ☐ 1:50 000 ☐ 1:250 000 ☐ 1:500 000 ☐ 1:1 000 000	☐ Study area ☐ Municipal ☐ Provincial ☐ National	☐ Daily ☐ Weekly ☐ Monthly	☐ Limited importance (0 -20%) ☐ Moderately importance (21% - 40%) ☐ Important dataset (41% - 60%) ☐ Very important (61% - 80%) ☐ Crucial (81% - 100%)	☐ Custodian ☐ Vendor ☐ Personal network connection

ACCESS PLATFORMS – Q6.3: COMBINATION OF DATASETS IN THEIR NATIVE FORMATS AND CUSTOM OR PROPRIETARY PRODUCTS

A compilation of questions 7 to 17 was presented as questions 18 to 28 if this option was selected.

D. Additional comments.

29.   Do you have any additional comments pertaining to your ability to obtain spatial environmental data?

ANNEXURE C: INTERVIEW PARTICIPANTS

Name	Institution	Position	Org. Size
Graeme Engelbrecht	IDS	Director / Owner	Small < 5
Paul Classen	Environomics	Director	Small < 5
Rob Hicks	Teniti Ecotourism	Director	Small < 5
Willem de Frey	EkoInfo cc.	Director / Owner	Small < 5
James Brodie	LRI – Land Resources International	Director	Micro 5-19
Julian Conraad	GEOSS	Director / Owner	Micro 5-19
Stuart Martin	GeoTerraImage (Pty) Ltd	Director	Micro 5-19
Arno Otterman	PULA	Director / Owner	Medium 20-99
Garreth Champion	Agreenco – Environmental Projects	Project Management	Large > 100
Paul Lochner	CSIR	Project Management	Large > 100
Prof Adriaan van Niekerk	CGA – Centre for Geographical Analysis	Director	Large > 100
Zelda Els	Aurecon Consulting Engineers	Associate	Large > 100

ANNEXURE D: ENVIRONMENTAL PSGI REQUIERMENTS

Environmental PSGI	Number of times identified	Environmental PSGI	Number of times identified
Land cover data	*12*	Evaporation	2
Soil data	*12*	Heritage sites	2
Vegetation data	*12*	Land use	2
Elevation data	*11*	Spot building count	2
Mine data	*7*	Water management areas	2
River course data	*7*	Agricultural Potential map	1
Dams / water bodies	*6*	Air pollution	1
Protected areas data	*6*	Biodiversity conservation plans	1
Critical biodiversity area data	*5*	Conservation Plans	1
Degraded land	*5*	Drainage regions	1
Estuaries data	*5*	Field crop boundaries	1
Forestry data	*5*	Fire data	1
Geology data	*5*	Fishing	1
Land capacity data	*5*	Grazing Capacity	1
Slope data	*5*	Groundwater	1
Wetlands data	*5*	Hunting	1
Conservation data	*4*	Irrigated Land	1
Agriculture	3	Land Capability	1
Biomes	3	Land Cover Change Map	1
Climate data	3		

ANNEXURE E: INDUSTRY THAT RESPONDENTS OPERATE IN.

	Academic Research NGO	Private sector	Public sector			State owned enterprises, parastatal or statutory body	Total
			National authority	Provincial authority	Local authority		
Environmental management	7	71	11	5	9	8	111
Surveying	1	41	8	3	7	10	70
Civil Engineering	1	40	1	1	6	7	56
Spatial planning and information (urban and regional planning)	2	30	6	5	10	1	54
Other	3	28	7	1	7	5	51
Land Administration and/or Land information systems	1	20	9	6	7	5	48
Water resource management	5	27	3	2	6	3	46
Conservation	7	19	5	2	5	4	42
Energy	3	17	1	1	4	14	40
Minerals / Mining	2	29	-	-	-	3	34
Construction	2	22	2	2		3	31
Transportation (road, rail, water and air)	1	17	-	2	4	4	28
Agriculture, including food security	4	16	4	-	1	1	26
Disaster and Emergency Management	3	12	2	2	5	2	26
Housing	1	15	-	1	6	1	24
Climate change	2	10	1	2	1	2	18
Economic development	2	6	-	1	5	2	16
Public works	-	10	1	1	4	-	16
Forestry	2	10	3	-	-	-	15
Real Estate / Valuations	-	6	-	-	3	5	14
Science and technology	5	8	-	-	-	1	14
Health Services	2	6	1	-	4	-	13
Tourism and recreation	1	6	-	1	3	1	12
Defense and Intelligence	2	5	2	1	-	1	11
Education	6	2	-	-	-	1	9
Heritage management	1	4	-	1	3	-	9
Communication (Telecommunication)	2	4	1	-	-	1	8
Law enforcement	-	3	-	-	4	-	7
Weather and Meteorology	3	4	-	-	-	-	7
Financial	-	3	-	-	2		5
Marketing	-	3	-	-	1	1	5
Social Welfare	-	1	1	1	2	-	5
Statistics	1	2	2	-	-	-	5
Trade and industry	1	2	-	-	1	1	5
Arts and culture	1				2		3
Labour	-	1	-	-	1	-	2
Sport and recreation	-	-	-	-	2	-	2

ANNEXURE F: COMMERCIAL SECTOR DATA MATRIX

Environmental PSGI	Land cover data			Soil data			Vegetation data			Elevation data			Mine data			River course data		
Importance ranking	1			2			3			4			5			6		
Survey relevance	12			12			12			11			7			7		
Importance	4.50			4.41			4.33			4.27			3.14			3.14		
Importance (Construct)	4,4,5,4,5,5,4,5,4,4,5,5,			4,4,5,4,5,5,4,5,4,4,5,4,			5,4,5,4,5,5,4,5,4,4,3,4,			4,4,5,4,5,5,4,5,4,4,3			1,4,5,3,4,2,3			5,2,2,3,2,5,3		
Constraints type and associated level of constraint (5 (High) - 1 (Low)	Completeness	C	5	Completeness	C	5	Accessibility	A	5	Completeness	C	5	Completeness	C	5	Reliability	R	5
	Data maintenance	DM	5	Reliability	R	5	Data accuracy	DA	4	Data maintenance	DM	5	Metadata	M	5	Metadata	M	4
	Metadata	M	5	Accessibility	A	4	Usability	U	4	Metadata	M	5	Reliability	R	5	Accessibility	A	3
	Reliability	R	5	Data maintenance	DM	4	Metadata	M	3	Reliability	R	5	Data maintenance	DM	4	Completeness	C	3
	Accessibility	A	4	Metadata	M	4	Data maintenance	DM	2	Data accuracy	DA	4	Pricing policy	PP	4	Data accuracy	DA	3
	Pricing policy	PP	4	Pricing policy	PP	4	Data quality	DQ	1	Data quality	DQ	4	Accessibility	A	3	Data maintenance	DM	3
	Usability	U	4	Data accuracy	DA	3	-	-	-	Usability	U	4	Data quality	DQ	3	Usability	U	3
	Data accuracy	DA	3	Usability	U	3	-	-	-	Accessibility	A	3	Usability	U	3	Technological considerations	TC	2
	Technological considerations	TC	2	Data quality	DQ	2	-	-	-	Pricing policy	PP	3	Data accuracy	DA	2	Pricing policy	PP	1
	Data quality	DQ	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Environmental PSGI	Dams / water bodies			Protected areas data			Geology data			Critical biodiversity area data			Estuaries data			Forestry data		
Importance ranking	7			8			9			10			11			12		
Survey relevance	6			6			5			5			5			5		
Importance	3.3			3.33			3.2			3.4			3.4			2.4		
Importance (Construct)	2,3,2,4,5,4			5,4,3,2,4,2			2,4,3,4,5			5,4,4,2,2			1,4,5,3,4,			2,3,3,3,1		
Constraints type and associated level of constraint (5 (High) - 1 (Low)	Completeness	C	5	Metadata	M	3	Pricing policy	PP	5	Completeness	C	4	Completeness	C	5	Accessibility	A	4
	Metadata	M	5	Data Accuracy	DA	2	Accessibility	A	4	Accessibility	A	3	Data maintenance	DM	5	Data maintenance	DM	3
	Reliability	R	5	Data maintenance	DM	2	Data maintenance	DM	4	Data maintenance	DM	3	Metadata	M	5	Metadata	M	3
	Accessibility	A	4	Reliability	R	2	Metadata	M	4	Metadata	M	3	Reliability	R	5	Data quality	DQ	2
	Data accuracy	DA	3	Usability	U	1	Data quality	DQ	2	Reliability	R	3	Accessibility	A	3	-	-	-
	Data maintenance	DM	3	-	-	-	-	-	-	Usability	U	3	Usability	U	3	-	-	-
	Usability	U	3	-	-	-	-	-	-	Data accuracy	DA	2	Data accuracy	DA	2	-	-	-
	Data quality	DQ	2	-	-	-	-	-	-	Pricing policy	PP	1	Data quality	DQ	2	-	-	-
	Pricing policy	PP	1	-	-	-	-	-	-	-	-	-	Pricing policy	PP	2	-	-	-

Environmental PSGI	Slope data			Wetlands data			Land capacity data			Degraded land			Conservation data		
Importance ranking	13			14			15			16			17		
Survey relevance	5			5			5			5			4		
Importance	2.2			2.2			1.8			1.6			2.25		
Importance (Construct)	2,2,3,1,3			2,2,3,1,3			1,2,2,3,1			1,1,2,1,3			2,3,3,1		
Constraints type and associated level of constraint (5 (High) - 1 (Low)	Accessibility	A	4	Accessibility	A	4	Accessibility	A	5	Reliability	R	5	Accessibility	A	4
	Data maintenance	DM	3	Data maintenance	DM	4	Reliability	R	4	Metadata	M	4	Completeness	C	4
	Metadata	M	3	Metadata	M	3	Metadata	M	4	Completeness	C	4	Data accuracy	DA	4
	Data accuracy	DA	2	Usability	U	3	Consistency	C	4	Accessibility	A	3	Data maintenance	DM	3
	Data quality	DQ	2	Data accuracy	DA	2	Data maintenance	DM	3	Data accuracy	DA	3	Metadata	M	3
	Usability	U	2	Data quality	DQ	2	Usability	U	3	Data maintenance	DM	3	Usability	U	3
	-	-	-	-	-	-	Data accuracy	DA	2	Usability	U	3	Reliability	R	2
	-	-	-	-	-	-	Pricing policy	PP	1	Pricing policy	PP	1	Pricing policy	PP	1

ANNEXURE G: LEVEL OF CONSTRAINT PER ENVIRONMENTAL PSGI

Environmental PSGI	Access Barrier	Code	Level of constraint	Environmental PSGI	Access Barrier	Code	Level of constraint	Environmental PSGI	Access Barrier	Code	Level of constraint	Environmental PSGI	Access Barrier	Code	Level of constraint	Environmental PSGI	Access Barrier	Code	Level of constraint
3	Accessibility	A	5	1	Completeness	C	5	3	Data accuracy	DA	4	1	Data maintenance	DM	5	4	Data quality	DQ	4
15	Accessibility	A	5	2	Completeness	C	5	4	Data accuracy	DA	4	4	Data maintenance	DM	5	5	Data quality	DQ	3
1	Accessibility	A	4	4	Completeness	C	5	17	Data accuracy	DA	4	11	Data maintenance	DM	5	2	Data quality	DQ	2
2	Accessibility	A	4	5	Completeness	C	5	1	Data accuracy	DA	3	2	Data maintenance	DM	4	7	Data quality	DQ	2
7	Accessibility	A	4	7	Completeness	C	5	2	Data accuracy	DA	3	5	Data maintenance	DM	4	9	Data quality	DQ	2
9	Accessibility	A	4	11	Completeness	C	5	6	Data accuracy	DA	3	9	Data maintenance	DM	4	11	Data quality	DQ	2
12	Accessibility	A	4	10	Completeness	C	4	7	Data accuracy	DA	3	14	Data maintenance	DM	4	12	Data quality	DQ	2
13	Accessibility	A	4	15	Completeness	C	4	16	Data accuracy	DA	3	6	Data maintenance	DM	3	13	Data quality	DQ	2
14	Accessibility	A	4	16	Completeness	C	4	5	Data accuracy	DA	2	7	Data maintenance	DM	3	14	Data quality	DQ	2
17	Accessibility	A	4	6	Completeness	C	3	8	Data Accuracy	DA	2	10	Data maintenance	DM	3	1	Data quality	DQ	1
4	Accessibility	A	3	7	Completeness	C	1	10	Data accuracy	DA	2	12	Data maintenance	DM	3	3	Data quality	DQ	1
5	Accessibility	A	3					11	Data accuracy	DA	2	13	Data maintenance	DM	3				
6	Accessibility	A	3					13	Data accuracy	DA	2	15	Data maintenance	DM	3				
10	Accessibility	A	3					14	Data accuracy	DA	2	16	Data maintenance	DM	3				
11	Accessibility	A	3					15	Data accuracy	DA	2	17	Data maintenance	DM	3				
16	Accessibility	A	3									3	Data maintenance	DM	2				
												8	Data maintenance	DM	2				
Total			16	Total			11	Total			15	Total			17	Total			11

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Environmental PSGI	Access Barrier	Code	Level of constraint	Environmental PSGI	Access Barrier	Code	Level of constraint	Environmental PSGI	Access Barrier	Code	Level of constraint	Environmental PSGI	Access Barrier	Code	Level of constraint	Environmental PSGI	Access Barrier	Code	Level of constraint
1	Metadata	M	5	9	Pricing policy	PP	5	1	Reliability	R	5	1	Technological considerations	TC	2	1	Usability	U	4
4	Metadata	M	5	1	Pricing policy	PP	4	2	Reliability	R	5	6	Technological considerations	TC	2	3	Usability	U	4
5	Metadata	M	5	2	Pricing policy	PP	4	4	Reliability	R	5					4	Usability	U	4
7	Metadata	M	5	5	Pricing policy	PP	4	5	Reliability	R	5					2	Usability	U	3
11	Metadata	M	5	4	Pricing policy	PP	3	6	Reliability	R	5					5	Usability	U	3
2	Metadata	M	4	11	Pricing policy	PP	2	7	Reliability	R	5					6	Usability	U	3
6	Metadata	M	4	6	Pricing policy	PP	1	11	Reliability	R	5					7	Usability	U	3
9	Metadata	M	4	7	Pricing policy	PP	1	16	Reliability	R	5					10	Usability	U	3
15	Metadata	M	4	10	Pricing policy	PP	1	15	Reliability	R	4					11	Usability	U	3
16	Metadata	M	4	15	Pricing policy	PP	1	10	Reliability	R	3					14	Usability	U	3
3	Metadata	M	3	16	Pricing policy	PP	1	8	Reliability	R	2					15	Usability	U	3
8	Metadata	M	3	17	Pricing policy	PP	1	17	Reliability	R	2					16	Usability	U	3
10	Metadata	M	3													17	Usability	U	3
12	Metadata	M	3													13	Usability	U	2
13	Metadata	M	3													8	Usability	U	1
14	Metadata	M	3																
17	Metadata	M	3																
Total			17	Total			12	Total			12	Total			2	Total			15

ANNEXURE H: CORE BUSINESS

	Academic Research NGO	Private sector	Public sector			State owned enterprises, parastatal or statutory body	Total
			National authority	Provincial authority	Local authority		
Data acquisition / collection / collation	41.20%	49.30%	51.30%	73.30%	66.70%	57.10%	53.00%
Data analysis and interpretation	52.90%	48.60%	41.00%	73.30%	66.70%	45.70%	50.40%
Data management	23.50%	38.40%	33.30%	73.30%	62.50%	42.90%	41.40%
Visualization and mapping	29.40%	39.10%	41.00%	33.30%	50.00%	45.70%	40.30%
Planning	35.30%	30.40%	38.50%	46.70%	62.50%	51.40%	38.40%
Project management	29.40%	40.60%	17.90%	40.00%	41.70%	31.40%	35.40%
EIA	23.50%	43.50%	2.60%	6.70%	4.20%	22.90%	28.00%
Spatial products development	23.50%	26.10%	23.10%	40.00%	20.80%	17.10%	24.60%
SDF	29.40%	21.70%	25.60%	33.30%	20.80%	8.60%	21.60%
Database administration	11.80%	14.50%	20.50%	46.70%	45.80%	25.70%	21.30%
Training	29.40%	17.40%	15.40%	20.00%	33.30%	25.70%	20.50%
EMF	23.50%	23.20%	2.60%	13.30%	8.30%	14.30%	17.20%
Data warehousing	5.90%	8.00%	5.10%	20.00%	25.00%	14.30%	10.40%
Software development	5.90%	15.90%	-	13.30%	-	5.70%	10.10%
Policy development and governance	29.40%	4.30%	12.80%	6.70%	16.70%	8.60%	9.00%
System analysis	11.80%	8.70%	2.60%	13.30%	16.70%	8.60%	9.00%
Data vendor	-	10.10%	12.80%	6.70%		5.70%	8.20%
Other	-	3.60%	-	6.70%	4.20%	5.70%	3.40%
Marketing and communication	5.90%	4.30%	-	-	4.20%	-	3.00%

ANNEXURE I: ACCESS PLATFORM RATIONAL

1. Selection rational for data in its native format

	Academic Research NGO	Private sector	Public sector			State owned enterprises, parastatal or statutory body	Total
			National authority	Provincial authority	Local authority		
Prefer to work with the raw data	33%	35%	46%	46%	36%	33%	37%
Internal system requirements datasets	13%	27%	24%	54%	32%	27%	28%
Data is not available through custom / proprietary product or service	27%	24%	3%	23%	32%	33%	23%
Do not have access to custom / proprietary products or services due to financial constraints	7%	8%	6%	23%	9%	20%	10%
Do not have access to custom / proprietary products or services due to technology constraints	7%	2%	6%	23%	14%	10%	6%
Other				33%	10%		3%

ANNEXURE J: ENVIRONMENTAL PSGI PER ACCESS PLATFORM.

Question 6. How do you access the spatial environmental data that you require for your daily operations? Cross tabulated with Question 8. Which spatial environmental datasets do you currently use in its native format?			
Environmental PSGI	(1) Spatial environmental datasets in native form	(3) Combination (native & custom)	Total
Land Cover data	32	38	*70*
Elevation data	26	37	*63*
Dams / water body data	13	34	*47*
Conserved areas data	13	31	*44*
Protected areas data	21	21	*42*
Critical biodiversity areas data	12	29	*41*
Vegetation data	13	23	*36*
Wetlands data	10	24	*34*
Rivers course data	11	21	*32*
Geology data	8	19	*27*
Land capability data	5	14	19
Soil type data	6	9	15
Mine data	6	7	13
Slope data	6	4	10
Forestry data	1	5	6
Estuaries data	0	3	3
Degraded land data	1	1	2

Question 6. How do you access the spatial environmental data that you require for your daily operations? Cross tabulated with Question 9. Do you require any additional spatial environmental datasets?			
Environmental PSGI	(1) Spatial environmental datasets in native form	(3) Combination (native & custom)	Total
Land Cover data	10	14	*24*
Slope data	11	10	*21*
Degraded land data	6	12	*18*
Geology data	6	12	*18*
Protected areas data	5	10	*15*
Vegetation data	4	11	*15*
Soil type data	6	8	*14*
Wetlands data	4	10	*14*
Elevation data	5	8	*13*
Critical biodiversity areas data	3	9	*12*
Rivers course data	6	6	*12*
Mine data	6	5	11
Forestry data	5	5	10
Land capability data	6	4	10
Dams / water body data	2	5	7
Conserved areas data	2	4	6
Estuaries data	0	2	2

ANNEXURE K: ENVIRONMENTAL PSGI PER ORGANISATION.

Environmental PSGI	n	Academic/ Research/ NGO	Private sector	Public sector National authority	Public sector Provincial authority	Public sector Local authority	State owned enterprises, parastatal or statutory body	Total
Land Cover data	n	3	28	14	8	5	12	*70*
Elevation data	n	7	34	6	3	4	9	*63*
Dams / water body data	n	6	18	8	2	3	10	*47*
Conserved areas data	n	2	27	4	2	3	6	*44*
Protected areas data	n	4	15	7	4	3	9	*42*
Critical biodiversity areas data	n	1	22	4	4	4	6	*41*
Vegetation data	n	5	15	3	4	1	8	*36*
Wetlands data	n	1	18	1	3	3	8	*34*
Rivers course data	n	3	18	3	2	1	5	*32*
Geology data	n	2	17	2	2	1	3	*27*
Land capability data	n	-	11	3	3	1	1	19
Soil type data	n	1	9	3	1	2	-	15
Mine data	n	-	8	1	1	-	3	13
Slope data	n	1	6	1	-	-	2	10
Forestry data	n	-	4	2	-	-	-	6
Degraded land data	n	-	1	1	-	-	-	2
Estuaries data	n	-	3	-	-	-	-	2

Question 8. Which spatial environmental datasets do you currently use *in its native format? Cross tabulated with Question 3. Type of organisation that you are affiliated to.*

Environmental PSGI	n	Academic/ Research/ NGO	Private sector	Public sector National authority	Public sector Provincial authority	Public sector Local authority	State owned enterprises, parastatal or statutory body	Total
Land Cover data	n	1	7	2	1	6	7	*24*
Slope data	n	1	10	2	3	1	4	*21*
Degraded land data	n	-	7	3	2	1	5	*18*
Geology data	n	1	8	3	-	1	5	*18*
Protected areas data	n	1	9	1	-	1	3	*15*
Vegetation data	n	1	9	1	3	-	1	*15*
Soil type data	n	1	5	2	3	-	3	*14*
Wetlands data	n	-	7	4	-	1	2	*14*
Elevation data	n	-	5	2	-	3	3	*13*
Critical biodiversity areas data	n	2	6	1	1	-	2	*12*
Rivers course data	n	1	5	1	3	1	1	*12*
Mine data	n	2	2	1	1	1	4	11
Forestry data	n	-	7	1	2	-	-	10
Land capability data	n	-	5	1	1	1	2	10
Dams / water body data	n	-	5	-	2	-	-	7
Conserved areas data	n	-	2	2	2	-	-	6
Estuaries data	n	-	-	1	1	-	-	2

Question 9. Do you require any additional spatial environmental datasets*? Cross tabulated with Question 3. Type of organisation that you are affiliated to.*

ANNEXURE L: CORRELATION ANALYSIS OF SUPPLY AND DEMAND REQUIREMENTS

Environmental PSGI - Supply and demand correlation analysis
(Commercial organisations - Relevance ranking)

	Land cover	Soil	Vegetation	Elevation	Mine	River course	Dams / water bodies	Protected areas	Geology	Critical biodiversity	Estuaries	Forestry	Slope	Wetlands	Land capacity	Degraded	Conservation
SS - Interview relevance	100%	100%	100%	92%	58%	58%	50%	50%	42%	42%	42%	42%	42%	42%	42%	42%	33%
DS - Survey requierment	27%	24%	18%	17%	16%	16%	14%	13%	12%	10%	7%	6%	5%	4%	2%	1%	1%
SS - Importance	4.5	4.41	4.33	4.27	3.14	3.14	3.3	3.33	3.2	3.4	3.4	2.4	2.2	2.2	1.8	1.6	2.25
SS - Cumelitive level of constraint	3.8	3.8	3.2	4.2	3.8	3.0	3.4	2.0	3.8	2.8	3.6	3.0	2.7	3.0	3.3	3.3	3.0

Environmental PSGI Relevance ranking