Developing and Comparison of Strategies Towards Market Driven NSDI in India

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by

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Dedicated to

……. Tsunami Victims

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Padmavathy A S

Abstract

Many countries including India are developing spatial data infrastructure at national level to support the availability and access to Geo-information (GI) for effective use. This approach facilitates the data sharing and gives a scope to unfold the economic potential of GI. Further step is to understand the value of GI and take action to develop and exploit the market potential. Stimulating the GI market might be both a means and an end to achieve the development of NSDI; also success of a NSDI initiative will primarily depend on the market demand for related services and products.

The objective of this study is to develop strategies towards market driven NSDI in India. Demand, trend and the major issues were reviewed to understand the GI market in India. Extensive literature survey was done to understand the GI market situation of the world. GI market status of USA, Canada, Netherlands, Germany and United Kingdom are discussed in detail. Data was collected through questionnaire, interviews and from the literature to understand the Indian GI market scenario. SWOT analysis was done to understand the current situation based the data collected to arrive at suitable strategies. These strategies were further scrutinised through Multi Criteria Analysis. Various strategies to foster the GI market in the country are discussed in detail.

The Government continues to play a major role in inventory and mapping of major national resources and establishing a map information base in the country. Presently, NSDI is more of GI generator driven than market driven as it is in the initial stage and the fundamental concentration is in the task of making the data available to all. Demand for GI will multiply once data is available as it gives an immense scope for value adding which would trigger the GI market. There is a need to have the commitment from data provider to make the data available; and commitment of the Government to make the transparency of data availability and use through appropriate pricing and policy to stimulate the demand.

First and foremost thing required to make NSDI successful is to make the data available and easily accessible. Public – Private – Partnership needs be encouraged and commercial ventures in GI market needs to be taken up by Government organisations, than the relying on the government controlled service oriented approach. Consequently, cost recovery approach could be adopted to generate fund towards maintenance of NSDI.

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Acronyms Used

Number Equivalence			Currency Equivalence
1 Lakh	=	100000	1 EURO = **56.4** Indian Rupees (abbreviated as Rs.) (Exchange rate effective on February 2005)
100 Lakhs	=	1 Crore	
10 Lakhs	=	1 Million	
100 Crore	=	1 Billion	
,	≡	•	
(Comma	=	Points)	

DAC	-	Department of Agriculture & Cooperation
DOEnF	-	Department of Environment & Forest
DOS	-	Department of Space
DST	-	Department of Science & Technology
FSI	-	Forest Survey of India
FY	-	Financial Year (April 1st to March 31st)
GI	-	Geo-spatial Information
GOI	-	Government of India
GSI	-	Geological Survey of India
IMD	-	India Meteorological Department
IMSD	-	Integrated Mission for Sustainable Development
IRS	-	Indian Remote Sensing Satellite
ISRO HQ	-	Indian Space Research Organisations Headquarters
MCA	-	Multi Criteria Analysis
NATMO	-	National Atlas Thematic Mapping Organisation
NMA	-	National Mapping Agency
NNRMS	-	National Natural Resources Management System
NRDMS	-	Natural Resources Data Management System
NRIS	-	National (Natural) Resources Information System
NRSA	-	National Remote Sensing Agency
NSDI	-	National Spatial Data Infrastructure
NUIS	-	National Urban Information System
OS	-	Ordinance Survey
RRSSC	-	Regional Remote Sensing Service Centre
SAC	-	Space Applications Centre
SC	-	Standing Committee
SOI	-	Survey of India
SRSAC	-	State Remote Sensing Applications Centre
TF	-	Task Force
UK	-	United Kingdom
USA	-	United States of America

1. Overview

1.1. Background

India has realized the importance of 'data' as 'national resource' and efforts are going on in order to establish the National Spatial Data Infrastructure (NSDI). The main purpose of NSDI is to establish an infrastructure, at the national level for the availability of and access to organized spatial (and non-spatial) data and multilevel information networking to contribute to local, national and global needs of sustained economic growth, social progress, environmental quality and stability. It is envisaged that all major GI providers would commit to establish a GIS database in conformity with NSDI Standard serves as a NSDI Node. These nodes will be networked along with NSDI Metadata Server and NSDI Web-Server to the NSDI Clearinghouse. The NSDI Clearinghouse would be the mechanism to provide access to the metadata and finally to the actual data sets from the participating agency. The NSDI Gateway and user interface allows a user to query distributed collection of spatial information through their metadata descriptions (ISRO 2001).

NSDI *Strategy and Action Plan* was launched in 2001 defining the direction for the Indian NSDI to become a reality; since then vigorous efforts are going on by various organisations to establish their respective NSDI node. In addition, NSDI Task-Force is going ahead with developing national standards for metadata, exchange format, content standard etc., A Proto-type NSDI was developed and demonstrated covering a full-fledged Metadata Server and demonstration-level NSDI Data and NSDI Applications servers, and the NSDI Portal by two organisations; i.e., National Natural resources Management System (NNRMS) and Survey of India (SOI). It is expected that NSDI will ultimately emerge as a major driver for impetus to development activities and also enable the emergence of an information business sector that will promote economics and commerce activities.

One of the key issues related to creation of NSDI is funding. Economic issues associated with the development, implementation and maintenance of SDI have not been debated and discussed in a manner that technical issues have been researched on, especially in developing economies like India(Feedback 2004). The efficient implementation and maintenance of these SDIs will require long and short term financing models. Funding mechanisms are essential tools for SDI implementation since, without proper financing, it would be impossible to efficiently implement and maintain an SDI. Funding mechanisms must be clear to address the different phases of SDI, development phase, implementation phase, and maintenance phase. These funding mechanisms will serve as a guideline to SDI program coordinators on how to integrate, formalize, structure, manage, present and source financing for SDI development, implementation and maintenance. This is achieved through the analysis, testing and model simulation of the funding mechanisms under different circumstances. Funding models will enhance the capabilities to identify the external and internal economic changes to an SDI that affect financing and adopt alternative models to meet these challenges (Giff and Coleman 2003).

The NSDI objective is to create a market driven infrastructure for geo-spatial data and services. Market driven Infrastructure implies that Geo-spatial Information (GI) is to be sold and bought similar

to consumer commodities (Kuhn, Basedow et al. 2000). It is proposed to explore the demand of GI products / service and develop strategies for market driven NSDI in India.

1.2. Problem Context

In many countries, the main dilemmas of management of public GI organisations are less and less budget from the government, low efficiency of the organization, and no market for their existing maps. Hence, they need to revise their mission to business perspective in the competitive market without violating its national mandate. The driving forces for GI organizations to change their strategies are (Radwan et al. 2001):

- The reduction of government funds to the NMAs and the need to generate revenue to support its existence;
- The fast developing GIS-market and the merge of new generation of GI users;
- The long delays in responding to GIS users, as a result of the lengthy base-mapping programs, and consequently user's dissatisfaction;
- The need for diverse GI products and substitutes for the conventional base maps;
- The threat of new competitors who are encouraged by the presence of cheap technology and easy access to raw spatial data and have a flexible approach to adapt to changing requirements;
- The continuous development in information technology and its fast impact on the geo-information industry.

On the other hand, GI is considered as public or quasi public goods collected and produced with positive externalities having Non-rival and Non-excludable characteristics in consumption. The intrinsic value of GI qualifies it as an economic good which can be produced, add value in value chains, packaged, offered for sale, purchased and paid for. Thus:

- GI has value
- Value can be added in various processing steps
- Different value for different application and change of value in time

However, GI remains too often locked out from the expected market growth, as it is

- held in proprietary formats
- too complex to be easily browsed or combined with other information
- marketed through price that reflect production costs rather than value.

Kuhn et al observes that this situation can be improved through metadata, simplified viewer software, and alternative pricing policies(Kuhn, Basedow et al. 2000).

In India, the concept of GI market is relatively new, and not yet explored. In spite of the potential commercial value for GI and the fact that NSDI is stimulating and supporting the GI transactions, there is not much effort is put towards exploiting this asset; marketing and cost recovery initiatives in India are not adequate to compensate the lack of funds. In this context, it is necessary to study the current GI market and explore the unfolded economic potential of GI.

1.3. Prior Research

More than half the countries in the world are developing NSDI (Masser 2003). Though the objective of NSDI was to support the availability and access to GI, facilitating the data sharing, it gave a scope to unfold the economic potential of GI. Many countries understanding the value of GI are taking action

to develop and exploit the market potential of GI. Stimulating the GI market might be both a means and an end to achieve the development of NSDI; also success of a NSDI initiative will primarily depend on the market demand for related services and products.

The NSDI being an over-arching framework over the existing agency-efforts provides tremendous opportunities for development of new value added products. In this context, there is a scope for emergence of spatial business from the highly volatile and dynamic synergy of information. However, questions like "how much it cost to run NSDI and can such estimates made meaningfully?" noted by researchers (Rhind 2000), are valid. Researchers like de Vries acknowledge the fact that it is difficult to make a proper assessment of its cost, and even more difficult to assess its benefits, simply because most of them are very intangible. However, he suggests overcoming this problem by decomposing the cost into various approaches like microanalyses, activity-based analyses, cross-sectoral analyses and virtual enterprises (Vries 2004). In spite of all these facts, it was recognised that Geo-spatial data have great market potential.

1.4. Research Objective

The main purpose of this study is to develop strategies to shift from Budget driven NSDI towards Market driven NSDI in India. Hence, the main objectives are:

1. To explore the demand of GI market in India and to exploit its commercial potential in the context of NSDI.
2. To develop and compare strategies for market driven NSDI.

1.5. Research Questions

The major constituents of GI market needs to be studied in detail to understand the GI market in India. The list of the GI providers and the products / services they provide are available from the existing literature and the mailing list of NSDI Secretariat. The following questions needs to be addressed:

1. What is the trend in growth of GI market – in terms of increase in sale, more diverse customers, and demand for specific products?
2. Where is the high market potential?
3. How does one data product/case (with high market potential) compare with that of another case (with low market potential)?
4. To what extent, NSDI influences the GI Market and vice versa?
5. Do the user's need matches with provider's capacity? If not to which extent Public-Private-Partnership cater the under capacity of the provider?
6. What is the impact of a strategy on the GI market? Which instrument will be used to measure the impact?
7. Which is the best strategy to be adopted for market driven NSDI?

1.6. Research Methodology

The present research is a combination of descriptive and evaluative type of study. It involves both qualitative and quantitative approach to study Indian GI market in detail. Digital data products and services, disseminations, customers satisfaction are studied and presented in detail. Quantitative data is collected through Questionnaires with a set of direct questions about information technology status, Internet access, arrangements for data dissemination and policy related parameters. The study is also of qualitative as best practices use experience learned in other countries or direct comparison with

other, similar, countries and based on opinion of experts collected either through literature or interviews.

a. Extensive literature review was done to understand the current trend and GI market situation in the country as well as elsewhere in the world. Impact of various instruments like metadata, NSDI Bill and Information Policy on the GI market was studied. Various text books and documents from major international professional associations like FIG, UN, GINIE etc., were consulted for the definition of GI market. In order to understand the present state-of-art, journals, review articles and thesis will be reviewed. Similarly, present policies are extracted from the government publications and bulletins. In order to get the GI turnover and the value of assets of GI Organisations, Annual Reports, market survey reports and Fact Books were consulted.

b. Key issues were identified through situation analysis. Quantitative parameters like total revenue increase, number of products sold, number of new customers and new products introduced were used to determine the market growth. The result of the situation analysis was used to prepare the questionnaire. In order to understand the commercial potential of GI products, four representative cases will be considered. These are:

i. Topographical map by Survey of India (SOI)
ii. Wasteland map or Ground Water Potential map by NNRMS
iii. City map by Eicher Goodearth Ltd
iv. Socio-economic information from Census department

The products i and ii are from the federal government organizations with different organisational culture where as the product iii is from the private party. The product iv is a non-spatial data from the government organization. In this study, cost behaviour of these products in the market was observed which gives a vital clue for selecting the strategy.

Customers need analysis was done to understand the customer's need and the buying potential. A questionnaire was prepared and finalised after getting the expert opinion and circulated among the customers. This was done in the following steps :

i. Shortlist the potential customer
ii. Categorize the customer
iii. Identify the right person for contact through known sources
iv. Shortlist the possible respondent
v. Identify the specific person and establish the contact
vi. Send the questionnaire
vii. Interview the selected people through phone or direct after fixing the appointment

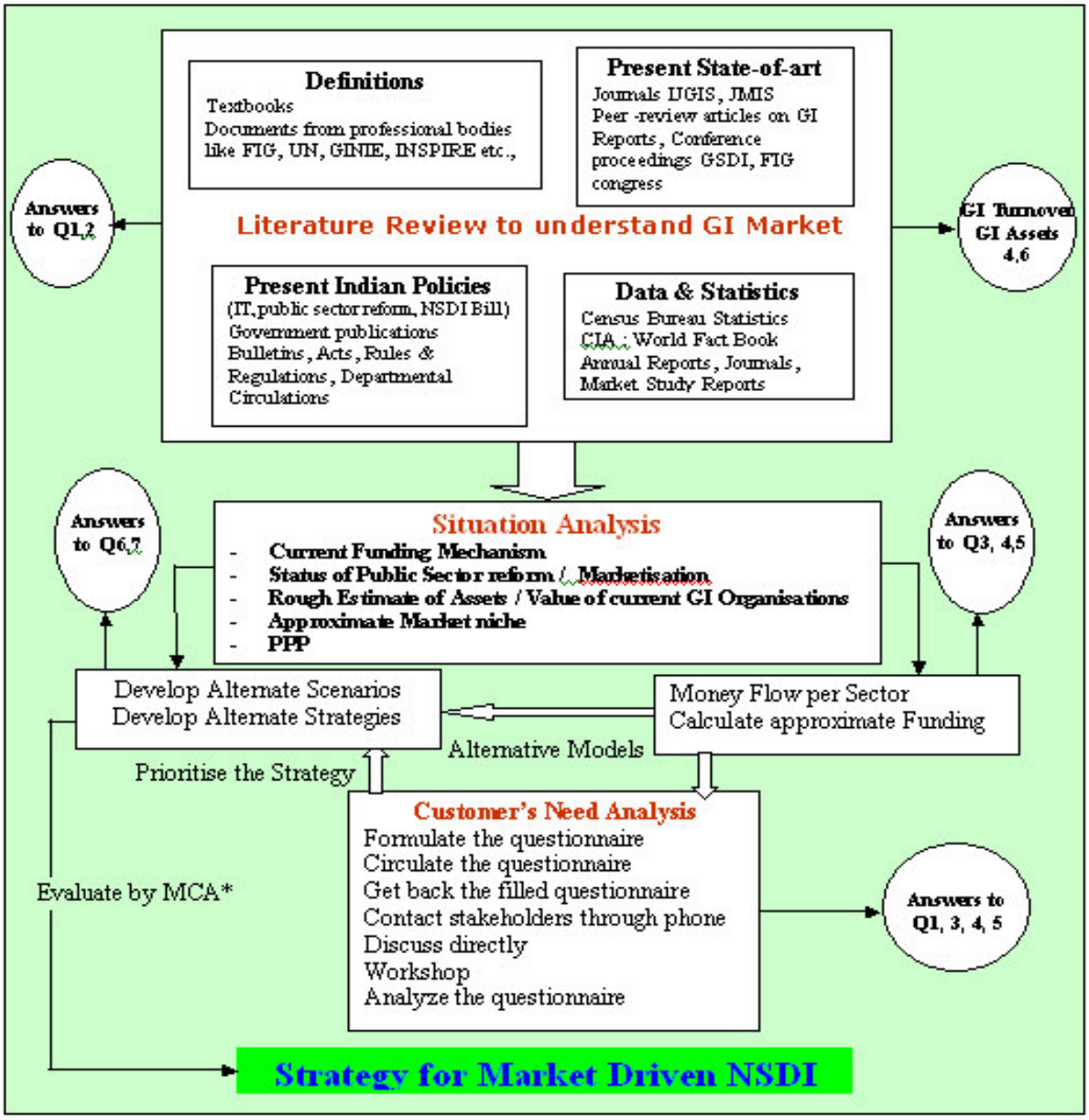
d. Returned Questionnaire was clustered and analysed based on a relevant statistical method.

e. SWOT analysis was performed to arrive at various strategies after knowing the exact situation in the country through the data collected. Alternative strategies suggested were evaluated using multi-criteria analysis incorporating the feedback from the customer need analysis.

f. Based on the result, an appropriate strategy will be suggested to exploit commercial potential of GI to shift from the "budget driven" to "market driven" NSDI, and from "Principle driven" to "Agent driven" NSDI.

g. The expected output is comparative strategies with its weights from MCA and corresponding implications, which can be used by GI managers for decision making.

The detail of the methodology is given below:



MCA : Multi Criteria Analysis

Figure 1-1: Research Flow Diagram

1.7. Research Schedule

A detailed schedule is given below:

Activity	2004						2005		
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Initial Proposal	◄►								
Detailed Proposal	◄	———	►						
Literature Review	◄	———	———	►					
Situation Analysis			◄	———	►				
Preparation of Questionnaire			◄	———	———	►			
Customer Analysis			◄	►					
Pre Field Work Preparation			◄	►					
Field Work				◄	———	———	►		
Post Field Work Data compilation and clustering. Data Analysis				◄	———	———	►		
Report Writing			◄	———	———	———	———	►	
Conclusions & Recommendation				◄	———	———	———	►	
First draft document preparation					◄	———	———	———	►
Mid-term Presentation						*			
Compiling comments on draft						◄►			
Workshop to finalize strategies						*			
Final thesis Submission								◄►	
Preparation for presentation							◄	———	►
Final presentation									*

Figure 1-2 : Operational Plan

1.8. Thesis Structure

1.8.1. Chapter 1 - Overview

The first chapter is an overview of the research. It presents the background of the study, the research problem context, the prior research work, research objectives, the research questions and the methodology used to answer these questions and the schedule. It also gives an overview of the structure of the thesis.

1.8.2. Chapter 2 - Review of GI Worldwide Market

Literature review for GI market in the world is discussed in this chapter. GI market status of USA, Canada, Netherlands, Germany and United Kingdom. Each section gives the detail of GI market in individual country followed by summary and the lessons to India.

1.8.3. Chapter 3 - GI Market – Indian Scenario

This chapter gives details on GI Providers and Customers, data dependency between the organizations, Product / Service Analysis, NSDI status, Various GI projects and the Conclusion with respect to India.

1.8.4. Chapter 4 – Data Collection and Analysis

This chapter outlines methodology for collection of data needed to understand the GI market trend in India and to develop strategy for market driven NSDI. Questionnaire preparation, clustering customers, distribution of questionnaire, Interview with GI experts and feedback is discussed. Data analysis using statistical methods, completeness of result, and accuracy of result and validation of field data collected are discussed.

1.8.5. Chapter 5 - Strategies and guidelines for Market Driven NSDI

This chapter firstly describes the current situation (general socio-economic, political and technological situation) in India. Various strategies to foster the GI market in the country are discussed in detail.

1.8.6. Chapter 6 - Conclusions and Recommendations

This chapter will highlight the summary of the findings of the research. The results are outlined as well as recommendation for further research is discussed.

1.9. Modus Operandi

This study was carried out at ITC, The Netherlands till 15th September 2004, later continued at ISRO HQs, Bangalore, India through distance supervision (e-supervision). Progress of the work was communicated to the supervisor at ITC through yahoo-chat, e-mail and occasionally on telephone. The mid – term presentation was made through teleconference.

2. Review of Worldwide GI Market

2.1. Introduction

Estimating the size of the market for GI (data) and GIS (GI systems software and hardware) has never been an easy task. The major IT market research firms periodically attempt to estimate the size to the "GIS marketplace" based on a range of market sector definitions across various geographical regions. In recent years, these firms have also started to include figures for "data and data related services". These tend to be even more variable in definition than the GIS component of the market estimate. The market projections are almost always "global" in scope, based heavily on supply-side information from the USA/North America GI/GIS vendors and less so from other geographic regions of the world. In this chapter, an attempt has been done to understand the GI market in the world through literature review and various surveys conducted by many leading agencies in the world.

2.2. Size of the GI Market

Countries across the world are developing NSDI. Though the objective of NSDI were to support the availability and access to GI, facilitating the data sharing, it gave a scope to unfold the economic potential of GI. Many countries understanding the value of GI are taking action to develop and exploit the market potential of GI. Stimulating the GI market might be both a means and an end to achieve the development of NSDI; also success of a NSDI initiative will primarily depend on the market demand for related services and products. Many surveys are carried ou to understand GI market potential. Few such surveys are briefed below:

According to e-mapsite news, GI Market to top 8 billion Euros by 2007. This site reports that leading analysts Frost and Sullivan have published a new report on World Commercial Remote Sensing Imagery, GIS Software, Data and Value Added e-Services Markets. This is a rough estimation of the GI economical potential[1].

Daratech, Inc. of USA has forecast total GIS core-business revenue to top $2.02 billion in 2004, an increase of 9.7% over 2003. In 2003, core GIS revenue reached $1.84 billion, up 5.1%, by Daratech estimates. Core-business revenue includes software, hardware, services and data products. Of core-business revenue, Software accounted for the lion's share, comprising approximately two-thirds (64%) of the pie, with revenues from GIS software vendors reaching $1.175 billion. Services were the second-largest component, accounting for 24% of total core-business revenues, or $447 million. Hardware, a declining component of core-business revenues for many years, accounted for just 4% of total core-business revenues in 2003, or $70 million. Data products accounted for 8% of total core-business revenues[2].

A systematic survey was done by Geographical Information Network in Europe (GINIE) to assess the key players in the GI market within Europe and came to the conclusion that there is a

big GI market in Europe. They have estimated that the volume of European GI market is approximately 780 Million Euros (Probert 2003).

In Germany, the government commissioned consultants to produce a market survey within the framework of the country's SDI project in order to investigate the economic aspects of the geo-spatial data market and the institutional barriers impeding market growth. The market study was subdivided into four areas, of which the value added can be estimated conservatively as follows: GIS applications 45 Million German Marks (MGM), navigation 30 MGM, Geo-marketing (distribution, location analysis, etc.) 20 MGM, emerging markets (mobile radio communication, Internet, multimedia) 5 MGM. This results in total value added of about 100 MGM. The report acknowledges that only 15% of the GI market potential has been tapped in Germany.

2.3. Market Status in Selected Countries / Organisations

Few, representative countries with different technology and business strategies are considered in this study. The countries included are United Kingdom (Ordinance Survey), Germany, Netherland (Dutch Kadaster & Dataland) Canada and USA where NSDI initiatives are in advanced stage of maturity. Their experiences, success and failure factors needs to considered while implementing GI business strategies for Indian NSDI.

As the NSDI is the backbone for the GI market, an attempt has been made to understand the NSDI status and GI market in few countries. Numerous SDI-related activities at the national, state, and local levels in many countries share similar core objectives to stimulate coordinated collection, dissemination, and use of spatial data by public and private entities. This coordination is to result in digital databases that would be easily accessible and seamless across administrative and organizational boundaries and that would contribute social, environmental, and economic benefits to the involved communities (Nedovic-Budica, Feeneyb et al. 2004).

2.3.1. Europe

Many research projects are funded by European Union (EU) towards establishing a European GI Infrastructure. Also, policy debate was reoriented towards the broader issues of access and reuse of Public Sector Information (PSI), of which GI is a recognised important component. European Umbrella Organisation for GI (EUROGI) is specifically looks into the development of a European GI strategy. The EUROGI was established in 1993 with the mission to maximize the effective use of GI for the benefit of the citizen, good governance and commerce in Europe and to represent the views of the geographic information community. EUROGI achieves this by promoting, stimulating, encouraging and supporting the development and use of geographic information and technology.

EUROGI, published a consultation paper "Towards a strategy for GI in Europe" in October 2000 which was well received within the GI community and the EC and as a result a proposal to implement parts of the strategy was submitted to the EC for consideration as a fully funded project within the Information Society Technologies Programme. This resulted in the Geographic Information Network in Europe (GINIE) project. Since the start of GINIE, a major new initiative

has been launched by the EC with the aim of developing an Infrastructure for Spatial Information in Europe (INSPIRE). INSPIRE addresses many important issues at the European level, including common architecture and standards, data policy and legal framework, metadata, and funding issues. The objective of INSPIRE is to develop a legal framework for a European infrastructure, starting from the requirements of environmental policy, but with subsequent daughter legislation addressing other sectors such as transport, regional policy, and agricultural policy.

INSPIRE Proposal for a Directive has been adopted by the European Commission on 23rd July 2004. This is a major milestone for the use of Geographical Information in Europe as a contribution to environmental policy and sustainable development. Consequently, this can foster the GI market in EU Member State[3].

2.3.2. United Kingdom (UK)

The aim of UK National Geo-spatial Data Framework (NGDF) is to facilitate the unlocking of geo-spatial information (GI) through enabling better awareness of data availability, improving access to the data and integrating data by encouraging the use of standards. NDGF will not create a physical framework or deliver datasets, services or products, but its use will help facilitate value-added services by enabling the combination of data from multiple sources.' The Inter-government Group on Geographic Information (IGGI), was formed in 1993 in order to enable UK government departments to liaise effectively and exchange best practice for geographic information (Longhorn 2001).

Much has been written about the alleged restrictions to more widespread use of GI caused by strict enforcement of Crown Copyright in regard to the UK's national topographic digital mapping as maintained by Ordnance Survey (OS), in pursuit of national government's policy of cost recovery for certain agencies.

2.3.2.1. Ordnance Survey

Ordnance Survey (OS) is an internationally recognised market leader in its field, being the first National Mapping Organisation in the world to complete a programme of national large-scale electronic mapping in 1995, and since then remaining at the forefront of e-business innovation and use of new technology. According to OXERA reports, OS contributed £79–£136 billion worth of gross value added (GVA) during 1999. This economic contribution of OS comes through the use of OS products and services as a primary input into production by several key sectors in the economy e.g. utilities, local government and transport (OXERA 1999); Annual Report 2003-04 of OS reflects that it exceeds targets and delivers profit as data use grows. The report also reveals that Ordnance Survey has successfully returned an overall operating profit for its first full five-year period as a self-financing Trading Fund, as well as exceeding the government-set target of securing a 9% annual average return on capital employed. Over the period from 1999 to 2004 it has also invested more heavily than ever before in new products, services and technology. For 2003-04 Ordnance Survey posted a surplus of £5.6 million (before interest and exceptional charges) on turnover from operating activities of £116.3 million – and

has exceeded the entire annual financial and service quality targets set for it by Ministers (OS 2004).

a. Products

In its role as the national mapping agency, OS produces a range of products and services, including a base dataset, which are driven by the needs of the national interest and the demands of customers. The base data is generated from the National Topographic Database, which is created and maintained by OS. This covers urban areas at the 1:1 250 scale, rural areas at the 1:2 500 scale, and mountain / moorland at the 1:10 000 scale. OS also provides many other products / services generated from this base database combined with the base data with other GI (e.g. postal codes). Table 3.1 shows a range of the services provided to OS by a sample of 100 companies.

Paper maps A range of leisure, motoring and planning maps are produced at different scales. Examples include the 1:50 000 scale Landranger series and the larger 1:25 000 scale maps, which include the Outdoor Leisure™, Explorer and Pathfinder® series
Scale Raster Digital data with a familiar map appearance on two scales 1:50 000 and 1:10 000
Land-Line Large-scale maps available on three different scales—1:1 250 (urban), 1:2 500 (small towns and villages, and developed rural areas), 1:10 000 (mountain and moorland areas).
Superplan Data® Large-scale (1:1 250) street-level data
Code-Point™ A precise geographic location for each postcode unit
ADDRESS-POINT Locates and defines residential, business and public postal addresses
Land-Form Provides a visual representation of the terrain in Great Britain
Strategi A strategic decision-making tool based on a 1:250 000 vector dataset
BaseData.GB® A dataset which gives an overview of Great Britain on the 1:625 000 scale
Meridian A vector dataset which can be used for regional analysis
Boundary-Line™ A vector dataset containing electoral and administrative boundaries
OSCAR A family of products for customers who use roads or manage assets relating to roads. The products are OSCAR Asset-Manager; OSCAR Traffic-Manager; OSCAR Route-Manager; OSCAR Network-Manager® and OSCAR Drive Restricted Information

Table 2.1: OS products and services

b. Distribution

There are four main routes by which customers obtain OS-related products and services.

1. Direct account sales—confined to business users.
2. Value-Added Resellers (VARs)—these are private and public organisations which form partnerships with OS to produce 'off-the-shelf' computer packages incorporating OS

data. Complete solutions are offered (e.g. farm-management packages) and prices are negotiated. OS gains a royalty for the data.

3. SuperplanTM Agents—these supply the full Superplan and Landplan product ranges by producing maps and data on demand, using installed computer terminals. There are now 35 fully equipped agents in Great Britain.
4. Wholesalers and Retailers—these service the consumer sector and are primarily responsible for the distribution of paper maps.

c. Customers

OS has a heterogeneous customer base which is divided into the business sector (responsible for 80% of total revenues) and the consumer sector. In OS's marketing strategy, these sectors are sub-divided into the following market segments. The major customers are from British Geological Survey, Coal Authority, English Heritage, English Nature, Environment Agency, Forestry Commission, Government Offices for the Regions, Her Majesty's Land Registry (HMLR), Highways Agency, Historic Scotland, Home Office, Intervention Board (MAFF), Maritime and Coastguard Agency, MOD, MAFF—operational, ONS, Planning Inspectorate, Radio Communications Executive, Registers of Scotland, Royal Mail, Scottish Environmental Protection Agency, Scottish Fisheries Protection Agency and SOAEFD, Norwich Union, Network Rail and The National Trust, utilities including gas, electricity, water and telecommunications companies. Department for Constitutional Affairs, the Department for Education and skills, Cairngorms National Park Authority, Sport England, Visit Britain and the Welsh Cancer Intelligence & Surveillance Unit, Land Registry, English Heritage and the Met Office.

Business segments	
Architects, engineers, survey and construction	Manufacturing
Central government	Marketing and business consultancy
Computer and related activities	Mining, drilling and quarrying
Education	Publishing and broadcasting
Emergency services and security	Real estate
Farming and forestry	Recreation, culture and sport
Finance and insurance	Restaurants, public houses and hotels
Health and non-local-authority work	Transport
Legal and environmental consultancy	Utilities
Local government	Wholesalers and Retailers
Consumer segments	
Drivers	Other leisure pursuits
Referencers	Walkers

Table 2.2 : OS Customers from different segments

d. Competitors

There are several other companies operating in the GI market in Great Britain, producing both paper products, and digital products and services. While OS remains the leader in the business sector, the intensity of competition has increased significantly in recent years. Many competitors also combine the role of information providers, System Suppliers and VARs to provide a

complete package of services to customers. It is clear, however, that the majority of these competitors use OS information as the basis of their products and services. In fact, most of the key players are OS licensees.

OS is also facing competition in the GI market from providers of alternatives to the traditional map, particularly via the Internet. For example, Global Positioning Systems and high-resolution air photography are providing consumers with alternative means of visualizing the required data.

e. Customer Satisfaction

According to customer surveys, Ordnance Survey is more customer-focused than ever before (OS 2004). OS is developing a greater understanding of customers' longer-term needs through their partner community. OS believes in serving their customers as paramount importance to and are committed to consulting those who use their products. Key findings from customer satisfaction surveys during 2003–04 are summarized below:

- 100% of callers to the Customer Service Centre said they would use OS service again.
- 91% of callers to the Customer Service Centre felt OS provided services better than other organisations.
- 74% of customers were satisfied with the way OS dealt with their complaint.

Results

	Year to March 2004	Year to March 2003	% variance
Complaints*	323	1 427	-77
Telephone	74 775	83 228	-10
Correspondence	20 365	21 585	-6
Total enquiries	95 463	106 240	-10
Order lines	614 684	567 103	8
Trade orders	18 277	20 121	-9
Response times	19.96 secs	18 secs	
Lost calls	1.97%	1.9%	

*The total complaints for the period ending March 2004 is considerably lower than previous periods.

Table 2.3 : Customer Satisfaction Surveys of 2003–04

2.3.3. Germany

SDI started from the state level in Germany. One key player is the state of North Rhine-Westphalia (NRW) started GDI NRW, with GI international norms and standards, which is a crucial initiation for stimulation of the GI market. The ultimate goal of the SDI is to stimulate the GI market, by connecting the value chains of users, service providers, service enablers, integrators, data producers and infrastructure providers. The government commissioned consultants to produce a market survey acknowledges that only 15% of the GI market potential has been tapped in Germany and emphasizes that the success of SDI will primarily depend on the demand for geographically related services and information products, following the removal of barriers related to pricing, rights of use, procurement transparency etc (Fornefeld and Oefinger 2001; Fornefeld and Oefinger 2002).

a. Products

The basic GI market includes all the products and services concerning status maps and basic data mapping such as the cadaster map, the real property register, the topographic mapping as well as aerial photographs. It is expected to have the following new products and services would develop based on basic GI in four market segments:

Segments	Area	Segments	Area
1. ***GIS applications***	• Planning • Network documentation • Facility Management	2. ***Geo-marketing***	• Controlling • Sales management • Site analyses • Marketing
3. Navigation	• In-car navigation • Routing / Telematics • Fleet management • Information systems	***4. Emerging Markets***	• Mobile radio communications, WAP, UMTS • Multimedia • Online applications

Table 2.4 : GI Market Segments

b. Distribution

Presently, there are four sales channels, namely (1) Internet (2) Letter/ Fax (3) Telephone and (4) E-mail exists. However, it is envisaged that Internet is the only channel, which will dominate for the following reasons :

- o Rapid access to the information
- o Clarity with respect to the source
- o Price transparency
- o Relevance

c. Customers

In the case of the GIS applications the customers are from the public administration sector as well as the business customers of the construction, energy and water supply, transportation and telecommunication sectors, in engineering consultant's offices and the architectural sector. In the case of the three new sub-markets: geo-marketing, navigation and emerging markets, the customers are from the target groups of the industry, banks / insurance companies, commerce and services sectors.

d. Customer Satisfaction

Though customer satisfaction is not directly dealt, it was observed that the providers of EO-based services are interested in a sustainable customer relationship. Strategies capable of supporting long-term customer relationship are being thought off.

2.3.4. The Netherlands

The development and implementation of the Dutch national clearinghouse for geo-spatial data is presented as an example of one step in the evaluation towards NGDI. The Netherlands, a more structured thinking on the organisation and development of the national geo-spatial data infrastructure started to appear around 1992, when the RAVI (the Netherlands Council for

Geographic Information) released a policy document, related to property (parcel based) information. On the basis of this document, several projects were initiated to develop the standards, policy issues, data, pricing etc. of Dutch NGDI. RAVI is the responsibility of the Minister for Housing, Spatial Planning and the Environment and was originally established as a collaborative undertaking of Governmental bodies concerned with GI but now includes the Dutch Association of municipalities, provinces, water boards and utility companies. Two booming GI organizations representing public and private sector each are given in the following section.

2.3.4.1. Dutch Kadaster

Kadaster, or Dutch Land Registry Office is a "Self-Administering State Body" - a legal entity under public law performing its tasks as an independent organisation. It collects information about registered properties in the Netherlands, records them in public registers and in cadastral maps and makes this information available to members of the public, companies and other interested parties in society (Probert 2003). Under the strategic objectives 'to define its directive role in the light of its public task' and 'to focus more specifically on the provision of information'(Georgiadou and Molen, 2002), Dutch Kadaster recognises the important focus of organising and improving the accessibility to information. It is interesting to note that Dutch Kadaster & Topografische Dienst Nederland got merged and serving the people better.

a. Products

Dutch Kadaster collects, processes and manages real estate data. Cadastral maps form an important component of Kadaster's data system. Dutch Kadaster promotes legal security in society's transactions in real estate that include properties such as dwellings, apartments and undeveloped plots of land, ships and aircrafts. It plays an important role in land development, maintains a national system of coordinate points, called the National Triangulation System. The real-estate information has been organised in an information system containing more than seven million objects and the cadastres.

b. Distribution

- Information is accessible to the public through 15 branches spread across The Netherlands which are organised into six regions.
- Customers have direct access to real-estate digital information
- Dutch Kadaster provides analogue information if desired by a user
- Over 5,000 business to business (B-B) users are connected to the Kadaster's on-line service and most data sales are performed via on-line distribution (93% in 2001).

c. Customers

The biggest customer of Kadaster products is mainly the notaries. The other customers are real estate agents, municipalities, financial institutions, water boards and individuals. The percentage data consumption by various users is given in the Table 2.5

Sl.No	User	% GI consumed
1	Notaries	81%
2	Real Estate Agents	5%
3	Municipalities	3%
4	Financial Institutions	3%
5	Water Boards	2%
6	Private Individuals	2%
7	Others	4%

Table 2.5 : Customers of Dutch Kadaster

d. Customer Satisfaction

Dutch Kadaster considers customer satisfaction as one of the critical success factor. The organisational learning is done through regular customer satisfaction survey.

2.3.4.2. DataLand

The EPSINet project team has published a report on 5 cases of exploitation of Public Sector Information (PSI), assessing the conformity with the rules on re-use of PSI set out in the Directive of European Parliament. (Directive 2003/98/EC of the European Parliament dated 17 November 2003 on the re-use of PSI). One example is **DataLand** of Netherlands, which is quite a success story. In three years time, it has become the Dutch national service point for municipality information on buildings. Users benefit by having a single point of access where uniform data can be obtained at transparent price. Being very transparent both on the availability of data and on its pricing policy, DataLand is a perfect example of a venture meeting the principles of the Directive.

a. Products

DataLand provides digital information on buildings of approximately 130 municipalities in The Netherlands, up to the highest possible detail. It collects information from municipalities, repackages, syndicates and delivers its information to users. This information combined with other information like statistical services, cadastral services become highly valuable and widely applicable. There are three groups of information within the repository that can be bought is listed in the table 2.2.

1. Address level	2. Architectural level	3. Use level
Information on addresses X, Y-Coordinates	Volume of buildings Superficies of buildings Number of floors Year of finishing construction Building classification	Current use of the building Kind of building Ownership / rent Monument - yes or no ?

Table 2.6 : Information at three different levels

b. Distribution

Full catalogues of all data for sale and all municipalities participating are available on-line. Users can directly access the information through Internet. In order to ensure uniform data organization and delivery, DataLand has developed software module (on-line downloadable), allowing the municipalities to generate the metadata required to tap into the DataLand system, without much effort. The module automatically converts the data into useable files that are interoperable with

existing standards in the GI area. Descriptions of the module and its functioning are available on the website. Towards users, all information is provided digitally.

c. Customers

The major customers are retailers, building companies, police and fire brigades, tax authorities, health services, regional and national policy makers etc. apart from the individual property buyers.

d. Customer Satisfaction

Customers are happy as uniform and transparent pricing conditions are available. Licenses are transparent and equal conditions are offered to all buyers and suppliers.

2.3.5. Canada

The Canadian NSDI is known as the Canadian Geo-spatial Data Infrastructure (CGDI), and is the key point of coordination for the common interests amongst various organizations regarding the dissemination of GI. The lead agency for CGDI is Natural Resources Canada.The main aim is to support the availability of better quality data for applications providing useful information to end users in a consistent, transparent manner (Brooks 2000).

It is interesting to note that one of the first SDI in operations in Canada was not from government but from the private sector. In 1990 a number of oil and gas companies in Canada had calculated that their geologists and geophysicists spent more than 60% of their time looking for data and 20% of their time putting it to use. Thus the shared facility of Canadian Oil and GAS GIS (CANOGGIS) was born. The implementation of CANOGGIS reduced data access costs by a factor of 10 within the first three years. Its successful implementation also resulted in a number of positive secondary effects as well (Hall 2003).

KPMG Consulting, Inc. which was given the responsibility to study the Canadian Geo-spatial Data Policy made the following observations and recommended to take proper measures (Sears 2001):

- Many pricing policies are inconsistent in their implementation across agencies in the same level of government, or even within the same departments. Many policies have competing priorities.
- Decisions are taken without using the best available data because the cost of the data exceeds available budgets and/or perceived value.
- The cost of framework data has resulted in many agencies ignoring available data and creating their own, or manipulating or degrading the data to avoid licensing / royalty restrictions. This resulted in inconsistent with the federal framework maps, making data exchange and integration more difficult.
- Once cost-recovery has been implemented, departments and agencies find it nearly impossible to change things in spite of federal government instructions.
- Cost recovery has helped make government departments and agencies more business like, but this may have come at the expense of public good interests.
- There are unclear definitions regarding the government's role in providing "value-added" services.

Products

The data products include Geodetic data, Data Alignment Layer, satellite imagery, Road networks, Hydrographic data, Elevation data and Administrative Boundaries of Canada (Masser 2002). It will also include, integrated geo-spatial information products, Global Positioning System Correction System for emerging real-time positioning applications.

Distribution

Digital topographic data and other quality geo-spatial data to the users are offered free of cost for unrestricted use under certain licensing conditions and arrangement.

Customers

The customers could be from all the sectors of Canada – Government agencies, Private sector, General Public, Non-Profit organisations and Others.

2.4. United States of America

The USA was one of the first countries that formalized its National Spatial Data Infrastructure (NSDI). In 1990 an inter-agency Federal Geographic Data Committee (FGDC) was set up as a result of the Circular A-16 issued by the Office of Management and Budget (OMB). The circular required coordination in the development, use, sharing and dissemination of surveying, mapping and related spatial data, primarily to facilitate the sharing of digital geographic data (Hall 2003). The main aim is to support the availability of current and accurate geo-spatial data to contribute locally, nationally and globally to economic growth, environmental quality and stability and social progress. Hence a large amount of GI and other intellectual resources have been made available as public goods by governments at the local, state and national levels for the general benefit of all citizens through a range of legal and institutional mechanisms. In its broadest sense the infrastructure also included cultural, environmental, economic, political, legal and educational values and institutions that support, facilitate and shape its character, including the form in which spatial data are represented and utilized throughout society. With generally free and open access to federal public domain data, US users are satisfied and feel major business opportunities result.

United States domestic federal information policy is relatively straightforward: a high freedom of information law, no government copyright, fees limited to recouping the cost of dissemination, and no restrictions on reuse (David 2001).

a. Products

The United States Geological Survey (USGS) is the national topographic mapping agency. Their base product is the 1:64,000 topographic map. Other special-purpose maps are topographic-bathymetric maps, photo image maps, satellite image maps, geologic maps, land use and land cover maps, and hydrologic maps. Each type of map has a distinct purpose and appearance and, like topographic maps, all are available to the public for the cost of reproduction and distribution.

b. Distribution

The US The National Map is providing around-the-clock access through the Internet to basic spatial data; access will be based on user-specified combinations of data and geographic area of coverage. Multiple web-based services, including image service (Web mapping), feature service (data streaming in support of location-based services and metadata browsing), and data extract

(feature access and spatial data transfer) are available. Views of the data and transfers of reasonable amounts of data through the Internet is provided at no cost. Access to large volumes of data may require a fee to pay for media and other distribution costs. The USGS will review data distribution charges periodically to ensure compliance with Federal pricing policy.

c. Customers

The customers are Government agencies, Private sector, Non-Profit organisations and General Public. Planners, Decision-makers, Community groups involved in envisioning local futures and resolving local problems are among the most obvious potential beneficiaries of the evolving spatial data infrastructures (Nedovic-Budica, Feeneyb et al. 2004).

d. Customer satisfaction

There is a general feeling that, the potential of GIS has not been fully realized. While steps have been taken to improve the coordination of government GIS efforts, much more work still needs to be done to round out a comprehensive set of standards and to ensure that they are being broadly applied. Geo-spatial One-Stop, in particular, while addressing useful near-term tasks, has not focused on the need for a longer-term strategy for facing the challenges of implementing the NSDI (Koontz. 2003).

2.5. Discussion and Conclusion

A literature review of GI market in the world was carried out in this chapter. GI market status of USA, Canada, Netherlands, Germany and United Kingdom were studied in terms of GI products, data distribution, customers and customer satisfaction. The key issues for data sharing and successful GI market were identified.

Systematic surveys were done to assess the GI market in Europe and USA came to the conclusion that there is a big GI market in the world. Segmentation of GI market into GIS applications, Geo-marketing, Navigation and Emerging Markets in Germany shows a tremendous market potential for GI. Many countries across world are exploiting this tremendous potential for GI market through proper strategies. However, it is noted that it is also important to define a clear pricing policy in the initial stage itself as the inconsistent pricing policies resulted in very high cost of GI. It is also observed that technical standardization is incomplete without harmonization at the institutional levels.

Ordnance Survey (OS) is an internationally recognised market leader in GI is typical example of market driven organisation where production and volume of GI is controlled by the market. Dutch Kadaster has sought full cost recovery policy and customer satisfaction is the one of the motto of this organisation. Dataland of The Netherlands is an example for other public sector organizations and companies how the Directive could and should be applied. In Germany, the ultimate goal of the SDI is to stimulate the GI market, by connecting the value chains of users, service providers, service enablers, integrators, data producers and infrastructure providers. Though USA is one of the first countries that formalized its NSDI, the potential of GIS has not been fully realized. It is facing the problem in implementation, as long-term strategies were not focused. The Canadian experience shows how sharing of data reduces cost of access.

3. GI Market - Indian Scenario

3.1. Introduction

In this chapter an attempt has been done to understand the GI market in India. The GI providers, existing users and the potential users, data dependency between the organisations, products and the major issues for data sharing are studied and presented.

3.2. Background

India is one of the oldest civilizations with a kaleidoscopic variety and rich heritage with billion Plus population. Twenty-Eight States and Seven Union Territories span the length and breadth of the Country, marked by diversity in culture and geography but bound together by a common chord of Nationalism. There are 602 Districts in India administered by their respective State / UT Government. India is located in the southern part of Asia, bordering the Arabian Sea and the Bay of Bengal, between Burma and Pakistan. The total area of India is about 3.28 million sq km, is slightly more than one-third the size of the United States of America. India operates a democratic system of Government with the head of the country as the President in whom all executive powers are vested, but the real administrator of the country is the Prime Minister.

India, with its diverse landscape is a perfect fit for a technology like GIS and has been employed in many different areas and in newer fields of applications. Government of India has increased its budget from 4.70 billion (FY2003-04)[4] to 7.50 billion of Rupees this year (FY2004-05)[5] for development and promotion of Information Technology. It is estimated that GIS can play a major role in e-governance. Use of GIS by municipality is a certainly big market as in India as there are 400 major cities in the country. In addition, ministry of rural development has planned Rs.2500 crores for developing rural land record in coming years where GIS has a major role to play.

3.3. Major GI Providers

India has a good institutional infrastructure for GI growth; there is no dearth of data. There is a huge network of institutions collecting geographic information on every conceivable socially and scientifically relevant subject. There are organisations generating data at National and State level and by Private parties.

3.3.1. National Level GI Providers

In India, GI is being generated for the past 240 years with the establishment of Survey of India (SOI) which is the oldest survey institute of the world. Geological Survey of India (GSI) started after a century is also serving the nation with geological maps. However, GI activities suddenly boomed with the inception of aerial photography and satellite Remote Sensing in the later stages; Remote Sensing activities in the country began with the use of aerial photographs in 1960's mainly by geoscientists and foresters. National Remote Sensing Agency (NRSA) was set up in

1975 as a prime organization for receiving, acquiring, archiving and dissemination of satellite & aerial data and to carry out Remote Sensing based application projects. Remote sensing in conjunction with GIS technology is likely to become a major area of commercial activity.

Recognizing the need and importance of natural resources management, the Planning Commission, Government of India set up the National Natural Resources Management System (NNRMS) in 1983 with Department of Space (DOS) as nodal agency. NNRMS is conceived as a system to facilitate optimal utilization of the country's natural resources through a proper and systematic inventory of the resource availability and reducing regional imbalances through effective planning using latest technology like remote sensing, GPS and GIS.

Other major GI providers in the country are National Bureau of Soil Survey and Land Use Planning (NBSSLUP), National Atlas and Thematic Mapping Organization (NATMO), National Informatics Centre (NIC), Forest Survey of India (FSI), Natural Resource Database Management Systems (NRDMS), Indian Meteorology Department (IMD) and Census of India (COI), Central Ground Water Board (CGWB), National Information on Ocean (NIO), Oil and Natural Gas Center (ONGC) which are generating GI at National level. There are many more organisations in India other than what is described in the above section generating GI for their own purpose. It is impossible to give the detail of these organisations within the limited time period. Few representative organisations are discussed in the next few paragraphs and also price list from various organisations are given in ***Annexure 1.***

3.3.1.1. Survey of India

SOI, the National Survey and Mapping Organization of the country under the Department of Science & Technology, is the oldest (established in 1767) scientific department of the Government of India is responsible for surveying activity of the Nation. They provide Topographical maps at various scale, Geodetic Control data, Geophysical surveys data etc., India with 3.28 Million hectare is covered by nearly 385 toposheets on 1:2,50,000 scale, called Degree Sheets. Each degree sheet has 16 toposheets of 1:50,000 scale and covered by 5096 toposheets. Each 1:50,000 scale sheet contains four 1:25,000 scale sheets for few selected area (35% of the country) has also been covered on this scale (Srikantia 2000). Other maps include Plastic Relief Maps, District Planning Maps, State Maps, Tourist Maps, General Wall Maps, Trekking Maps, Discover India Maps, Guide maps etc., The cost of the analogue map varies from Rs.6 to Rs.50. Other type of data namely, Control Data consisting horizontal / vertical control costs minimum Rs.1000/- for 5 or less than 5 points, with an additional cost Rs. 200/- per point for more than 5 points.

Till recently, all these maps were in analog form. SOI has now switched over from analog maps to digital and released the first digital map during the end of 2002. The cost for other digital data is given in the Annexure 1[6]. The annual budget is almost stable and increasing slightly with Rs.150 – 170 crores of Rupees (Table 3.1)

SOI is investing huge amount of money for creation, updation and maintenance of data. But, these GI are sold for very minimal cost, not even the material cost. Toposheet is the base for all other agencies to create their thematic layer and hence a good demand exists. However, the

mandate from the Government is to serve the society better with the topological requirement, not to make any profit.

3.3.1.2. Geological Survey of India

Geological Survey of India (GSI) established nearly 150 years back and holds the key to mineral exploration. It has strength of 2900 geoscientists and technical professionals with a network of offices located in all the states of the country. It is the custodian of Geo-scientific database including geological maps of the whole country on 1:50,000 scale specialised thematic maps on 1:25,000 scale for selected area. GSI is capable of handling jobs in different sub-disciplines of earth science (from geological mapping to deposit modelling).

GSI takes up the projects to study the Seismotectonic activities to address the effects of tectonic movements eg. Earthquakes, Geo-environmental studies to address the environmental impact due to mining and industry, mitigation of effects of the impact of natural hazards and urban development and On-shore, off-shore and aerial mapping besides geological studies of Antarctica.

A digitization program of geological maps in order to reduce the transaction cost and speed up the dissemination of geological maps to the users in underway (Mathur 2004).

GSI provides various products like memoirs, records, journals, bulletins, different thematic maps and atlases, and unpublished reports. The price list is given Annexure I[7]: The GSI maps are extensively used of disaster studies like earth quake, landslide etc., Thus, the mandate of this organisation is to serve the society better.

3.3.1.3. Census of India

The Indian Census is the largest single source of statistics on the people of India. With a history of more than 125 years, this reliable, time tested exercise has been bringing out a veritable wealth of statistics every 10 years beginning from 1872 when the first census was conducted in India non-synchronously in different parts. Census department with its 7000 staff including 5500 data entry staffs, 15 data entry centres and 640 terminals is providing the Census data online, mainly on the important demographic and socio-economic aspects of the country. COI Provides Census of India statistics on a large number of key indicators, such as, Area, Population, Number of Households, Nuptiality, Fertility, Literacy Rates, Work participation Rates, Religions, Languages, Housing and Household Amenities etc every ten years. The price list of COI is shown in table in Annexure I.

Census Organization has introduced a special consultancy services to help data users in meeting their requirements on a short term or a long-term basis. The Consultancy Service will be made available at a reasonable price depending upon volume of data to be used, time spent, requirement of software development, etc[8].,

The data from this organisation is mainly used various Government departments for planning scheme based on the population, literacy, Schedule Caste / Schedule Tribe population etc.,. However, COI started its consultancy services providing user specified products for price.

3.3.1.4. National Atlas and Thematic Mapping Organisation

Important publications of NATMO are: National Atlas of India, Tourist Atlas of India, Atlas of Agricultural Resources of India, Forest Atlas of India, Atlas of the City of Calcutta and Its Environs, Water Resources Development Atlas, Land Resources Atlas, Students Reference Atlas, Indian Ocean Atlas, National School Atlas, Socio-Economic Atlas, Health and Disease Atlas etc., The price is varying from Rs.10 for the loose sheets to Rs. 290 to the Atlas in the book form.

3.3.1.5. National Remote Sensing Agency

NRSA is the sole organisation in the country to disseminate remote sensing satellite data. It is responsible for acquisition, processing, and dissemination of remote sensing data from Indian satellites as well as other satellites. The Indian Remote Sensing Satellite (IRS) System became operational with the launch of IRS-1A, on March 17, 1988. This launch made India the 5th country in the world to have a sophisticated and indigenously developed state-of-art remote sensing satellite. IRS System presently has the world's largest constellation of five remote sensing satellites – IRS-1B, IRS-1C, IRS-1D, IRS-P3, IRS-P4 (OCEANSAT-1) and IRS-P6 (RESOURCESAT) offering space-based data in a range of spectral bands, spatial resolutions and swaths. Over years, NRSA has acquired a rich database from thee Satellite at various resolutions in temporal, spatial and spectral domain. The various data products from NRSA Data Center (NDC) is given in the price list (Annexure I)

Direct Sale from NRSA

NRSA is the only one Government organisation selling the satellite imagery and earning visible revenue. Hence, detail of the data sale and revenue earned is presented in this paragraph. A graph of revenue earned for the past 10 years is shown in figure 3.1 where it is clear that revenue is increasing every year. During the year 2003-04 total sale was 17804 – which resulted in revenue of Rs 2441 Lakhs. This consists both regular satellite data products and Value Added Products. This revenue earned by data sales is highest so far and is almost 10% more than last year's figure of Rs 2220 Lakhs.

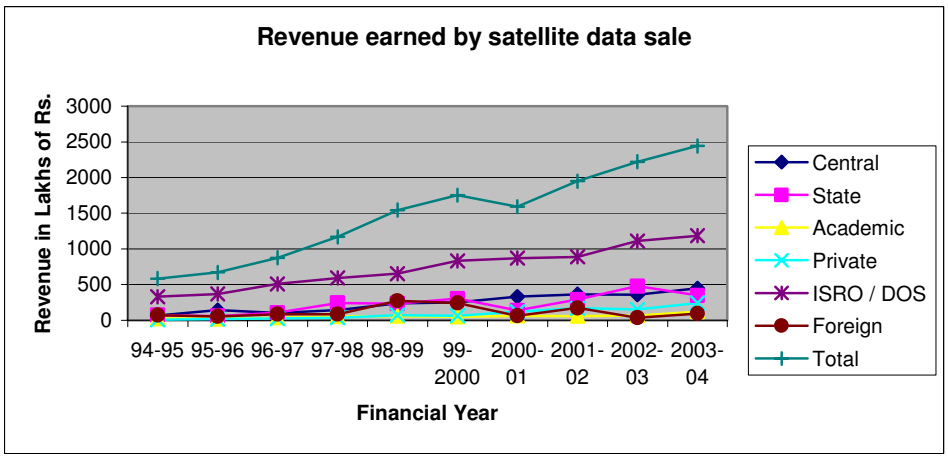


Figure 3-1 : Revenue earned by NRSA

3.3.1.6. National Natural Resources Management System

Under NNRMS, a number of mechanisms have been devised for effective interaction / coordination among users for optimal management of country's natural resources. Standing Committees (SCs) in various natural resources sectors were formed for sectoral coordination and guidance. Infrastructure and human resource developmental activities such as setting up of Regional Remote Sensing Service Centres (RRSSCs), State Remote Sensing Application Centres, Cells/Units in Govt. departments, entrepreneurs, training, introduction of remote sensing in the curriculum & research projects etc.

The utility of remote sensing data in India has been highly appreciated by policy makers / planners The data is used for several applications covering agriculture, water resources, urban development, mineral prospecting, environment, forestry, drought and flood forecasting and ocean resources. Thus the IRS system has become the mainstay of NNRMS for effectively managing India's natural resources. One of the most unique application of IRS data is in the Integrated Mission for Sustainable Development (IMSD) launched in 1992. IMSD covers 175 districts and is aimed at deriving locale specific prescriptions for sustainable development using satellite and collateral socio-economic data. NNRMS is responsible in providing a huge database of Natural Resources Information System (NRIS) for 14 states and work is going on for the rest of the states. There are more than 50 projects are ongoing in collaboration with other organisations with a total cost of Rs. 400 crores. ***(ISRO 2004).***

The product from NNRMS, say ground water potential map is prepared for another Government organisation (funded by Department of Rural Development). These maps are used by another government agencies like state government department for locating the well sites. Thus, Ground water map is by the Government agency, for the government agency and goes to another government agency. Hence, these type of products are prepared for the societal benefits rather than commercially viability.

3.3.1.7. Annual Budget of the Major GI Providers

An attempt was done to get the annual budget of major GI providers at National level in India. The following table gives the budget of few ones as presented on the Web[9]. Total budget of these major agencies is more than Rs 10,000 crores for year 2004-05 (Table 3.1). However, partial budget may be spent on GI production and services. It was also observed that total; revenue earned through the sale of products and other services provided under GI domain is only of the order of 10% of the total budget.

Organisation	2002-2003 crores of Rs.	2003-2004 crores of Rs.		2004 - 2005 crores of Rs.
	BE	RE	BE	BE
DOS	2263.87	2163.87	2368.47	2731.29
SOI	167.33	156.84	156.42	166.95
NATMO	8.25	7.40	7.50	8.0
IMD	167.82	167.08	112.81	Not available
GSI	325.28	245.73	338.51	333.8
Indian Bureau of Mines	29.60	29.09	31.28	33.15
TCPO	3.83	3.75	3.42	3.5
NCR	56.50	56.50	51.90	55.0
National Informatics Center	175.02	175.02	165.70	170.5
Forestry Survey of India	395.41	373.68	438.70	10.55
Census Of India (COI)	168.90	133.22	118.14	Not available
Central Water Commission	92.36	80.97	90.80	96.08
Dept of ocean Dept	199.28	174.28	199.33	230.08
Public Works Department (PWD)	169.18	159.57	165.61	185
Scientific and Research Activities	830.28	746.19	982.29	1300
Department of Tourism	257.21	288.63	366.30	541.74
National Institute of Hydrology	6.23	6.14	6.98	7.5
Ministry of Home Affairs	702.76	677.60	717.86	735.31
Department of Tourism	257.21	288.63	366.30	541.74
Disaster Management Center	4.07	4.07	4.87	Not available
Ministry of Information and Broadcasting	1533.50	1513.59	1521.12	1514.17
Department of IT	500.38	502.38	502.66	786
Central Ground Water Board	146.46	134.49	133.33	146.87
Flood Control Board	52.69	51.97	49.36	
Ministry of Environment and Forest	1111.05	1053.80	1124.69	1301.21
Wadia Institute of Himalayan Geology		7.18	7.25	8.5

Table 3.1 : Annual Budget of Prime GI Providers in India

3.3.2. State Level GI Providers

There are 28 states and 7 union territories in India. Each state has its own departments for soil, agriculture, forest, irrigation, mines and geology, land administration etc. All these departments are generating the data pertaining to the need of the respective states and governed by their own state laws. Apart from these NNRMS has promoted and encouraged the establishment of State Remote Sensing Applications Centres (SRSAC) in states - mainly to support and cater the state requirements of remote sensing data analysis, GIS and developmental support. Totally, 28 states have established their respective SRSACs and generated huge amount of GI through national level programmes / missions co-ordinated by various Central Government Departments. A list of major state government organisations are briefed in the next table.

Institution / organizations	Main functions
State Remote Sensing Centres	To support and cater the state requirements of remote sensing data analysis, GIS and developmental support. Carry out various application projects of relevance to their respective States.
Land Records Administration (LandAdministration Department)	Micro and macro level planning. Preparation and continuous updating of land records and registration of land transactions through cadastral surveys. Implement all land related laws including land reform laws Collects land revenue, non-agricultural land assessment, irrigation dues, agricultural loans and all other dues under the Public Demands Recovery Act, Collection of agricultural statistics
Irrigation Department	Ensure the proper utilization of water resources of state Ensure irrigation by mean of Canals, tube-wells, dams etc. Flood control in river, Removal of water logging, Training of rivers for protection of towns
Public Works Department (PWD)	Planning, designing, construction and maintenance of Government buildings, bridges, national highways, state highways, major district roads, air strips Planning for irrigation Taking measures for flood-control
Ground Water Departments	Provide the hydrology maps on all scales covering that particular state.
Department of mines and Geology	To prepare geological, geophysical and geo-chemical maps and explore and assess mineral resources of the state.
State Forest Department	To prepare the forest boundary map and assess the forest resources.
State Soil Department	To provide the soil information.

Table 3.2 : Major State level organizations and functions

3.3.3. Private GI Providers

There are many private firms generating GI in the country. Reliance of India is one such example which had developed database of the 140 cities on 1:1000 scale for its internal use; however, firms like Eicher map provides the detailed city maps for sale. Major private on-line GI providers of the countries are listed in the table.

Name	Products
Cochin City Map	Interactive Map of Cochin City
EicherMaps.com	Detailed Digital Map Data approved by the Ministry of Defence, for the major Indian cities Delhi, Mumbai, Chennai, Bangalore and Kolkata
Free India Map	State & District maps of India.
iMapIndia.com	An Interactive Map Server for the cities of Delhi, Mumbai, Chennai, Kolkatta, Bangalore, Hyderabad, and Pune
Keralamap.com	Clickable maps, and other of information about Kerala
ManChitra.com	An Interactive Map Server for cities of Delhi, Mumbai, Chennai, Bangalore, etc.

TERI maps	National forest vegetation map, Soil Degradation map, Energy Generating Units map, Some Major Industries, Water Quality in major river systems map.
mapsofindia.com	Indian maps for presentation purpose like Country, State, District Boundaries, Road Network, Rail Network, you can get all these at this site
Micronet Solutions	Micronet Solutions the sole distributors for the sale of soil resource maps (for entire India on 1:250,000 scale) of National Bureau of Soil Surveys & Land Use Planning, Nagpur.
Spinfosoft.com	Digital maps for states of Karnataka, Kerala, Bangalore and Chennai at District, Taluk / Tehsil, Village levels along with integrated information of roads, social economic data and census data.
Spotomatic.com	Digital map of Chennai, both in English and regional language of Tamil
mapmyindia.com	Road Network map of the entire country and interactive queries

Table 3.3 : Non-government / Private GI providers at local level

3.4. Major Users of GI

We can classify the GI users as existing users and potential users. Following two sections explains them briefly.

3.4.1. Existing Users

Many organizations play the dual role of both GI Provider as well as GI Customers. There are more than 2300 GI Stakeholders exists in the country (NDC 2005). Though the Government agencies are the main GI providers as well as users of GI, other users are from the various sectors like private, public organizations, NGOs, Academia and Research Community etc., Major stakeholders are analysed based on whether they are Supplier / Producer, Regular Consumers, Occasional Consumers or only the beneficiaries. Out of over 2300 stakeholders, few major stakeholders (188) analysed are listed in ***Annexure-2.***

3.4.2. Potential Users

The emerging market of GI opens up ample opportunities for GI generating agencies like SOI, NATMO, IMD to exploit the market potential and earn revenue for their respective departments. They can become self reliant by selling the data after doing the value addition and making their data more user-oriented (Gupta 2000). When these data comes from a one-stop source through NSDI, will lead to a major source for all GIS activities and thus bigger market. With the recent Tsunami disaster, major emphasis will be given to disaster management in the country. The first and foremost requirement would be the creation of database, and GI would play a major role.

However, there is a tremendous scope for value addition to these raw data. One can think of services that can be provided using this infrastructure is to support the planning and development activities, specially the management of natural resources, disaster management, watershed management/development, district planning, state planning, resources monitoring, rural development, Land capability Analysis; Optimal Landuse Planning; Water Resources Development; Agricultural Development; Irrigation planning; Watershed Development; Wasteland Development, Settlement Hierarchy, Facilities Planning etc. Government would find use of NSDI to prepare spatial plans for the whole country - annual plans, five-year plans,

perspective plans; inventory of natural resources; for quick assessment of damages during natural calamities and disasters and monitoring and evaluating the various governmental policies and programs. Other services include cadastral / tax mapping, crime analysis, education, emergency services, environmental management, health, military/defence, oil and gas, property management, public safety, telecommunications, tourism, utilities, etc. Few examples where already information is reaching every realm of the society is given in the next paragraphs..

3.4.2.1. e-Choupal

e-Choupal, the unique web based initiative[10] of Indian MNC, ITC which offers the Indian Farmers all the information, products and services they need to enhance farm productivity, improve farm-gate price realisation and cut transaction costs. Farmers can access latest local and global information on weather, scientific farming practices as well as market prices at the village itself through this web portal - all in Hindi. Choupal also facilitates supply of high quality farm inputs as well as purchase of commodities at their doorstep. Given the literacy and infrastructure constraints at village level, this model is designed to provide physical service support through a Choupal Sanchalak - himself a lead farmer - who acts as the interface between computer terminal and the farmers.

At village level, a solar powered computer set up with a VSAT is connected through a hub to provide all the needed information and services. There are already 5000 e-Choupals covering about 30,000 villages in Madhya Pradesh, Uttar Pradesh, Rajasthan and Maharastra, and adding 30 new villages per day. It is expected to achieve transactions of Rs.10,000 Crores by year 2010 (Sahai 2004).

Cost incurred by farmer Rs./Tonne	Trading cost for	Mandi	e-choupal
	Trolley freight	120	120
	Labour	50	nil
	Middleman	150	nil
	Handling loss	50	nil
	Total	370	120
Cost incurred by processor Rs./Tonne	Commission	100	50
	Gunny bags	75	75
	Freight to factory	120	nil
	Storage & Handling	40	40
	Disbursement cost	nil	50
	Total	335	215
	Total Chain	705	335

Table 3.4 : Cost saving by e-Choupal (ex. of oil seed trading)

By the table 3.4, it is clear that by shifting to e-choupal, farmers save 68% of the cost and processing company about 36%. Today, it is the trend for Indian based Multi National Companies (MNC) to invest in rural India, taking the latest technology to the rural in giving the information directly to the farmers (Saran 2004).

3.4.2.2. Bhoomi

The Department of Revenue in Karnataka has computerized 20 million records of land ownership of 6.7 million farmers in the state. Previously, farmers had to seek out the Village Accountant to get a copy of the Record of Rights, Tenancy and Crops (RTC) - a document needed for many tasks such as obtaining bank loans. There were delays and harassment. Bribes had to be paid. Today, for a fee of Rs.15, a printed copy of the RTC can be obtained online at computerized land record kiosks (Bhoomi centers) in 140 *taluk* offices. The remaining 37 *taluks* are expected to have a Bhoomi center by March 2002. In the next phase, all the *taluk* databases are to be uploaded to a web-enabled central database. RTCs would then be available online at Internet kiosks, which are likely to be set up in rural areas.

During one month (October 2004) alone (Revenue 2004), 775043 farmers used this kiosks and paid Rs. 11,625,650.00. This works out to be Rs.10 Crore in a year. Similar such programs are being implemented in many other states. For example, “Friends” in Kerala, “JanmaBhoommi” in Andra Pradesh. If such kiosk made available through out the Nation (28 States and 4 Union Territories), and if similar usage is found then, the average revenue per year could be Rs. 280 Crores (say Rs.300 Crores).

3.4.2.3. Location Based Services (LBS)

LBS envisage accurate, real time positioning of mobile users and delivery of quick response to request for location specific information on mobile devices anywhere at any time. Emergency help is the prime reason. During emergency calls, response time can be substantially reduced to mobile user if the call responders have information concerning the location of the person making the call. The request may be related to points of interest such as hospitals, police stations, restaurants, convenience, entertainment, ATMs , hotels, traffic, weather etc. Response may cover information about location of interest, or route direction, delivered via wireless devices.

LBS may facilitate certain jobs across industries. For example, emergency call regarding breakdown of drainage pipeline may help a plumber to quickly find the location of the pipe, details of the surroundings etc. Mobile device with Global Navigation Satellite System (GNSS) built in can be used to query a database consisting of locations of valves that would permit the isolation of drain water supply at the appropriate location. Similarly, dispatchers for taxies, logistics providers and sales force can use the technology to track drivers, service and sales personnel carrying cell phones and direct them along the most expedient routes(Kaushal 2004).

3.5. Data Sharing among the GI Organisations

It is observed that, Government continues to play a major role in inventory and mapping of national resources and establishing a rich information base in the country. Each organization depends on another organization for the base information. The inter relationship between two

organizations to produce a map is shown in the Figure-1. The topographical maps at various scales are ideally suited for the professional work of geologists, geographers, foresters, engineers, planners, tourists, trekkers, mountaineers and others. From the figure it is clear that most of the organisations make use topomaps and satellite image as input to produce their thematic data.

(Selected group of stakeholders adopted from Acharya P. 2003)

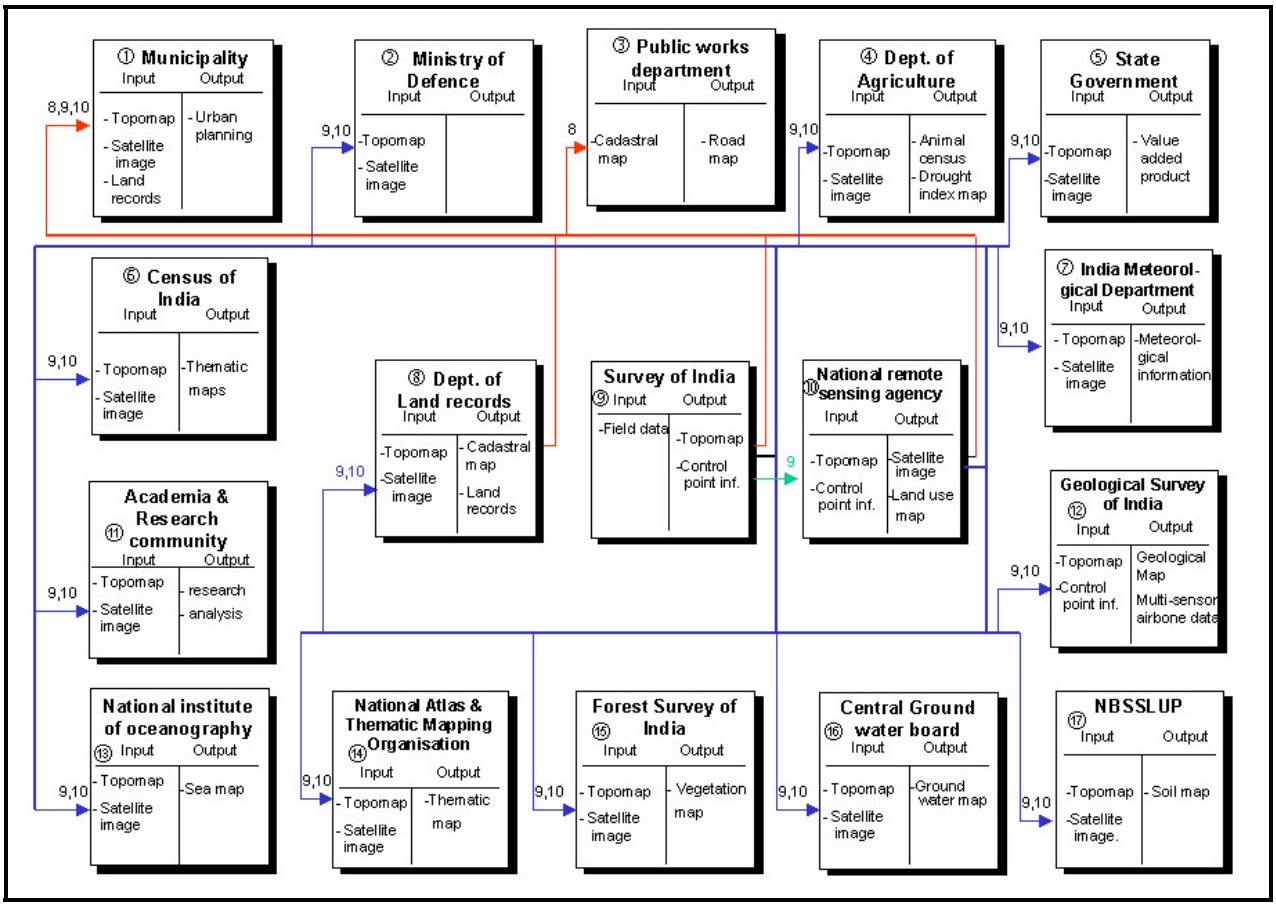


Figure 3-2 : GI Sharing among the Organizations

3.6. Indirect Benefits

Information has economic value only if individuals and institutions use it for making decisions. One way of looking at the economic value of information is to link it with its role in decision-making. In this approach, if superior (more accurate, more timely and easier to use) information is available, institutions will use it to improve decisions. Such improvements in decision-making would add value to the activities of the institution. In traditional neo-classical economic theory, firms, organisations and individuals that compete with each other are supposed to have equal access to perfect information. In the real world, many organisations dominate industries and markets because of their ability to secure, use and manage superior information. They create

asymmetric competencies that provide them with long term sustained growth opportunities. Moreover, in actual practice even though superior sources of information may be available, individuals and institutions differ widely on their ability and capability to use such information.

A three-member independent team was constituted to review and evaluate the costs and benefits of the remote sensing programme of the country. The analysis of the few applications considered shows that the potential benefits of remote sensing to the economy would be at least Rs 3,000-6,000 crores a year (Rajan 2000). The detail is given in ***Annexure III***.

3.7. Capacity Building

Large number of universities has introduced Remote Sensing as a full course/paper/part of paper. Around 9500 personnel have been trained at Indian Institute of Remote Sensing, NRSA, GSI, CGWB, FSI, NBSS&LUP, IRS so far. Apart from this large number of teachers and working level scientists were trained by special training programmes organized by NNRMS.

3.8. Status of NSDI

NSDI plays a strategic role in GI provision; one of the crucial factor for GI market is the maturity of the SDI at National level. The maturity of the NSDI from an organizational perspective can be measured by the existence of a vision, leadership, communication strategy, coherence and intention of the geographic community to initiate new innovations. The extent to which these aspects are present in an SDI initiative determines its stage of development, and as a result the success of that SDI (Kok and van Loenen 2004). These aspects in addition with existence of facilities like Internet, Website portal etc., has been studied and presented in the Table 3.5 below:

Element	Status	
	5 Years back*	Today
Vision	No	Yes
Strategy for NSDI	No	Available
Data in analog form	Yes	Yes
Digital data	No	Partially yes
Metadata	No	National Standard exist, metadata is being populated
Networking	No	Partially yes
Institutional arrangements	No	No
Standard	No	Metadata Standard Exchange format Thematic content standard exist
Policies	No	NSDI Bill Information Act Remote Sensing Data Dissemination policy

No. of organisation with GIS	Few	Many
No. of organisations with GIS & Internet	Very Few	Many
No. of organisations with GIS Portal	Nil	Few
Clearing House	No	Evolving
Data Pricing Policy	No	Yet to Evolve
Data dissemination policy	No	Yet to Evolve
Information economy	Poor	Improving
Copyright	Each Org. with its copyright	Each Organisation with its own copyright. However, no copyright policy for digital data
Freedom of Information	No	Partial

*Source : Prospects and Problems of GIS in India (Gupta 1999)
Table adopted from "Evaluation of Africa's readiness for SDI" (Ezigbalike, Selebalo et al. 2000)

Table 3.5: Evaluation of Readiness of India's SDI

3.9. Product / Service Analysis

NSDI is providing the products listed in the Table-2 through NSDI clearing house which is the mechanism to provide access to the metadata and finally to the actual data sets from the participating agency. The NSDI Gateway and user interface allows a user to query distributed collection of spatial information through their metadata descriptions. Metadata helps the prospective users to determine what data exist, the fitness of existing data for planned applications, and the conditions for accessing existing data, and to transfer data to a user's system (ISRO 2003).

The detailed list describing the custodian of data, type of data, coverage and the scale is listed in Table (***Annexure IV)***. Topological Maps, Satellite Imagery, Geological Maps, Soil Maps, Hydrological Maps, Natural Resources Information Systems, Census Information etc., available in the country will form the core of NSDI. The agencies listed are only from the Federal Governments; The NSDI would get augmented with organizations of the State Governments and then in turn by non-governmental agencies.

3.10. Summary of GI Market

NSDI would trigger business potentials in Information generation (new as well as updation), Access and Networking, Hardware/Software solutions, and Value-added Services. A broad estimation of GI market in various sectors is given in the following table.

Sl. No	Sector	Total Market Size*
1	Agriculture	Rs. 500 crores
2	Farm Management Services	Rs. 200 crores
3	Water Resources	Rs. 500 crores
4	Utilities Management	Rs. 500 crores
5	Mineral Exploration & Mining	Rs. 100 crores

Sl. No	Sector	Total Market Size*
6	Coastal & Fisheries	Rs. 100 crores
7	Environment & Forests	Rs. 100 crores
8	Land Information System	Rs. 1000 crores
9	Citizen's Information Service	Rs. 500 crores
10	Urban Area	Rs.3285 crores
11	Disaster Management	Rs. 625 crores
12	Bhoomi type of application	Rs. 1500 crores
13	Location Based Services	Rs.2500 crores**
Total		**Rs. 8910 + 2500 crores including LBS**

*For the next 5 years ** Yet to take-off.

Table 3.6 : Summary of NSDI Business Opportunities

It may be noted that Source for serial No. 1-9 : Extracted from the Presentation during 2nd NSDI Workshop, 2002, Ooty - NSDI Business Opportunity (Sridharamurthi, Rao et al. 2002). Serial No. 10-13 are the on-going projects. From the above table one can expect a total Rs.2000 crores annually.

Another important observation is that GI Market exists, even without NSDI. Many organisations are selling the data and earning revenue even without NSDI. GI market can be thought of as an automobile market if NSDI is something similar to National Highway (NH). Even without NH automobile industry exist, similar to GI industry.

3.11. Major Issues

Though, there is a good base of rich information and dependency between the organisations, effective use of GIS has not been seen with the conventional approach. Major issue is the data access to the public because of the restriction policy. Maps of restricted areas are not easily accessible. Aerial photography in whole of the country is considered secret or top secret by the government. Private sector is virtually debarred from entering into this sector. Digitisation of Survey of India toposheets can be done by only a few government agencies. Digital data is not available with most of the data producing agencies and at times even analogue data is not accessible(Gupta 1999).

Most of the organisations in the country are not ready to share the data as they feel they own it. It is extremely difficult to access any government-generated data. Moreover, existing datasets have been collected to different specification making it difficult to integrate the data collected from different sources. In summary following are the issues Concerning Business:

- The current strategic plan is not matching with the fast growing GIS market and ICT.
- Marketing and cost recovery initiatives are not adequate.
- Mandatory activities are behind schedule
- Policies for sharing of data and GIS resources are being formulated.
- There is no National standards which overcomes heterogeneity and facilitate the sharing of data / service.

- Development of human resources in GIS / ICT is inadequate.
- Being very conservative in 'Vision', never explored the collaborative work.
- 'Pricing' is yet to be decided.

Many factor either technical, organisational, cultural or institutional issues are not encouraging the GI business in the country. For a successful market, one important aspect to be considered is that though GI is feasible from technological point of view, it may not be desirable by the society. Care must be taken to involve the society in providing solution-using GI(Erik de Man 2004). Another important aspect of market is the customer satisfaction (Tuladhar 2004). Organisation must sell the product / service what customer wants, not just the map / product what organization produces. It is necessary for an organisation modify its product as per the customer specification. Also in order to respond faster there is a need to consider distribution of GI products through e-service, which call for shift from the current market-place to market-space(Beerens and Vries 2002).

3.12. Conclusion

Large-scale investment in communications technology is expected as India moves to exploit the full potential of the information age. Recent initiatives by the Government, including the IT Act, as well as announced plans for private and public investment, make it clear that within a few years an unprecedented capability will exist for sharing of data along electronic superhighways. GI will be a major content.

India, with its diverse landscape is a perfect fit for a technology like GIS and has been employed in many different areas and in newer fields of applications. Hence usage and type of applications is now incredibly diverse. The use of GI has always been considered to be a vital asset in decision-making; hence, a large number of government departments, both at the centre and the state level, have established GIS centres.

Technology is helping to realize the benefits of GI and also policy change reflects the desire in society for improved openness and inclusiveness. It is also envisaged, that at an appropriate time after operationalisation of NSDI, access to NSDI could be driven by commerce. Harmonized specifications will immensely facilitate the sharing of information between the various data providers/producers. The current practice of parallel and sometimes conflicting maintenance of the same information in different databases, due to data incompatibility, will significantly decrease. Reducing duplication will reduce the cost of maintenance, increase the quality and reliability of the data, and reduce the time interval between the occurrence of an event and the availability of the relevant information to the users.

India has a good institutional infrastructure for GI growth. There is a huge network of institutions collecting geographic information on every conceivable socially and scientifically relevant subject. There is a huge investment made by the Government and is expected to boost the GI market to Rs.2000 crores annually. Also, it was estimated that potential benefits of remote sensing projects alone is Rs. 3000 – 6000 crores annually.

4. Data Collection and Analysis

4.1. Introduction

In the previous chapter, GI market scenario in India was discussed based on the data collected through literature reviews, interviews and questionnaires. In this chapter, methodology for data collection, design and preparation of questionnaire, clustering customers, distribution of questionnaire, Interview with various GI experts and feedback from workshop are discussed in detail. Data analysis using statistical methods, completeness of result, and accuracy of result and validation of field data collected are also discussed.

4.2. Background

For any research data is very important. Data can be collected by four methods, namely Instrumentation, Communication, Observation and Participation (Kaewsonthi and Harding 1992). In this study Communication and Observations are the mainstay of the data collection. Evidences are sought from the documentation, archival records, direct observation, participant's observation and physical artefact as suggested by the researchers (Yin 2003).

4.3. Methodology

There are two approaches for data collection through primary data sources and secondary data sources. In the current research both the methods were used to collect the data. In case of primary data collection, questionnaire and interview method was used. At the end, a workshop was conducted to get the opinion of experts after developing strategies for market driven NSDI. The secondary data is extracted from books, records, market survey reports, annual reports, published articles and Internet. The details of the data collection methods are given in the following sections.

4.4. Scope of Required Data

The main purpose of data collection was to assess the GI market in the country. Information on GI demand, supply, products/services, current use, current status of data exchange, constraints, policies, institutional arrangements, metadata, pricing, standards and the perceived use of GI are being collected through questionnaires and interviews.

4.5. Questionnaire

The questionnaire allowed data collection from a large group of people in a relatively short time at a relatively inexpensive cost. Data collection is done by a structured questionnaire sent and returned by mail. Two questionnaires were designed and issued separately, one for public organisations and another for private organisations, as the culture and mandate of these

organisations are different. Option of separate questionnaire for GI user and GI provider was thought about. However, initial studies showed that majority of the organisations are both GI user as well as GI provider; so there is no point in having separate questionnaire, as the same organisation needs to provide the information. Hence, the GI market is assessed from perception of public and private organisations.

The questionnaire was prepared to understand the GI market situation in the country. The questionnaire contains both open and closed type of questions; most of the questions are with "multiple choice" and *yes* or *no* answers. Other question types included short explanation and filling in tabular information. The questionnaire was designed targeting the respondents who are familiar with GI and its use. The respondents were also assumed to be primarily professional or managerial level people with a high level of education. There are 50 questions for public organisations and 40 for private. The similar questions were grouped together into eight sections, so that respondent can feel comfortable to answer. The questionnaires were designed using other sample questionnaires such as The USGS Standards Survey and User requirement: user survey by UK[11], Survey of NSDI by Harlan Onsrud[1] and various ITC theses. The questionnaires are given in ***Annexure 5 & 6.***

Mailing list was prepared covering the sectors Geology, Forestry, Topography, Water Resources, Ocean, Town planning, Soil, Census and service provider. It was clear from the beginning that it would be impossible to include all possible users of GI, as there are more than 5000 existing users in India. However, reasonable representations of GI users of various sectors were considered. Care was taken to include all the members of the NSDI-Task Force and the major organisations who are using satellite data and dealing with GI. 150 questionnaire were sent to all the sectors like Central Government, State Government, Academic Institutions, NGO and private parties, covering the whole geographical area. 47 questionnaires were received out of 150 issued representing 31% return rate. Table 4.1 provides an overview of the number of questionnaires sent and response received.

Sector	Questionnaire sent	Response Received	Sector-wise average Response %	% Response w.r.t Total
Central Govt. Organisation	77	24	31	51%
State Govt. Organisation	25	7	28	15%
Academic	9	2	22	4%
NGOs	4	2	50	4%
Private	35	12	34	26%
Total	150	47	31	100%

Table 4.1 : Response Rate of Questionnaire

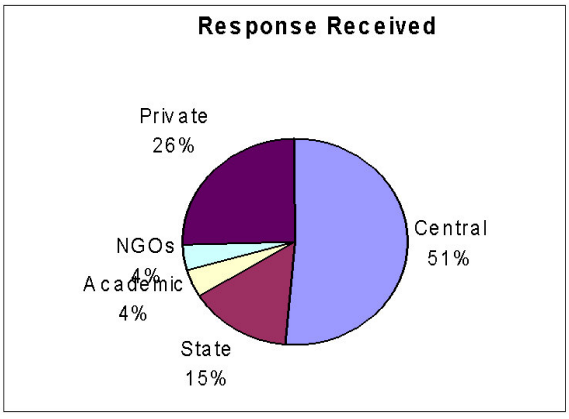


Figure 4-1 : Percentage Response

4.5.1. Reasons Behind Good Response Rate

Two questionnaires were sent to each organizations (one to the Director / Head and another to working level scientist / Middle level managers). This is because, if Director feels he is too busy to respond these questionnaires, at least next level person can reply. In this way, at least one questionnaire will be assured from one organization. However, when the organization is big and consists of many divisions responsible for particular thematic activities, a separate questionnaire was sent to each division.

A self-addressed stamped reply envelope was attached with the questionnaire to get better response. This makes it convenient for the respondent to reply and also the identification number on the envelope helps the further follow-up.

Participated in NSDI-IV workshop and discussed with various GI experts regarding the key issues of NSDI and GI market. Also, few more questionnaires were distributed during the workshop.

It was possible to track the questionnaires as every respondent gave their identity, though the name was optional. This helped in reminding the people who had not returned the questionnaire.

4.6. Interview

Interviews are useful in obtaining background information as well as clarifying a number of issues in the questionnaires. Interviews were conducted at various locations like Delhi, Ahmedabad, Gandhinagar, Lucknow, Mangalore, Hyderabad and Bangalore. In this study, a semi-structured interview is adopted. Here, the interviewer uses an interview guide with questions that are mostly open-ended, designed to encourage the respondent to talk freely around each topic. 17 GI experts from 15 organisations (who are either heading the organizations or leading a national team or national project) were interviewed. Typical issues discussed during interviews are strategies to be followed, NSDI bill, legal aspects like copy right, map policy, bottlenecks for implementing NSDI, challenging issues and the public private partnership etc., The responses were recorded in respondent's own words during the interviews.

4.7. Workshop

One-day workshop on "evaluation of strategies towards market driven NSDI" was held on 28th January 2005. 24 participants from 11 organisations were participated. Separate sessions were organized for private and public organisations. The results of the study were presented and the final opinions about the strategies developed were sought through Delphi method survey.

During the workshop, few Additional criteria were added are – Firstly, GI is flourishing in most of the organisations where "GIS Champion" is heading. There is a need to identify the allies and train them. It is the responsibility of the leader to discover who are likely to be allies and who may need some persuasion. Secondly, it was felt that GI should be provided in the local language as majority of the users may not be knowing English.

Strategies were grouped in terms of technical, organizational, institutional and cultural issues. Two strategies in each of the categories were prioritized after getting the opinion from the

participants. It was agreed that the problems for GI access, use and market is technical organizational as well as institutional and all these needs to be tackled simultaneously.

4.8. Document Review

Source of Secondary data are background information in the form of reports, legislations, evidences that can be used to substantiate conclusions to make them as objective as possible. Extensive literature review was done to understand the current trend and GI market situation in the country as well as elsewhere in the world. In order to get the GI turnover and the value of assets of GI Organisations, Annual Reports, market survey reports and ***indiastat*** website were consulted. A summary of the types of data collected is listed below.

- Policy documents – NSDI Bill (draft), Remote Sensing Data Dissemination Policy
- NSDI Documents – Strategy and Action Plan, Metadata Standard
- Project Reports – NRIS Project, NRDMS Project, NUIS Project, Disaster Management
- Excerpts of Statistical Reports
- 10^{th} Five Year Plan Document
- Annual Reports of various organizations
- Market Study by MICUS, OXERA, GINIE Report
- Various Internet Sites

4.9. Overview of Survey

It was clear from the beginning that it would be impossible to include all possible users of GI, as there are more than 5000 existing users (2300 from NDC mailing list another 2700 estimated figure) in India. Care was taken to include all the major GI providers and the users in different sectors at national or state level. The authors believe that this goal has more or less been reached and that national organizations are in nearly all cases faithfully represented. Questionnaires from some state or national authorities give insight into data existence on local and regional level. Thus this survey will nevertheless provide comprehensive picture of the data availability in the country.

4.9.1. Reliability of Results

The questionnaires were sent to the organizations, which are using Remote Sensing, GIS technologies and aware of NSDI. The majority of the respondents are having experience of more than 10 years in use of GI in the relevant field. Year of experience of all the 47 respondents is given in the figure below. The data is considered to be reliable on the basis that the respondents are conversant and knowledgeable about the issues raised during the workshop and the survey. They also represent key persons within the GI organization, and various GI societies.

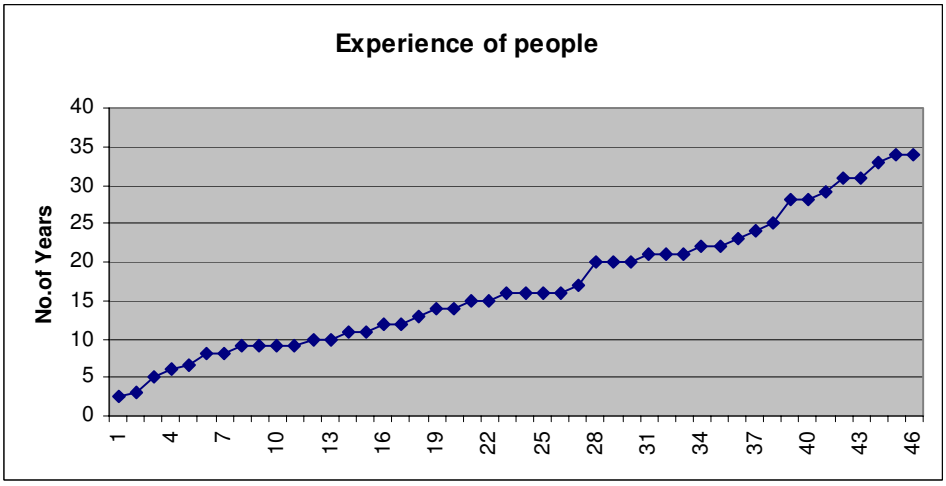


Figure 4-2 : Experience of the Respondents

4.9.2. Completeness of Results

Response was received from all the sectors with the same percentage as questionnaire sent. For example, questionnaire was sent to different sectors in Central Govt., State Govt., Private, Academic and NGOs in the ratio of 51 : 17 : 23 : 6: 3 respectively, and received in the ratio of 51 : 15 : 26 : 4 : 4 respectively. All most all the questions were answered; however, a few cases existed where information was doubtful which were clarified through telephonic and personal interviews.

4.9.3. Accuracy of Results

The data collected are considered accurate because they compare well with other reports available. Author has the advantage of access to many internal reports that was compared with answers provided by the respondents.

4.10. Summary of Data Analysis

Database of returned questionnaire is being prepared to make the analysis easy and fast. Data will be clustered and analysed based on a relevant statistical method. Strategies suggested which were developed after literature survey and the interviews will be evaluated using multi-criteria analysis incorporating the feedback from the customer need analysis.

4.10.1. Infrastructure Availability

One of the important component NSDI and GI market is the availability of infrastructure like Computers, GIS and Image Processing software, database management systems, Internet and network connectivity. Availability of Geo-ICT was Investigated and presented in the next few paragraphs.

4.10.1.1. Geo-ICT

Most of the organisations responded have good infrastructure facilities. Apart from the basic computer facilities, these organisations equipped with good image processing facilities, GIS s/w as well as h/w and GPS. Majority of the people are using ESRI products. Some of the

organisations even have dedicated Digital Photogrammetric Total Stations and virtual GIS and CAD S/W Palmtop etc.,

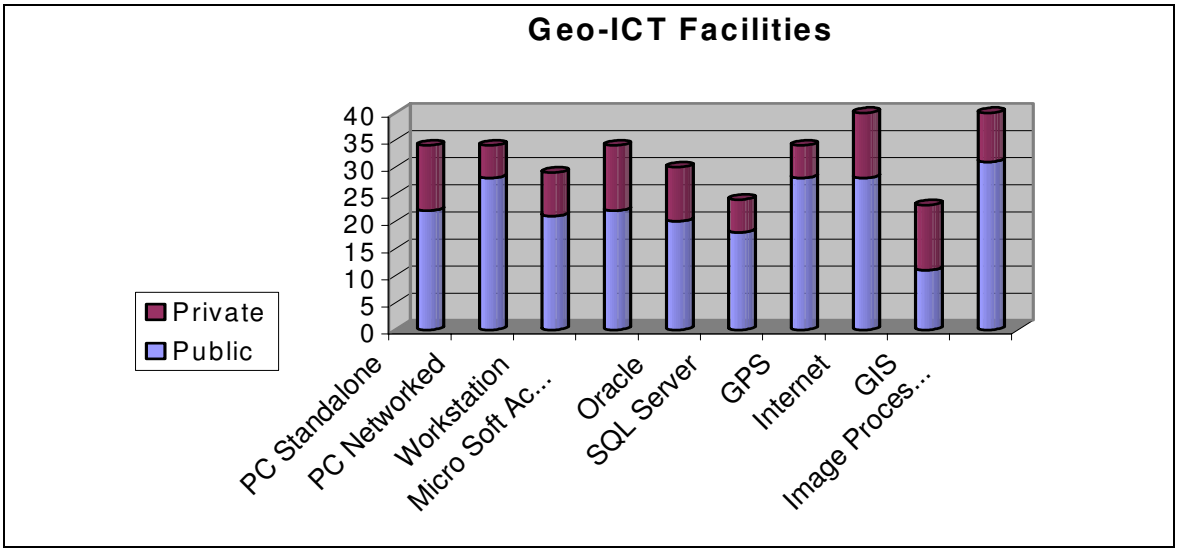


Figure 4-3 : Availability of Geo-ICT Facilities

4.10.1.2. Network Infrastructure

Concerning the availability and use of technology, no significant difference can be observed between different types of organizations, between the public or private sector or research and educational organizations. Each Organisation is well equipped and has Internet facility; 80% of the organizations have their website. However, only 10% organizations are using the same for selling their products

4.10.2. Customers

4.10.2.1. Change in Customer's Numbers

Majority of the data is being supplied to the Government organisations. There is a steep increase in the number of customers in the recent years. 84% of the respondent feels that number of customers has risen in the range of 10 – 50 % . Also, the customers are expecting new products with higher resolution and more value added products.

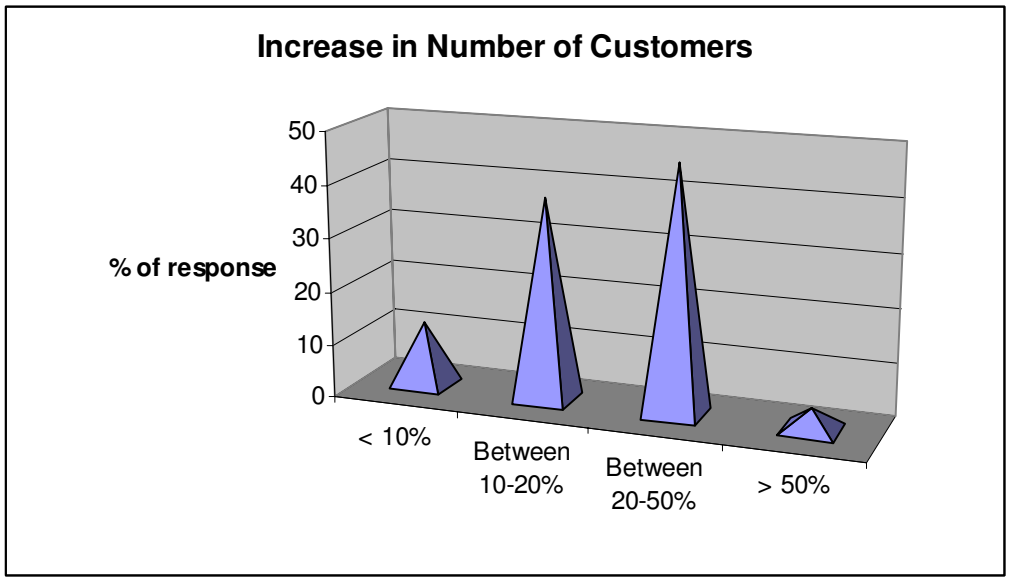


Figure 4-4 : Growth in Customer Number

4.10.2.2. Customer's Satisfaction

In the market driven NSDI, customer satisfaction in defining and prioritising products, product's coverage, on-going maintenance and access needs to be emphasised. Survey reveals that all the customers are satisfied (100% respondent agreed). However, next question regarding level of satisfaction, all the private parties agree that customers are "totally satisfied", whereas public organisation's response is "partially satisfied".

4.10.2.3. Threat for the Private Parties

It is clear from the graph that the private companies are not facing any problem from the competition, but lack of awareness and unfair competition and policies are the major threat for the GI business.

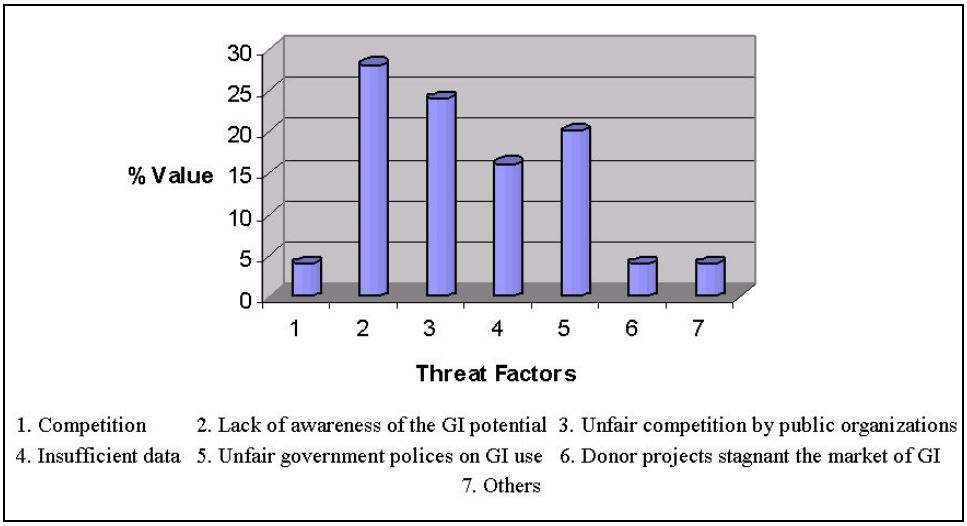


Figure 4-5 : Threat for the Private Parties

4.10.3. NSDI Related

4.10.3.1. NSDI Participation

Majority of the respondents are participating in developing NSDI either actively involved in all the activates of NSDI or by working towards implementing NSDI in their organisation.

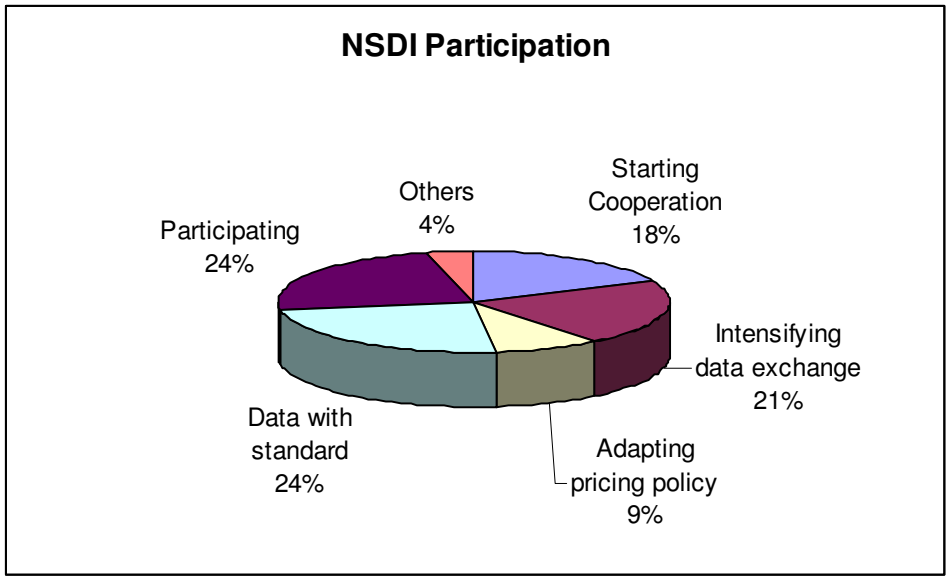


Figure 4-6 : Participation in different NSDI activities

4.10.3.2. Metadata:

In most of the organizations, metadata is being prepared. Though few organisations are developing metadata through proprietary formats, more number of organisations are developing using NSDI Metadata standard. Also, people are of the opinion that metadata will boost the GI market.

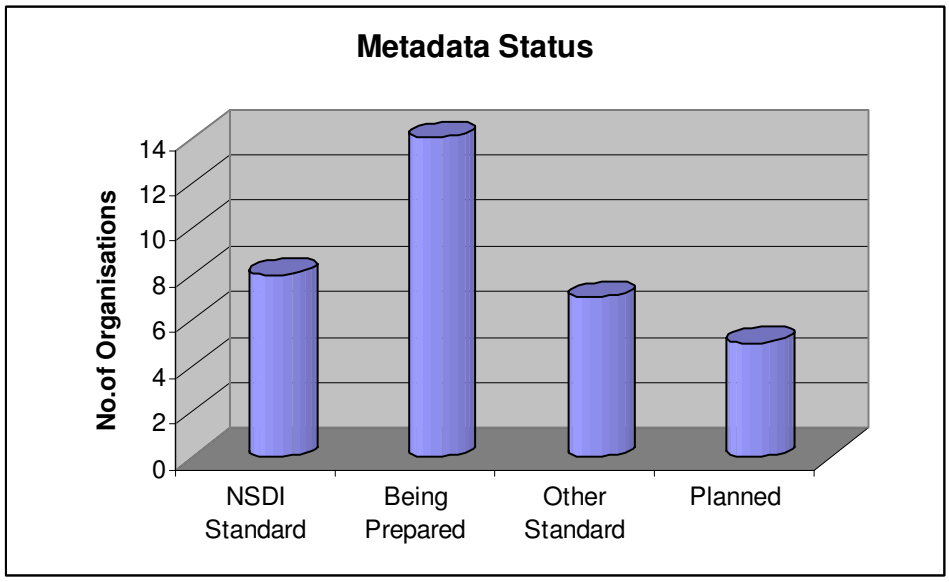


Figure 4-7 : Status of Metadata Development

4.10.4. Data

Data of all types are available – the main problem is not the existence of the data, but the way to access it. There is no single organization that distributes data and is difficult to find, and it is also difficult to understand the access conditions. As a general rule, it is noted that GI is owned by Government organisations (both Central and State); Private firms owns data, but not for sale as abide by the restriction policy, and Academic people use data for R & D and they don't possess any data.

4.10.4.1. Data Dissemination

Each and every organisation is depending on other organisation for GI in order to produce their products. Mode of data exchange is mainly the magnetic media and dispatched through post. Though Internet is available with many organisations, it is not being used for transfer of data.

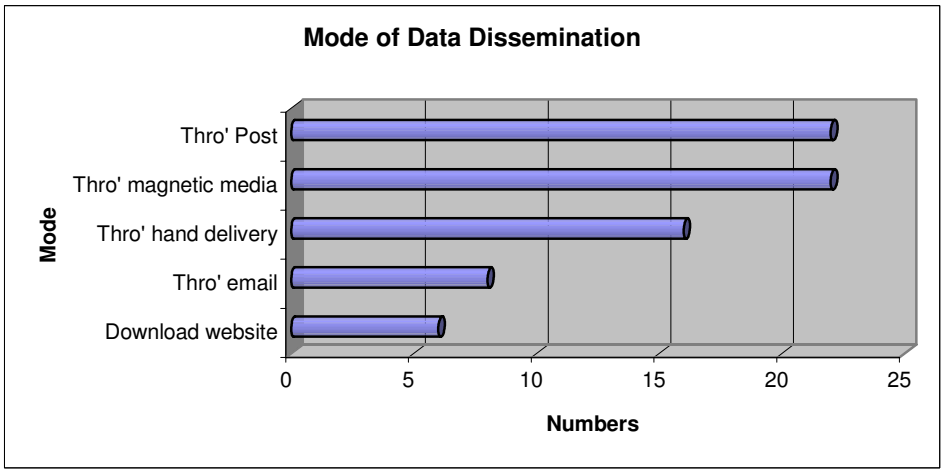


Figure 4-8 : Data Dissemination Mode

4.10.4.2. Barriers to data exchange

It was observed that physical location and proximity is not a matter of concern while exchanging GI with other organizations. The major complaint is that information provided is outdated, incomplete, delayed delivery and incompatibility of data formats. Very less people felt the poor customer services.

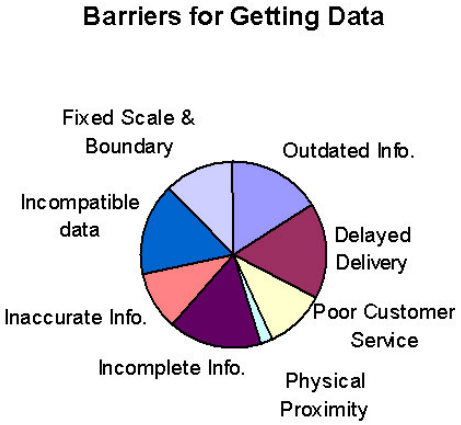


Figure 4-9 : Barriers for getting data

4.10.5. User Requirement

Few questions were designed to know the additional user requirements like different scale data, expected response time, type of data requirement etc.,

4.10.5.1. Response Time

It was agreed by the private parties that one of the barrier for data exchange is delayed data delivery. Even the same was felt by the government organisations too. Majority of the people are getting the data between 1 month to 3 months of time after ordering the data. Discussion with the individual revealed that they prefer to get the data within a week.

4.10.5.2. Scale of GI:

Users preferred the data on 1:50,000 scale. However, there is a demand for GI on larger scale, specifically on 1:10,000; 1:2000; and 1: 1000. This is because, the application of remote sensing and GIS technologies are extending to many new areas like Urban Planning, Utility Management, Cadastral etc.,

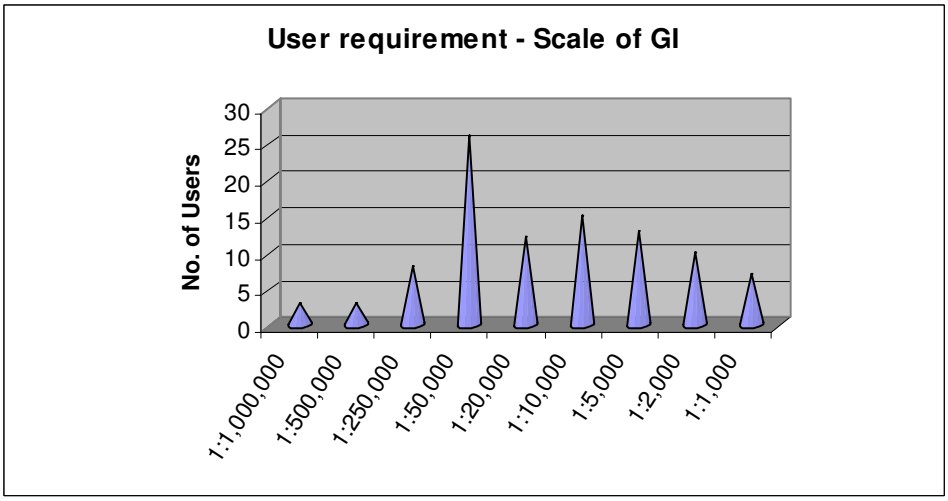


Figure 4-10 : Requirement of Different Scale

4.10.6. Type of Data Requirement:

Majority of the customers require Base maps followed by Satellite data and cadastral maps. Very few organisations are requiring the special data like orthophotos and others.

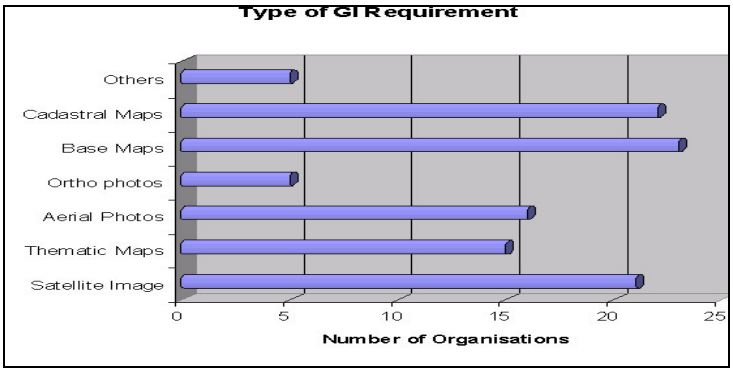


Figure 4-11 : Type of GI Requirement

4.10.6.1. Purpose of buying GI

Majority of the users require GI for their “internal use”, followed by “adding value and sell”. Nobody is buying GI for re-sale. Though one respondent said they are re-selling, after clarification, it was confirmed that they are not re-selling the data.

4.10.7. Human Resources

It was observed that only 14% personnel are working in Geo-ICT field. Total human resources of the organisations responded are 33,412 out of which 4739 are working in the area of Geo-ICT. Though care was taken to eliminate the numbers when response was received from the same organisations located in different geographical area, could not add from the organisations which are not responded. Hence, this number is just a representative figure, not the actual considering the fact that there are more than 5000 GI users in the country.

4.10.8. Marketing

It is interesting to note that we hardly find any marketing division or marketing personnel in the Government organisations. However, some Technical Officers deal with external organisations, though there is no window for sales/marketing.

4.10.9. Revenue and Funding

Most of the organisations are taking the projects, rather than selling the GI. The project cost will be calculated based on the data cost and the manpower requirement. Hence, it was difficult to get the exact profit or revenue earned; however, every respondent agreed that the revenue is increasing.

4.10.10. Challenging Factors

Respondents were asked to give their opinion about the most challenging factor for development of NSDI and for their Business from the following 12 choices : 1).Copyright 2).Pricing Policy 3).Political concerns regarding access to data 4).Metadata development 5).On-line Services 6).Limited Bandwidth of Network 7).Creation of Digital Database 8).Maintenance of core data 9).Quality of data 10).Data Standards 11).Budget /Funding 12)Others

The analysis shows that the highest challenge for NSDI would be Data standard, Creation of digital database and Metadata development; whereas, Pricing policy, On-line services and Budget / Funding are the biggest challenges for the business. It is interesting to note that Budget / Funding and Pricing policies are not an issue for NSDI and similarly Metadata is also not an issue for the business.

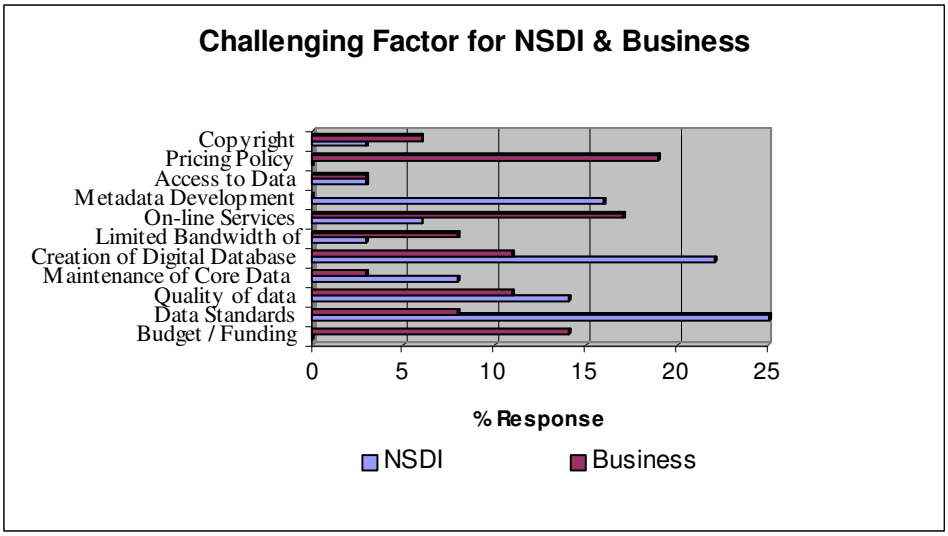


Figure 4-12 : Challenging Factors for NSDI & Business

4.10.11. Collaboration / Partnership of GI Organisations:

Though Public-Private Partnership was not observed from the questionnaire; however, a strong collaboration of Department of Space (Central Government Organisation) and State Remote Sensing Centre (State Government Organisation) was observed.

DOS has established partnership with all the 28 State Remote sensing centres through National Natural Resources Information Systems (NRIS) program on best-effort basis. The purpose of NRIS was to develop spatial database and decision support system for district level planning. In this regard, ISRO / DOS and State Centre responsibilities are :

Responsibilities of ISRO / DOS	Responsibilities of State Centre
* Provide HW & SW	o Provide Site/environment for system
* Node design standard	o Sharing of digitisation cost
* Digitisation contract	o Procurement of Pan/LISS-3 data for district /state
* Sharing of digitisation cost	o Define needs for analysis and query shell
* Quality-checks on database	o Form district level committees for nodes
* Analysis/query shell development	o Forms state coordination boards for monitoring
	o Operational utilisation of nodes

4.10.12. GI Market

Survey covered all most all the representative fields like geology, forestry, urban, rural, agriculture and soil, water resources, environment and general disciplines like Geo-ICT experts. The opinion about new area of emergence and strategies needs to considered for development of GI market were asked. The detail is given in the next few sections.

4.10.12.1. New area

According to the survey, following are the area where GI would boom in near future.

- Large-scale maps
- Consumer oriented products like location specifications traffic management, fleet management etc.
- Infrastructure and amenities planning
- Urban Information System
- Cadastral level Information
- Mobile applications
- Environmental Impact Assessment
- Location Based Services

4.10.12.2. Strategies Required

The respondents suggest various strategies; most important is to raise the awareness of GI and its use through conference, workshop, training, magazine etc., The next important strategy suggested was to provide the products required by the customers. Other issues are access to GI, availability of GI from a single window etc., the same is summarized in the list below:

- o Popularizing the GI Use through advertisements in all media, Popularise the advantages of GI among depts. Etc.,
- o Provide consumer oriented value added products
- o Hassle free access to GI from a single window
- o Cheap and user friendly interfaces to view GI

- Data sharing, data access over web
- Customized training programmes
- Adoption of Web based Open Standards
- Relax map/digital data exchange policy for civilian use
- Increase network band width
- Providing the information on website with metadata
- Involving the line departments
- Taking the technology to the grass root level
- Involve the end user at the line of complementation
- Lowering of data price
- Map use culture
- Supply GI in ready to use format

4.11. Interview Results

Interviews were very useful in getting the information on ideas and opinion of the experts in GI field. Various topics like policy, current situation of GI in the country, strategies to be followed, NSDI bill, legal aspects like copyright, map policy, bottlenecks for implementing NSDI, challenging issues and the public private partnership etc., were discussed. Summary of interviews is given below:

- In general, the burning issues is the map restriction policy as it is affecting both Private and Public organisations. Private parties are affected as the access to digital data is denied, and they are generating data afresh even after knowing such data exists. Public organisations are unhappy that high-resolution satellite data are masked and supplied; when urban area is purchased, they find more patches than actual usable area and this hinders their study. Hence, experts are of the opinion that policy should be made enabling not restrictive as technology and the commercial value drives the people to beat the system.
- Implementation of NSDI is very slow; this is not because of the technology or policy; but the culture of the organisation. But, with the recent tsunami that lashed the southern coast, India is sensing the criticality of existence of NSDI and is likely to take a closer look at its mapping policy.
- There is an indirect mechanism of GI users to meet. Various forums, new magazines, national associations, who meet at least once in a year and exchange their idea. However, there is a need to intensify the effort as it reached only the known users.
- Today, GI market is seen from the data provider's perception. NSDI may boost GI market, as the real use of GI will be felt only after it comes to the market in a systematic way.
- People are ready to pay for the reliable and timely information.
- GI awareness needs to be started from school level itself. Map should be made use of in all the conferences, workshops etc.,
- Protection of data against illegal copying, hacking are of the major concern, as GI has very high value. Clear policies on copyright, IPR, price and use of GI is needed.

4.12. Conclusions

Huge data was collected from the field through questionnaire, interview and workshop. These data were used in developing the strategies using strategic plan appropriate to Indian GI Market. Following are the observations:

- In the chapter a detailed analysis was made from the data collected through field survey. Following points are observed:
- In general, the burning issues is the map restriction policy as it is affecting both Private and Public organisations. Hence, experts are of the opinion that policy should be made enabling not restrictive as technology and the commercial value drives the people to beat the system.
- In India, wide variety of GI is available. Many organisations have invested in building Geo-ICT facility and human resources.
- There is increase in number of customers over the years. The increase is anywhere between 10-50%. The majority of the data is being supplied to government organisations. Regarding customer satisfaction, private organisations feel customers are fully happy where as Government organisations feel their customers are partially satisfied.
- Also, the demand for new production is increasing. Customers are expecting products with higher resolution data and more value added products. People are ready to pay for reliable and timely information.
- Most required GI is base map followed by satellite data cadastral. Though the first two exists, cadastral information (in digital) form yet to be made ready.
- No emphasis is given to the marketing aspects. There is no marketing division or management personnel in the government organisations; some technical officers deal with external organisations.
- Most of the organisation are participating in NSDI venture and implementing infrastructure in their organisation. They are developing metadata in NSDI standard. However, the implementation is very slow.
- Private parties feel that major threat for business would be lack of awareness of GI potential and unfair compilation by government organisation and unfair policies on GI use.
- All the respondent agreed that the budget is increasing every year, thought they have negotiate; also revenue is also increasing every year. However, there is no quantitative figure, by absolutes it is increasing.
- Creation of digital database and development of metadata are the challenges for NSDI. Pricing policy on line service and budget/funding are the major challenges for business. Also budget and pricing policy are not issues for NSDI, similarly metadata is not an issue for business.

5. Strategies and Guidelines Towards Market Driven NSDI in India

5.1. Introduction

In order to develop a suitable strategy for market driven NSDI by effective management of Geo-ICT and efficient sharing of data, it is essential to analyse the current status of the data availability, exchange and use. Additionally, the impact of the current ICT readiness and institutional issues on the future development needs to be studied. India is a microcosm featuring some of the oldest survey institutions in the world, world class civilian remote sensing expertise, some of the best software engineers as well as some of the most severe development problems.

5.2. Development of Strategic Plan

Strategic planning can be performed at a national, geo-spatial sector level and also at the level of a single mapping organisation. This level is also important, because at the end of the day national SDI policies & strategies will have to be "translated" into the strategic plans and capacity building programs for individual organisation. Strategic planning is a common and above all an iterative process that we all use in everyday life! The analytical process of strategic planning is the same in all cases; the only difference is in the content of the analysis and the kind of outputs produced (anon).

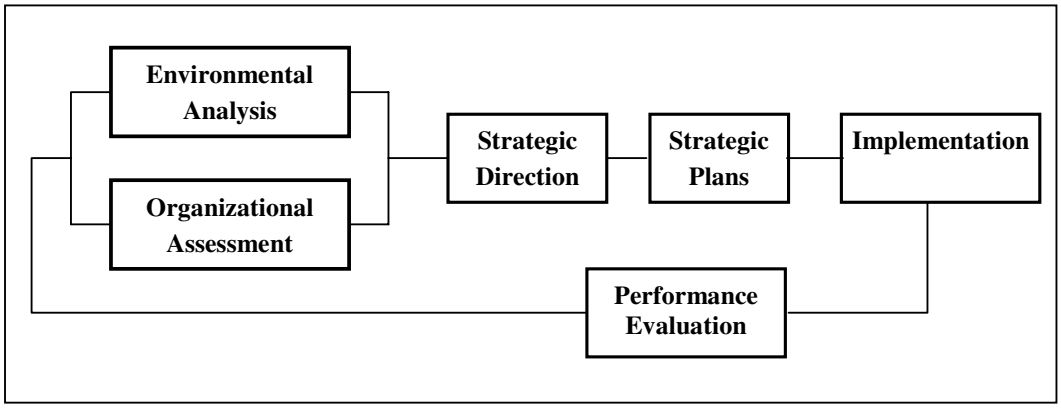


Figure 5-1 : Strategic Management Model (Morrision and Wilson 1996)

Assessment of current status and the external environment is the first step in the process of strategic plan. SWOT has been used to assess the current situation and the environmental factors like the political, economic / market or technological forces influencing the Organisation. Information for the SWOT was obtained from the map policy of the Government and various acts

like copyright act, information act etc.; also from the data collected through interviews and questionnaires.

5.3. External Environment Scanning

The external scanning provides the framework for analysing the external factors affecting the organisations in terms of opportunities and threats available in the environment in which it operates. The external analysis takes into account the actual situation like the existing threats, non-exploited opportunities as well as possible trends and developments. The latter have to be realistic, with clear indications and without major speculations. Key dimensions of the external environment include the national priorities & programs, legal framework & data policies, stakeholder analysis, ICT infrastructure in the country, and last but not least, an understanding of how SDI advocates in other countries have succeeded to attract political support.

5.3.1. Opportunity

An opportunity can be defined as an external factor development that, if taken advantage of, can substantially contribute to the realisation of the organisation's mission. In general, opportunities include new possibilities for cooperation, favourable government policies and regulations, a new target group and the demand for new services. Specific opportunities is listed below and explained in the subsequent sections:

- Growing market demand
- Availability of Geo-ICT
- Demand for diverse product
- NSDI is a good forum for GI market
- Opportunities for all (Govt., private, academic and NGO)
- Scope for collaborative efforts
- Data can be made available at one-stop-shop
- Value of data increases by use
- Demand for high-resolution data
- Availability of NSDI Metadata
- Availability of interoperable GML

5.3.1.1. Market Demand

The use of high quality, reliable GI is critical to virtually every sphere of socio-economic activity like disaster management, forestry, urban planning, land management, agriculture and infrastructure development, etc., Hence, the demand for GI is ever growing. As user understanding of GIS capabilities grew, an understanding of the need for homogeneous and consistent data also grew. On the other hand, today, with the advance of information technology, geographic data and geographic functionalities can be shared and consumed over the web. The infrastructures are geared towards interoperable platforms. This also led to growth of market demand for GI. One simple example is sale of satellite data from NRSA; revenue earned grew from 5.83 crores in 1994–95 to 24.41 crore in 2003-04, an increase of more than 400% in 10 years.

Also, development of the GI market in the country has contributed to the creation of a new group of companies dealing in software, value-added data, and services. The initiatives by DOS in vendor development have encouraged more than 100 companies into GI business and service industry is expanding at 10–15% per annum (Gupta 2000). India is also fast emerging as a data conversion centre for GIS. The GIS companies from USA, Europe, Japan and Australia have either started operating directly or are subletting work to Indian companies. This has created enormous employment opportunities in the sector, which is leading to proliferation of this technology.

5.3.1.2. Geo-ICT

This Spatial Data Infrastructure can be effective only when reliable and efficient computing and communication technologies are in place. Thus more databases can be linked for the transfer of data or to provide a basis for inter-operability of heterogeneous software and hardware systems. It is universally recognized that the advancement of Information and Communication Technology (ICT) and Geo-ICT (GIS) are the highly leveraged enabling tool for delivery of data / services in the public and the private sector. India has a widely distributed and fast growing ICT industry; GIS is being implemented in most of the organizations.

The country's telephone network is one of the largest in the world. Since 1985 the communication facility has been augmented significantly in the form of fibre-optic cable and a domestic satellite system with 254 earth stations; mobile cellular service is getting very popular and is available in all most all the cities / towns. As per the latest news, mobile phones (44.51 million) have crossed the number of fixed line users of 43.96 millions. Consequently, one can think of business in the area of mobile-based location based services.

The most effective data conduits are computer networks and the Internet, which is well developed in the country. The information infrastructure also depends on other utility infrastructures, such as electricity and telecommunications. The fast development of Internet technology has motivated the improvement of GI sharing and now, the advent of web services enable GIS functionality to be shared and consumed in a distributed computing environment.

5.3.1.3. Demand for diverse product

GIS technology is been employed in many different areas and in newer fields of applications, as computer hardware and GIS software applications provide improved capabilities at reduced cost (Nebert 2004). Hence usage and type of applications is now incredibly diverse. GI has become a mass-market product on its own or is found integrated in hard- and software solutions. Nearly anyone can create their own maps, thanks to the use of desktop mapping, GIS, GPS surveying, satellite imagery, scanning and intelligent software.

5.3.1.4. NSDI as good forum for GI market

Vigorous efforts are being put by many organizations towards implementing NSDI in the country. Each organization is actively developing its portal, which can be linked eventually through NSDI. As a national infrastructure, NSDI will have the potential to serve as a "one-stop" source of spatial information and the "mining" of these GIS layers from the NSDI would be the major

source for all GIS activities in support of sustainable development and economic growth. It is envisaged that a separate activity of value-added services would emerge with private sector having tremendous opportunities to contribute to this. It will also open up tremendous opportunities for development of Application Shells using NSDI data

5.3.1.5. Opportunities for all (Govt., private, academic and NGO)

NSDI is the collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data at National level. It provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general (Nebert 2004). In order to provide such an environment, lots of efforts are required from multiple players in supplying multiple layers of data, providing the infrastructure including computer hardware, software, network connections, databases, value added products, developing and implementing standards, maintaining clearinghouse, providing education and training etc., Hence, there is a scope for all sectors to participate and contribute to the National endeavor of NSDI.

5.3.1.6. Collaborative efforts

In India, NSDI is network of SDIs from different domains each from different organisations. Since no one organisation can build a SDI at National level, collaborative efforts are essential for its success. Co-operation and partnerships across different levels of the public sector and with the private sector can be helpful at every stage of SDI development to collect, build, share, and maintain spatial data. Co-operation among Federal, State, local, private, and academic sectors is expected to be based on shared responsibilities, shared commitment, shared benefits, and shared control aiming at improving the spatial data delivery system.

5.3.1.7. One-stop-shop Data

Today, user needs to approach the individual organisations for different data and the effort is multi-fold. Realization of NSDI would result in one-stop-shop for GI of the country. User can just login to a single gateway, select the data or service of his interest and download the data. This will provide a better service to citizens, more collaboration, improved efficiency and improved homeland security. The portal would be the gateway to find (ESRI 2003):

- Existing local, state, and federal data and users—a network of distributed networks
- Planned data development activities
- Map services and problem solving applications
- Standards
- Geo-spatial best practices

5.3.1.8. GI Value increases by use

Its intrinsic value qualifies GI as an economic good which has to be produced, refined within value chains, offered for sale, purchased and paid for (Senkler and Remke 2001). However, A GI is not a standard economic good; it is a non-rival economic good, which means that one person's consumption does not diminish the amount available to other person. The same dataset can be used many times without wear and tear (Krek and Frank 2000). GI can be used, re-used integrated

with other GI, resold, but produced once. However, the cost of producing the first copy of the GI is very high, though the additional copy can be producing at low marginal cost. Also, different GI can be integrated to make another new value added product whose value will be much more than the individual GI.

5.3.1.9. Demand for high-resolution data

The use of Earth Observation (EO) data from the Indian Remote Sensing satellites (IRS) series has received a great impetus through the programmes of NNRMS – wherein projects for mapping and inventorying forests, wastelands, landuse, surface water bodies, wetlands, transportation networks etc have been successfully completed – though at scales of 1:250,000 and 1:50,000 for major parts of the country. However, it was observed that use of such a small scale map is limited to planning and monitoring of a project. There are many other applications in the areas of urban management, cadastral and locale specific applications which needs data much larger scale and better resolution.

5.3.1.10. Availability of NSDI Metadata

The metadata becomes important as it systemizes the process of documenting records of spatial data available with different agencies. At the same time, over a good search and access protocol users can access the metadata and locate the information of their interest. The sub-committee of the NSDI Task Force has developed the NSDI Metadata Standard (ISRO 2003). The same has been issued to agencies in order to populate their metadata as per a common reference and standard. The real success of the metadata will be when it is actually implemented by all agencies and we can have a common metadata server providing efficient search, access and locating tools which would be the first step of the NSDI becoming a reality.

5.3.1.11. Availability of interoperable GML

Vast amount of information is flow all over the world through Internet and World Wide Web (WWW) Internet GIS refers that Internet is used as a means to access and transmit remote data and present GIS results. Some of mapping organizations and private companies are providing geo-information through the Internet in a limited way. The web has brought several innovative developments, which are being used for GI provision and exchange. Firstly, object oriented programming language like Java with advanced graphic features is commonly used in the development of interactive mapping (Groot and Mclaughlin 2000). Secondly, Scalable Vector Graphic (SVG) and Extensible Mark-up Language (XML) are able to display quality vector and raster data with reduced image size(Green & Bossomaier 2002; Nebert 2004). Finally, Geographical Mark-up Language (GML) developed by Open GIS Consortium is an XML encoding for the modelling, transport and storage of GI including both the spatial and non-spatial properties of geographic features. GML is a new technique to formalise the packages of information being exchanged between providers and users of spatial data(Nebert 2004); it provides both a vendor neutral as well as implementation neutral format that is optimally suited for distribution over a network. Hence, it Increase the ability of organizations to share geographic application schemas and the information they describe.

5.3.2. Threats

A threat is an external factor that can have a substantial negative effect on an organisation's performance. Threats are challenges posed by unfavourable trends or developments in the environment that will lead to the erosion of the organisation's position if no corrective action is taken. Examples of threats include other projects/organisations coming in with similar products/services, changes in donor policies, restriction policies and diminishing resources etc., The threats for Indian GI market are :

- Digital data cannot be published on internet
- Technology is changing very fast
- Data security from National Security point of view
- Data security – unauthorized copying/duplication, hacking
- Pricing policy not clear
- Copy right yet to be decided
- Reducing budget in few organisations
- No legal framework for data sharing
- Question of leadership for NSDI
- Lack of awareness on GI
- Cultural factors play a major role for not sharing the data

5.3.2.1. Restriction of Digital data on Internet

A government restriction on maps is the biggest hurdle for GI market as it denies the publishing digital data on Internet and access to the public. However, this issue will not be discussed much here as efforts are being put by the concerned departments to liberalise it soon. In the recent interview by CSDMs with Kapil Sibal, Honourable Union Minister of State for Science and Technology and Ocean Development, Government of India has assured that "India will have its map policy in next six months"

5.3.2.2. Lack of legal framework for data sharing

In spite of having excellent organizations for data collection, there is no mandate for data dissemination. As a result, public may not even aware of the data holdings by these organizations. These arrangements neither benefit the public sector as a whole nor the private sector. Most of the government funded agencies do not understand the value of their data, consequently, they will not even bother to understand the market and price their asset. As a result, each organization has its own dissemination policy, pricing policy etc., Hence, inconsistent policies on dissemination and use of GI is of major concern.

5.3.2.3. Lack of spatial awareness among the people

In order to boost the GI market, there is a need to make the people more aware spatially. Graphical representation is very powerful if it represented properly. Example, is the sub-way railway system of European / western countries. Here if once a person enters the station with a destination, every information like how to go, which track to be taken, after how many stops to

get down etc., can be interpreted from the map pasted on the wall without enquiring anybody. If the GI presented in this form it reaches more number of people.

5.3.2.4. Commercial and Legal Issues

One of the important aspects of NSDI is protection of Data. It would be necessary to classify data in several ways : in terms of economic value and in terms of regional security. Access would also have to be suitably regulated. It has to be recognised that data generation and information processing activities are becoming commercial. Data pricing is an issue and so is the safeguarding of intellectual property. Information for public good should be priced low or be made free and access also should be open. Information leading to economic gain should be priced and "watermarked" to prevent unauthorised duplication. Information of strategic importance should be restricted to a government to government exchange at cost.

There is a need for a clear data policy which includes intellectual property rights, distribution mechanism and pricing of data.

5.4. Organizational Assessment / Internal Scanning

The internal scanning provides the framework for analysing the strengths and weaknesses of the organisation. Strengths are market advantages of the organisation or those things that does well from both organisation and the stakeholders it deals with. Weaknesses are those which needs to be improved. An organisation's strengths and weaknesses are internal factors that critically determine its performance. Attempt has been done to identify the strengths and weaknesses of Indian GI market and listed in the next paragraphs.

5.4.1. Strengths

The strength in this research is defined as an internal characteristic that contributes substantially to the realisation of the organisation's mission. The strength is any existing internal asset like good management, staff capacity, knowledge, resource, business links, etc., The strengths of Indian GI market are :

- Rich base of data available
- Reputed organisations responsible for providing quality data
- Standard are being developed
- Metadata standard available
- Availability of long "experience" of survey department and "expertise in latest technology" of relatively new organisations.
- Availability of skilled manpower
- Ongoing cross institutional initiatives on data exchange
- Availability of Geo-ICT including Internet facility
- Initiation of NSDI in many organisations

5.4.1.1. Availability of Rich base of data

Over the past years, India has produced a rich "base" of maps through systematic topographic surveys, geological surveys, soil surveys, cadastral surveys, various natural resources inventory

programmes and the use of the remote sensing images. Further, with the availability of precision, high-resolution satellite images, GIS, combined with the Global Positioning System (GPS) enabled the preparation of maps more frequent and updated with better accuracy and information content.

5.4.1.2. Data Providers

Reputed organisations are responsible for providing quality data. The data providers are National Survey Organisations like SOI, GSI, FSI, NBSSLU&P, CWC, NIC, ISRO etc., The foundation data is provided by SOI which is having the reputation of serving the nation for the past 240 years is one of the oldest survey institute of the world. Similarly GSI, which is of nearly 150 years old, is responsible to provide geological information to the country. Similarly, satellite imagery and thematic maps will be provided by the ISRO has its own standard.

5.4.1.3. Standard

One of the major problems is the data exchange. NSDI Task Force had realised this, and developed a National Standard for Data Exchange format (NSDE) through which one can exchange GI smoothly. NSDI – TF had set up various subcommittees to define the standardising content and schemas,

design and process, network protocols, exchange and transfer. The NSDI Standards will evolve and grow as more and more agencies commit and access the NSDI Nodes.

5.4.1.4. Metadata standard

Today, metadata standard suiting the country's requirement has been developed. Also, appropriate tools have been developed to populate the metadata by an organisation both off-line and online. Creation of metadata and making it available on the Internet is the first step towards e-business.

5.4.1.5. Experience and Expertise

India is featuring some of the oldest survey institutions in the world with rich experience, world-class civilian remote sensing expertise and some of the best software engineers of the world.

5.4.1.6. Human Resources

Many organisations have their own set up of training institutes in order to cater the needs of in-house requirement. Also many other organisations like IIRS, Regional Remote Sensing Center, NRSA are offering regular course in Geo-ICT related theme. Nearly 2000 personnel are trained annually.

5.4.1.7. Institutional initiatives

Subsequent to the release of NSDI Strategy and action plan in the year 2001, many organisations initiated effort towards implementation of NSDI. Each organisation is at different stage; some are yet to complete the digitisation task, which is huge, some organisations had already developed the web portal. Survey of India claims to digitize all the 1:50,000 scale maps and enters in partnerships with private sector; the Department of Space has already established its portal; the

Geological Survey of India initiates the process to build up an organizational network infrastructure and enterprise cum information portal; the Forest Survey of India says that it uses state of the art techniques in forest cover assessment; the National Informatics Centre moves from developing standalone systems to providing web based GIS solutions, Census department started consultancy services and many more.

5.4.2. Weaknesses

A weakness is an internal characteristic that threatens the functioning of the organisation. Weaknesses are internal conditions that erode the organisation's position, hamper cooperation with others or obstruct the exploitation of opportunities. The weaknesses affecting GI market are identified and listed below:

- Lack of information on data availability
- Volume of data to be digitized
- Data not yet distributed through Internet and also long response time
- Technological limitations for data transfer
- Exact value of GI is not known, and how to price the data is not clear
- Implementation of NSDI is very slow
- Insufficient marketing
- Data with limited resolution / scale
- Individual organisation is not be in the position to meet the user demand

5.4.2.1. Lack of information on data availability

Information about who holds what data is not known or known to only for few organisations. Most of the time the catalogues are either on paper, which has not circulated to all, or it may be poorly catalogued. Even if this information is known, how to access it, is not know in the absence of metadata.

5.4.2.2. Volume of data to be digitised

There is a huge collection of data; most of them are in analog form. Conversion of this into digital form is an enormous task. Each organisations needs to digitise their data to make available in NSDI.

5.4.2.3. Exact value of GI is not known

It is the known fact that exact value of GI is not known. As GI has special characteristic with positive externalities having Non-rival and Non-excludable characteristics in consumption. GI has value, this value can be added in various processing steps. It has different value for different application and this value also can change with time. Hence, it not known how to fix the price.

5.4.2.4. Long response time

It is the experience of many organisations that data is available only after a month of order; in some cases it may even take three months to get the data. One possible reason is the postal delay as the data or even the transaction is not available in Internet. Another problem is if data belongs to restricted area, there is a long procedure to get the clearance of approval authority.

5.4.2.5. Technological limitations

Generally, size of GI is very big and today it is not possible to transfer with the current bandwidth of the network.

5.4.2.6. Slow Implementation of NSDI

Implementation of NSDI is very slow in the country. This is not because of policy or financial background, but mainly because of the cultural aspects.

5.5. Strategic Direction

A common and shared vision about spatial data collaboration and co-operation may fundamentally change the landscape for a nation wide exchange of data and information. In order to get the various stakeholders on board, it may be essential to insist on joint development of a common vision. This may entail a cultural change in the attitude towards information and the exchange of information, a new approach how to manage and share information. The process of getting the concerned parties involved to accept and to actively support the idea of a SDI will need both a strong lead and a lot of creativity in order to minimise unnecessary resistance and not to de-motivate or suffocate creative initiatives (Nebert 2004). The objective of the strategic direction component is to help ensure that the organization's vision and goals (Morrision and Wilson 1996). Towards this, a common vision of NSDI has been defined by the NSDI – TF which can accomplished by all the organizations involved in the NSDI. The NSDI Vision is :

"National Infrastructure for the availability of and access to organised spatial data; use of the infrastructure at community, local, state, regional and national levels for the sustained economic growth".

A common mission needs to be arrived for or reason for being. Mission for the data providing organizations could be "provide the spatial data in one-stop-shop" as there is a need for all the organisations to work towards this direction.

5.6. Strategic Plan

The first step towards strategic plan is to scan the environment of GI market both internally (from all the organisations point of view) and externally for the opportunity and threat. A SWOT analysis was carried out to analyze the internal and external environment GI market in the context of NSDI in India. Possible strategic directions for GI distribution and use have been defined based on the analysis of SWOT.

	Strengths	**Weaknesses**
	1. Rich base of data available 2. Reputed organisations responsible for providing quality data 3. Standard are being developed 4. Metadata standard available 5. Availability of long "experience" of survey department and "expertise in latest technology" of relatively new organisations. 6. Availability of skilled manpower 7. Ongoing cross institutional initiatives on data exchange 8. Availability of Geo-ICT including Internet facility 9. Initiation of NSDI in many organisations	1. Lack of information on data availability 2. Volume of data to be digitized 3. Data not yet distributed through Internet and also long response time 4. Technological limitations for data transfer 5. Exact value of GI is not known, and how to price the data is not clear 6. Implementation of NSDI is very slow 7. Insufficient marketing 8. Data with limited resolution / scale 9. Individual organisation is not be in the position to meet the user demand 10. Cultural factors play a major role for not sharing the data
Opportunities 1. Growing market demand 2. Availability of Geo-ICT 3. Demand for diverse product 4. NSDI is a good forum for GI market 5. Opportunities for all (Govt., private, academic and NGO) to collaborate 6. Demand for quality data 7. Data can be made available at one-stop-shop 8. Value of data increases by use 9. Demand for high-resolution data 10. Availability of NSDI Metadata 11. Availability of interoperable GML	***SO Strategies*** **1. Publish the data in NSDI** **2. Exploit brand name** **3. Operationalise data / metadata servers** **4. Upgrade staff** **5. Respond to niche market** **6. Provide quality data** **7. Use standard GML format**	WO Strategies **1. User friendly query mechanism** **2. Treat customers as partner** **3. Aggressive advertisement and marketing** **4. Upgrade technologies** **5. Exploit NSDI platform for improving access and discovery** **6. Strategic Partnership with Private** **7. Install organisation-wide IT network**
Threats 1. Digital data cannot be published on internet 2. Technology is changing very fast 3. Data security from National Security point of view 4. Data security – unauthorized copying/duplication, hacking 5. Pricing policy not clear 6. Copy right yet to be decided 7. Reducing budget in few organisations 8. No legal framework for data sharing 9. Question of leadership for NSDI 10. Lack of awareness on GI	ST Strategies **1. Advertise success stories** **2. Enact NSDI Bill** **3. Liberalisation of Restriction Policy** **4. Bank upon staff commitment** **5. Adopt cost recovery strategy** **6. Adopt process-oriented management techniques**	WT Strategies **1. Collaborate with organisations providing similar data** **2. Prioritise data updating** **3. Enter high priority areas**

Table 5.1 SWOT Matrix

Following 23 strategies were developed as a result of SWOT analysis:

5.6.1. Strength-Opportunity (SO) strategies

Publish the data in NSDI: Make use of Strength "availability of rich base of maps" and publish the data in NSDI as NSDI is a good forum for GI Market. The first step towards making data available to all the stakeholder is to commit to NSDI by populating data and metadata.

Exploit brand name for better market reach: All the participants of NSDI are from reputed organisations; known for its accuracy, quality control and strict adherence to standards make use of this reputation as a provider of quality geo-spatial data throughout the country to reach of its business strategy.

Operationalise data / metadata servers: In order to facilitate access, exploration; and discovery of geo-spatial data, operationalise metadata using the standards developed by NSDI-TF

Upgrade staff and build technical and managerial capacities: In order to support addressing growing user needs, and the changing scenario of enabling Geo-ICT, there is a requirement to train staff on both the technical and managerial aspects of Geo-Information Science.

Respond to niche market: Defining and targeting the niche market e.g. government departments/ agencies with the provision of total data solutions based on the present strength of the data and enabling Geo-ICT could help increase income.

Provide quality data : Reliable and quality data is needed by many. It is therefore required to ensure continued availability of high quality updated geo-spatial data and services at reasonable and affordable cost to the existing and potential customers.

Use standard GML format: Improve customer satisfaction by decreasing processing cost overhead at his end with the provision of data sets in the standard GML format.

5.6.2. Weakness- Opportunity (WO) strategies

User friendly query mechanism for GI: Today all the data are based on the SOI gratitude grids. Also, the data selection is by sheet wise. Provide the flexibility to user to select the area of this interest. Also, shift from the present file-based system to Geo-DBMS based management system for improving the search mechanism vital to the access and provision of geo-spatial data. Provide user-friendly query mechanism by making use of web technology.

Treat customers as partner: Consider the users data collection needs as input while creating new data/services or updating the data.

Aggressive advertisement and marketing: In order to make the user aware and understand the strengths of GI better, it is desirable to invest in aggressive advertisement and promoting market facilities.

Upgrade technologies: Technologies are changing very fast with better and better features. There is a need to upgrade the technology continuously.

Exploit NSDI platform for improving access and discovery: Publish the metadata and subsequently data through NSDI.

Strategic Partnership with Private Organisations : Upgrade data distribution network by collaborative arrangement on partnership mode. In view of the increased scope in collaboration with the change due to the on-going reform process, work out partnership arrangement for data distribution with public and private agencies.

Install organisation-wide IT network: As many organisations are at National level, interlink the zonal offices for better sharing of data and to increase the coordination of implementing data distribution.

5.6.3. Strength-Threat (ST) strategies

Advertise success stories: In order to counter threat of growing irrelevance amongst the users, there is a need to advertise success stories about the usefulness of reliability and accuracy of data sets as well as the pilot project.

Enact NSDI Bill : As the major data providers are controlled by different Ministries / Departments of the Government, decisions and policies which are cross departmental in nature can be effective only if backed by legislative authority.

Liberalisation of Restriction Policy : For digitisation and publishing data in NSDI, the current restriction policy needs to liberalised; for the growth of GI market, policy must enabling.

Bank upon staff commitment: Availability of committed staff is one of the biggest assets of any Organisation and should be exploited in competing with the products being provided by other agencies.

Adopt cost recovery strategy: In view of the decreasing budgetary support from the Government, cost recovery strategy should be adopted for the sustenance of the Organisation.

Adopt process-oriented management techniques: Adopt a process-oriented approach to data distribution from the present system of product distribution following the diversification of products / services based on the need of the customer.

5.6.4. Weakness-Threat (WT) strategies

Collaborate with organisations providing similar data: Build collaborative partnership to support other organisations in area / themes where they are generating / providing geo-spatial data based on the principle of securing mutual benefits.

Prioritise data updating: Complete updating of the data sets as per a schedule of priorities worked out on the basis of a sound stakeholder analysis.

Enter high priority areas: Identify and enter high priority areas where other organisations have not made a dent so far with improved procedure for search, access and delivery; and decreased response time in provision of relevant data sets currently produced by the organisation.

5.6.5. Multi Criteria Analysis

Multi-Criteria Analysis (MCA) was used as an exploratory tool for developing strategy towards market driven NSDI in India. Although MCA supports decision makers and it certainly does not 'make the decision' in any mechanistic way, the underlying goal is to provide prescriptive

guidance. It has potential to throw light on some questions (for example exploiting the quantitative basis of the approach in order to facilitate the identification of robust alternatives that aren't optimal for any group of stakeholders but are broadly acceptable to most) where cognitive mapping and the like might not be so effective. Rather unusually for an MCA, the study devotes considerable attention to qualitative discussion of the 'framing assumptions' adopted in criteria definition and scoring.

All the above 23 strategies were discussed in the workshop and brought down to 8 strategies. These selected strategies were prioritised using MCA as explained in the last chapter. Prioritised strategies are:

A. Make Data available through NSDI
B. Reliable Quality Data
C. Enact NSDI Bill with policy on sharing data
D. Liberalization of Restriction on Digital data and Publication
E. Cost Recovery Strategy
F. Collaboration – Private Public Partnership
G. Solution in Local Language
H. Advertising & Marketing

Saaty's method was used for converting subjective assessments of relative importance to a set of overall scores or weights. For each pair of criteria, the participants required to respond to a pair wise comparison question asking the relative importance of the two. Responses are gathered in verbal form and subsequently codified on a nine-point intensity scale, as follows :

How important is A relative to B?	Preference index assigned
Equally important	1
Moderately more important	3
Strongly more important	5
Very strongly more important	7
Overwhelmingly more important	9

2, 4, 6 and 8 are intermediate values that can be used to represent shades of judgment between the five basic assessments.

If the judgement is that *B* is more important than *A*, then the reciprocal of the relevant index value is assigned. For example, if the strategy say *B* is felt to be very strongly more important as a strategy *A*, then the value $^1/_7$ would be assigned to *A* relative to *B*. Because the decision maker is assumed to be consistent in making judgements about any one pair of criteria and since all criteria will always rank equally when compared to themselves, it is only ever necessary to make $^1/_2 n(n - 1)$ comparisons to establish the full set of pair wise judgements for *n* criteria. The resultant matrix for establishing the relative importance of the above 8 strategies is as follows:

1	7	1	1/7	1/5	1/7	1/7	1
1/7	**1**	3	1/7	1/5	1/5	1	3
1	1/3	**1**	1	5	1/5	1	1

7	1	1	**1**	1/7	1/5	1	3
5	1/5	1/5	7	**1**	1/5	1	3
7	1/5	5	5	5	**1**	1/5	3
7	1	5	1	1	5	**1**	3
1	1/3	1	1/3	1/3	1/3	1/3	**1**

Table 5.2: Relative Importance of each Strategy

Further step was to estimate the set of weights (eight in the above example) that are most consistent with the relativities expressed in the matrix. Note that while there is complete consistency in the (reciprocal) judgments made about any one pair, consistency of judgments **between** pairs is not guaranteed. Thus the task is to search for the eight weights that will provide the best fit to the 'observations' recorded in the pair wise comparison matrix.

Saaty's basic method to identify the value of the weights depends on relatively advanced ideas in matrix algebra and calculates the weights as the elements in the eigenvector associated with the maximum eigenvalue of the matrix. For the above set of pair wise comparisons, the resulting weights obtained using Expert Choice software. The same is listed below and discussed in detail under section 5.8:

Strategy	Relative Weights
A	0.09
B	0.08
C	0.11
D	0.09
E	0.14
F	0.20
G	0.19
H	0.10

Table 5.3 : Relative weights after MCA

5.7. Efficacy Indicators

The strategic plan should incorporate the following performance indicator to evaluate how effectively the strategy is implemented. The indicators have been devised based on the survey of similar indicators published in literature and used by selected GI organisations. Although historically the focus had been primarily on financial indicators, there have been recent changes to devise and adopt supplementary indicators in view of the unsuitability of the financial indicators in assessing an organisation's performance in terms of wider strategic goals. Balanced score card approach is one such example to supplement traditional financial indicators(Lemmen 2004).

	Strategy	Efficacy Indicators
1.	Public Private Partnership	Number of agreements signed for data distribution

2.	Solution in local language	Number of non-English speaking users accessing GI Number of languages got linked with NSDI
3.	Cost Recovery Strategy	Amount of Revenue earned by the organisation How much less dependency on Government budget
4.	Enact of NSDI Bill	Increased access to organisation's network Number of products shared
5.	Advertising & Marketing	Increased number of stakeholders Increased number of GIS applications Customer service
6.	Publishing the data in NSDI	Number of organisations joining NSDI Number of organisations generated metadata
7.	Liberalization of restriction on digital data	Increased use of GI Number of GI availability
8.	Reliable Quality Data	Number of products accepted Customer satisfaction

Table 5.4 : Efficacy Indicators

5.8. Discussion of the Result

- Public Private Partnership collaboration got the highest weight of 0.20. This is true as the majority of data is with Government organisations; however, these organisation's mandate is to serve the society. Hence not much emphasis was given on business. This was clear from the questionnaire result that majority of the organisations are not having any marketing division or personnel. On the other hand, India has large numbers of well-educated and skilled people. The country is a major exporter of software services and software workers; the information technology sector leads the strong growth pattern. (CIA: World Fact Book; 2003). Thus, there are very good factors both in government and industry, which may be treated as their strengths and each other should share these for betterment in nation building. Hence this combination will boost the GI market in the country.
- Next preferred strategy is the provision of the solution in local language with 0.19 weights. Today, information is reaching the remote villages where there is no electricity neither telephone connection through solar powered computers and VSAT network (example e-choupal). There are 18 officially recognised languages in India; in fact states are divided based on the language they speak. Though English is also official language, it could not penetrate the villages. Hence, there is a need to provide solution in local language to capture the big market of rural area.
- Cost Recovery Strategy ranked third with 0.14 weight. Though Government holds biggest volume of data, it spends 1000s of Crores of Rupees on creating and maintaining this data. As there is huge commercial potential, one must think of exploiting this asset. Iin order to reduce the over dependency on the budgetary support of the Government and reduce pressure on public funds, all GI providers should start generating own revenue by adopting cost recovery approach. The government commercialisation approach has been adopted by a number of European nations. Essentially, the paradigm is to finance the operations of some government departments by charging users for services instead of financing their operations

through direct appropriations. Since this has in some cases significantly reduced direct cost to the government running the agencies, apparent savings can be claimed by advocates of such policies. Similar such strategies need to be adopted in our country too.

- Enact NSDI Bill with policy of sharing the data. Major data providing agencies are controlled by different Ministries / Departments of the government. Decisions, policies, which are across the departments, will be effective only if these are backed by legislative authority. This is the next essential requirement for better sharing of data as enforcement and implementation of decisions can be effective only with the requisite authority provided by law.
- Advertising & Marketing strategy scored 0.10 weight next to the score of NSDI Bill. To boost any market, first and foremost requirement is advertising.
- Publishing the data in NSDI and Liberalization of restriction on digital data strategies scores 0.09 each. Publishing data in NSDI is possible only when restriction on digitisation and publication of GI is removed or liberalised.
- Making the data available on NSDI is not sufficient; each organisations must provide the quality data in order to sustain. The quality of organisation may not mean anything to the customer. For example, if a customer wants data for some emergency study where stringent quality measures may not matter, but data is required instantly. If the provider takes months to supply the data with great accuracy, it becomes useless. Hence, it is organisations responsibility to provide the data as per customer requirement.

5.9. Conclusion

It is observed that public – private - partnership is most crucial for GI Market to grow in India. Provision of information in local languages and cost recovery strategies are required to see the boom in GI Market. Government commitment would be to create conducive atmosphere for growth of GI market by appropriate policies.

6. Conclusions and Recommendations

6.1. Conclusions

The main objective of this research was to develop strategies towards market driven NSDI in India. A review was done to understand the GI market in India and elsewhere. Strategies were developed using the concept of 'Strategic Planning'. These strategies were evaluated by multi criteria analysis. Main conclusions of the study is summarised in this section.

- NSDI in India is in the initial stage and the fundamental concentration is in the task of making the data available to all. The Government continues to play a major role in inventory and mapping of major national resources and establishing a map information base in the country. The three major stakes of NSDI are Provider's stake, Existing User's stake and Potential User's stake. Government has a major stake in managing GI as government agencies are not only the main GI providers but also because they exert a profound influence on national developments as a result of a concoction of laws, policies, conventions and precedents which determine the availability and price of spatial data. Also, Government organisations are showing lot of enthusiasm and investing huge amount; users having lots of expectations. With this many new areas will emerge if the proper atmosphere is created for GI market by the government.

- Presently, NSDI is more of GI generator driven than market driven. Demand for GI will multiply once data is available as it gives an immense scope for value adding. If the data is made available without any restriction to access, it can stimulate the private sector's investment in the GI market. The private sector, which can add more value to the existing GI, can re-disseminate the value added product to the public and promote the economic growth.

- There is a big market potential for GI in the order of Rs.2000 crores annually; major challenge over the next decade will be to increase the use of GI to support a wide variety of decisions at all levels of society. Transparent access to myriad databases could provide the information for countless applications, e.g., facility management, real estate transactions, taxation, land-use planning, transportation, emergency services, environmental assessment and monitoring, and research. Location based service, utility management and land cadastral level information are the new area of emergence. There is a need to have the commitment from data provider to make the data available; and

commitment of the Government to make the transparency of data availability and use through appropriate pricing and policy to stimulate the demand.

6.2. Recommendations

First and foremost thing required to make NSDI successful is to make the data available and easily accessible. Public – Private – Partnership needs be encouraged and commercial ventures in GI market needs to be taken up by Government organisations, than the relying on the government controlled service oriented approach. Consequently, cost recovery approach could be adopted to generate fund towards maintenance of NSDI.

The following two future research is recommended:

- Though cadastral and real estate information is the one of core of NSDI, has not been included in this study for the following reason. Initiation of NSDI has been envisaged from the central government organisations point of view, and subsequently will be enhanced by adding other state government organizations and private firms. As cadastral is related to Land administration (LA), which is very complicated in India as LA and land reform are the responsibility of states, though guidance is offered at federal level. There are 28 states and 7 union territories each with its own legislation and of institutional arrangements; even the extent to which these have been implemented successfully also varied significantly between the states. Currently, the cadastral map and other related data are in analogue form only, digitisation of which involves huge work. Hence there is a need to study this aspect separately. Hence, it is recommended to study further in the cadastral domain.

- Multi-Criteria Analysis (MCA) was used as an exploratory tool for to convert the subjective assessment into quantifiable weights. Although MCA supports decision makers and it certainly does not 'make the decision' in any mechanistic way, the underlying goal is to provide prescriptive guidance. It has potential to throw light on some questions (for example exploiting the quantitative basis of the approach in order to facilitate the identification of robust alternatives that aren't optimal for any group of stakeholders but are broadly acceptable to most) where cognitive mapping and the like might not be so effective. In the present study, a single relative importance matrix was created after consolidating the opinions from many experts. In the further study, a thorough individual assessment must be considered. For example, when opinion is sought from ‘n’ number experts, there must be ‘n’ number of ‘relative importance matrix’, which can be used directly from the statistical package. This will avoid the subjectivity to a great extent. It is suggested to analyse further using more intensive statistical methods.

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[7] http://www.gsi.gov.in/

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[11] http://www.bgs.ac.uk/dfid-kar-geoscience/metadata/userreq/docs/Userquestionnaire.pdf

Annexure 1: Price List from Various Organisations

SOI Price List:

Scale	Full Set	Single layer (Rs. @ 30% of the cost of full set)	Two layers combined (Rs. @ 50% of the cost of full set)	Three to five layers combined (Rs. @ 70% of the cost of full set)
1:250,000	35,270	10,580	17,640	24,690
1:50,000	22,260	6,670	11,130	15,580
1:25,000	14,030	4,210	7,020	9,820

Table 1.1 : Digital Cartographic Data Base (DCDB)

Administrative Boundary Data Base for India (ABDB)	Cost (Rs)
Upto Taluka level with Headquarters (Hqs)	40080
Upto District level with Headquarters (Hqs)	20030
Upto State level with Capitals	6690
Upto Taluka level with data base of Towns	66790
ABDB for State	
Upto Taluka level with Headquarters (Hqs)	13360
Upto District level with Headquarters (Hqs)	6690
For District upto Taluka level with Hqs	2900
Parliamentary and Assembly Constituency Maps (PACM)	
Whole of India	58750
Small States and Union Territories viz. Goa, Sikkim, Meghalaya, Tripura, Mizoram, Manipur, Nagaland and each UT	19580
Large States other than mentioned in above	39160

Table 1.2 : District Planning Map Services & Administrative Boundary Data Base

i.	Cost of predictions for secondary port per port per year	Rs. 5,700/-
ii.	Cost of 29 days analysis	Rs. 21,400/-
iii.	Cost of non harmonic tidal level and chart datum	Rs. 2,900/-
iv.	Indian tide table	Rs. 1,710/-
v.	Hugli river tide table	Rs. 485/-

Table 1.3 : Charges for tidal data in non digital format

GSI Price List

Products	Price in Rupees
	Minimum - Maximum
Publications	
Memoirs	87 – 530
Records	64 – 5036
Palaeontologia Indicator	151 - 310
Special Publications	70 - 745
Bulletins Series	5.8 – 130.8
Miscellaneous Publications	7.5 – 396
Catalogue Series	11 - 500
Maps	
Degree Sheets (Scale 1:250,000)	35 - 4170
Geological and Mineral Atlas of India	20
District Resource Maps	140 – 425
Geological and Mineral Map of States and Regions	20 - 795
Mineral belt Maps	500 - 1000
International Maps	165 – 330
Atlas	625 – 5775
Reports	
Ferrous Minerals	30 - 19,95,300
Polymetals	230 - 3,42,860

Table 1.4 : Price list from GSI

COI Price List

Products	Price in Rupees
	Minimum - Maximum
State and District Profile	16-46
Primary Census Abstract (PCA)	18-152
Population Tables	68-134
Population Projections	41
Economic Tables (B - Series)	69-70
Socio - Cultural Tables (C - Series)	47-51
Religion Tables	19 - 61
Language Tables	13-118
Migration Tables (D - Series)	46-97
Housing Tables (H - Series)	20-102
Town Directory	133

Analytical Study Report Series	50-62
Others	Free of cost-868

Table 1.5 : COI Price List

NDC Price List

1. IRS Satellite data products price list		
Satellite / Sensor	**Digital CD-ROM / Tapes**	**PhotogaphicProduct B&W / FCC**
1.1. IRS-P4 OCM		
FulL Scene/Shift along the Path (SAT)	4,000	
Quadrant scene	4,000	
North Oriented scene (100 x 100 km)	4,000	
Full pass	10,000	
1.2. IRS-1C/1D PAN		
Full scene/shift along the Path (SAT)	30,000	
Sub-scene / shift along the Path (SAT)	8,000	7,700
Stereo Product (2 sub scenes)	12,000	
Stereo Product (2 sub scenes)	15,000	
Geocoded (1:25,000)	7,000	7,000
Point geocoded (1:12,500)		7,000
Precision geocoded scene (1:25,000/1:12,500)	12,500	12,500
1.3. IRS-1C/1D LISS III		
Full scene / shift along the path (SAT)	16,000	12,100
Quadrant scene	10,000	9,900
Geocoded scene (1:50,000)	10,000	10,000
Precision geocoded scene (1:50,000)	15,000	15,000
1.4. IRS-1C/1D/P3 WIFS		
Full scene	10,000	5,500
1.5. IRS-P3 MOS		
One pass (8 scenes)	9,500	
One scene (600 km strip)		
IRS-1A/1B		
Full scene	6,100	6,200

Annexure 2 : Stakeholders Types

Sl.No.	Stakeholders	Producer	Supplier	Regular User	Occasional User	Non-consumer / beneficiaries
1	Survey of India (SOI)	P	S			
2	Geological Survey of India (GSI)	P	S			
3	National Remote Sensing Agency (NRSA)	P	S	R		
4	India Meteorological Department (IMD)	P	S			
5	National Bureau of Soil Survey & Land Use Planning (NBSS&LUP)	P	S			
6	Central Statistics Organisation (CSO)	P	S			
7	National Informatics Centre (NIC)	P	S			
8	Census Of India (COI)	P	S			
9	National Natural Resources Management System (NNRMS)	P	S			
10	Ground Water Boards (GWB)	P	S			
11	Pollution Control Boards		S		O	
12	Forestry Survey of India (FSI)	P	S			
13	Department Of Land Records (DLR)	P	S	R		
14	National Atlas and Thematic Mapping Agency (NATMO)	P	S			
15	Central Water Commission (CWC)	P	S			
16	National Institute of Oceanography (NIO)	P			O	
17	State Remote Sensing Centres (SRSCs)	P	S	R		
18	Public Works Department (PWD)	P		R		
19	State Government Departments			R		
20	Municipality	P	S	R		
21	Maps of India	P	S			
22	Eitcher maps	P	S			
23	Manchitra Service PVT.LtD		S			
24	TTK Maps	P	S			
25	Indian National Scientific Documentation Centre (INSDOC)	P	S			
26	Inflibnet Center		S			
27	Teleatlas	P	S			
28	Citizens			R		B
29	NGOs				O	B
30	Community Groups				O	B
31	Academic and Research Community				O	
32	Central Bureau Of Investigation (CBI)			R		
33	Central Vigilance Commission (CVC)			R		
34	Comptroller and Auditor General Of India (CAG)				O	
35	Election Commission of India			R		

Sl.No.	Stakeholders	Producer	Supplier	Regular User	Occasional User	Non-consumer / beneficiaries
36	National Commission on Population				O	
37	National Human Rights Commission (NHRC)				O	
38	Planning Commission		S	R		
39	Telecom Regulatory Authority of India (TRAI)		S		O	
40	Union Public Service Commission (UPSC)				O	
41	Department of Atomic Energy				O	
42	Judiciary Body	P	S		O	
43	Department of Tourism	P	S	R		
44	Atomic Energy Regulatory Board (AERB)				O	
45	Chhattisgarh Infotech Promotional Society (CHIPS)	P	S	R		
46	Coconut Development Board				O	B
47	Indian Academy of Sciences				O	
48	Indian Sciences Congress Association				O	
49	Indian Society for Medical Statistics (ISMS)				O	
50	National Horticulture Board (NHB)				O	
51	Science and Engineering Research Council (SERC)				O	
52	Society for Promotion of IT in Chandigarh (SPIC	P	S		O	
53	Technology Information, Forecasting and Assessment Council (TIFAC)				O	
54	National Centre for Medium Range Weather Forecasting (NCMRWF)	P	S		O	
55	Krishi Vigyan Kendra (KVK)	P	S		O	
56	Patent Facilitating Centre (PFC)				O	
57	Nuclear Science Centre				O	
58	Inter-University Centre for Astronomy and Astrophysics (IUCAA)				O	
59	Visvesvaraya Industrial and Technological Museum				O	
60	Water Technology Centre for Eastern Region (WTCER)	P	S		O	
61	Ahmedabad Textile Industry's Research Association (ATIRA)				O	
62	Atomic Minerals Directorate (AMD)	P	S	R		
63	Bhabha Atomic Research Centre (BARC)				O	
64	Birbal Sahni Institute of Palaeobotany				O	
65	Bombay Textile Research Association (BTRA)				O	
66	Bose Institute, Kolkata				O	
67	Central Power Research Institute (CPRI)				O	
68	Central Soil and Materials Research Station (CSMRS)	P	S		O	
69	Centre for Advanced Technology (CAT		S	R		
70	Centre for Development of Advanced Computing (C-DAC)		S	R		
71	Centre for Development of Telematics (C-DOT)	P		R		

Sl.No.	Stakeholders	Producer	Supplier	Regular User	Occasional User	Non-consumer / beneficiaries
72	Centre for Materials for Electronics Technology (C-MET)				O	
73	Council of Scientific and Industrial Research (CSIR)	P	S		O	
74	Defence Research and Development Organisation (DRDO)	P		R		
75	Heavy Water Board (HWB)				O	
76	Indian Association for the Cultivation of Science (IACS)				O	
77	Indian Council of Agricultural Research (ICAR)		S		O	
78	Indian Institute of Tropical Meteorology (IITM)	P	S	R		
79	Indian Jute Industries' Research Association (IJIRA)	P			O	
80	Indian National Academy of Engineering (INAE)				O	
81	Indian Rare Earths Limited	P	S	R		
82	Indian Statistical Institute (ISI)	P	S	R		
83	Indira Gandhi Centre for Atomic Research (IGCAR)				O	
84	Institute for Plasma Research (IPR)				O	
85	Institute of Bioresources and Sustainable Development (IBSD)				O	
86	Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)				O	
87	Man-Made Textiles Research Association (MANTRA)				O	
88	National Academy of Agricultural Research Management (NAARM)	P			O	
89	National Centre for Antarctic and Ocean Research (NCAOR)	P			O	
90	National Institute of Design (NID)				O	
91	National Institute of Hydrology (NIH)	P	S	R		
92	National Institute of Immunology (NII)				O	
93	National Institute of Ocean Technology	P	S	R		
94	National Research Laboratory for Conservation of Cultural Property				O	
95	Northern India Textile Research Association (NITRA)				O	
96	Research Designs and Standards Organisation (RDSO)				O	
97	Rural Technology Institute, Gujarat (RTIG)	P				
98	Society for Applied Microwave Electronic Engineering and Research				O	
99	South India Textile Research Association (SITRA)				O	
100	Synthetic and Art Silk Mills' Research Association (SASMIRA)				O	
101	Wadia Institute of Himalayan Geology	P	S	R		
102	Asian and Pacific Centre for Transfer of Technology (APCTT)		S	R		
103	Bio-Technology Information System	P		R		
104	Botanical Survey of India (BSI)				O	
105	Cochin University of Science And Technology (CUSAT)				O	
106	College of Engineering and Technology, Bhubaneshwar				O	
107	College of Engineering, Chengannur				O	

Sl.No.	Stakeholders	Producer	Supplier	Regular User	Occasional User	Non-consumer / beneficiaries
108	Department of Bio-Technology (DBT)				O	
109	National Resources Data Management System (NRDMS)	P	S	R		
110	Department of Scientific and Industrial Research (DSIR)				O	
111	e-Biotech Commerce				O	
112	Farm Net Asia				O	
113	Indian Medlars Centre (INDMED)				O	
114	Information Technology Department, Chandigarh				O	
115	Information Technology Department, Himachal Pradesh				O	
116	Malaviya National Institute of Technology, Jaipur (MNIT)					
117	National Institute of Science Communication and Information Resources		S	R		
118	National Science and Technology Entrepreneurship Development Board		S	R		
119	National Science and Technology Management Information System (NSTMIS)		S	R		
120	Networking of Social Scientists				O	
121	North Eastern Regional Institute of Science and Technology		S		O	
122	Patent Information Services	P	S		O	
123	Punjab Technical University				O	
124	Sardar Vallabhbhai National Institute of Technology, Surat				O	
125	State Councils for Science and Technology				O	
126	Technology Innovation Management and Entrepreneurship Information Service				O	
127	United Nations Educational Scientific and Cultural Organization				O	
128	Vigyan Prasar		S		O	
129	Indian Institute of Technology	P	S	R		
130	Indian Institute of Science	P	S	R		
131	University of Roorkee	P	S	R		
132	Kuvempu University	P	S	R		
133	Bharathidasan university	P	S	R		
134	Mangalore University	P	S	R		
135	Bangalore University	P	S	R		
136	Mysore University	P	S	R		
137	Jamiya Miliya Islamiya, Delhi	P	S	R		
138	West Bengal University of Technology (WBUTech)	P	S	R		
139	Zoological Survey of India (ZSI)				O	
140	Ministry of Agriculture			R		
141	Ministry of Agro and Rural Industries				O	

Sl.No.	Stakeholders	Producer	Supplier	Regular User	Occasional User	Non-consumer / beneficiaries
142	Ministry of Chemicals and Fertilizers			R		
143	Ministry of Civil Aviation			R		
144	Ministry of Coal			R		
145	Ministry of Commerce and Industry				O	
146	Ministry of Communications and Information Technology			R		
147	Ministry of Consumer Affairs, Food and Public Distribution				O	
148	Ministry of Defence			R		
149	Ministry of Disinvestments				O	
150	Ministry of Environment and Forests			R		
151	Ministry of External Affairs				O	
152	Ministry of Finance and Company Affairs				O	
153	Ministry of Food Processing Industries				O	
154	Ministry of Health and Family Welfare			R		
155	Ministry of Heavy Industries and Public Enterprises				O	
156	Ministry of Home Affairs			R		
157	Ministry of Human Resource Development				O	
158	Ministry of Information and Broadcasting			R		
159	Ministry of Labour				O	
160	Ministry of Law and Justice				O	
161	Ministry of Mines			R		
162	Ministry of Non-Conventional Energy Sources			R		
163	Ministry of Parliamentary Affairs				O	
164	Ministry of Personnel, Public Grievances and Pensions				O	
165	Ministry of Petroleum and Natural Gas			R		
166	Ministry of Power			R		
167	Ministry of Railways			R		
168	Ministry of Road Transport and Highways			R	O	
169	Ministry of Rural Development			R		
170	Ministry of Science and Technology			R		
171	Ministry of Shipping				O	
172	Ministry of Small Scale Industries				O	
173	Ministry of Social Justice and Empowerment				O	
174	Ministry of Statistics and Programme Implementation			R		
175	Ministry of Steel				O	
176	Ministry of Textiles				O	
177	Ministry of Tourism and Culture			R		

Sl.No.	Stakeholders	Producer	Supplier	Regular User	Occasional User	Non-consumer / beneficiaries
178	Ministry of Tribal Affairs			R		
179	Ministry of Urban Development and Poverty Alleviation			R		
180	Ministry of Water Resources			R		
181	Ministry of Youth Affairs and Sport				O	
182	Centre for Spatial Database Management & Solutions			R		
183	Indian School of Mines	P		R		
184	Private Tour Operators			R		
185	Flood Control Boards	P		R		
186	Disaster Management Center			R		
187	IFFCO	P		R		
188	Town and Country Planning Organisation	P	S	R		
Total		62	64	70	98	4

Annexure 3 : Benefits of Remote Sensing at a Glance

Area of Application	Quantifiable Benefits from Information Use	Annual benefit	
Cotton	Management of shortages.	Rs.	26.81 - 268.08 crores
	Improved management of inventory.	Rs	6.67 - 66.73 crores
	Underestimation of GDP	(Rs.	71.59 - 715.90 crores)1
		Rs.	33.48 - 334.81 crores
Sugarcane	Improvement in conversion of sugarcane to sugar.		
	Increase in the yield of sugarcane through superior management.	Rs.	473.62 – 1,894.48 crores
Irrigation	Improved reclamation of salt-affected and water logged areas.	Rs.	341.00 crores
		Rs.	142.00 - 1,422.00 crores
	Improved management, leading to less disparities between head and tail end portions of irrigation commands.	Rs.	43.00 crores
		Rs	526.00 – 1,806.00 crores
	Improved collection of water cess.		
Micro watershed management for rural development	Improvements in area under agriculture.		
	Increased area under agro-forestry.		
	Increased area under horticulture		
	Increases in milk yield through pasture land development.	Rs.	2,000.00 crores
Land use and land cover	Increase accuracy of statistics relating to agriculture and GDP.	(Rs	12,000.00 crores)1
Forestry	Costs savings in range management.	Rs.	19.00 crores
	Stock mapping.		
	Improving afforestation schemes.	Rs.	1.01 crores
		Rs.	2.10 crores
		Rs	22.11 crores
Mapping	Reduce costs for national level mapping applications.	Rs.	19.00 crores
	Reduce costs for urban mapping.		
		Rs.	46.00 crores
		Rs.	65.00 crores
DoS earnings from commercial operations		Rs	34.85 crores.
Total		Rs	3,155.06 - 6,157.25

Note: 1 Figures in parenthesis are not included while totaling the benefits, since these are more intangible than direct benefits.

Annexure 4 : Initial Content of NSDI

Sl.No	Agency	Maps	Scale	Coverage
1	Survey of India (SOI)	Topographical maps	1:250000 1:50000 1:25000	Whole Nation “ ” Selected Area
2	Geological Survey of India (GSI)	Geological maps	1:50000 others	Whole Nation Selected Area
3	National Bureau of Soil Survey and Landuse Planning (NBSSLUP)	Soil maps	1:250000 1:50000 others	Whole Nation “ ” Selected Area
4	Forest Survey of India (FSI)	Forest maps	1:50000	Whole Nation
5	Central Ground Water Board (CGWB)	Hydrology maps	All scales available	Whole Nation
6	National Remote Sensing Agency (NRSA)	Satellite images Landuse maps Wasteland maps Ground water potential maps Urban maps	Various resolutions 1:50000 1:50000 1:50000 1:50000	Whole Nation Whole Nation Whole Nation Whole Nation Urban Area
7	National Natural Resources Management System (NNRMS)	Natural Resources databases	1:50000 1:250000	All the Districts All the States
8	Central Water Commission (CWC)	Command area maps	All scales available	Whole Nation
9	Ministry of Environment and Forests (MoEnF)	Coastal Landuse maps	1:250000 1:50000	Whole Nation Whole Nation
10	Census Department	Census maps and census data	---	Whole Nation
11	National Atlas and Thematic Mapping Organisation (NATMO)	National atlases	1:1Million	Whole Nation
12	National Hydrographic Department (NHyD)	Hydrographic data	----	Whole Nation
13	India Meteorological Department (IMD)	Weather information	----	Whole Nation
14	Ocean Developments (DOD)	Ocean information	----	Whole Nation
15	Bureau of Economics and Statistics (BES)	Economics and Statistics	----	Whole Nation

Annexure 5 : Questionnaire for Public Organisations

Covering letter and questionnaire for Public organisations

INTERNATIONAL INSTITUTE FOR GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

Padmavathy AS **Department: GIM / PGM, ITC, The Netherlands**
E-mail : padma0859[1]@itc.nl; asp@isro.org
Phone : 080-22172447 ; 080- 23417359 Fax: 080-23417455

Date : 25th October 2004

Dear

Questionnaire: Assessment of GI market in the context of NSDI (India)

I am Padmavathy AS, Scientist from ISRO, currently pursuing my Master of Science in Geo-information Management (GIM) at ITC, The Netherlands. As part of the programme, I am conducting a research on the topic "**Developing and Comparison of Strategies towards Market Driven NSDI in India**".

As you are aware, most of the countries in the world are involved in developing spatial data infrastructures (SDI). The objective of National Spatial Data Infrastructure (NSDI) is to support the availability and access to Geospatial Information (GI), facilitate the data sharing; it also gives a scope to unfold the economic potential of GI. In India, NSDI is being implemented in a vigorous way. Many national organizations like Indian Space Research Organisation (ISRO), Survey of India (SOI), Forest Survey of India (FSI), Geological Survey of India (GSI) etc., are building their own SDI nodes. It is expected that these organizational nodes will be linked to NSDI server to provide the spatial data to the users from a single window.

Understanding the impact of NSDI on GI market is crucial element in operationalisation of NSDI. In this connection, a questionnaire has been prepared to know the demand, supply and use of GI. The results of this questionnaire will not only contribute to this research but also will provide useful information to the NSDI.

The questionnaire contains nearly 50 questions. It may take 50 - 60 minutes to complete. I would be very grateful if you could complete this questionnaire and return. Kindly note that the aim of this questionnaire / research is purely for academic interest. The results will be made available on request.

If you like to have any clarification while filling the questionnaire, please feel free to contact me either by phone or through e-mail addresses given above.

Thanking you,

Yours sincerely,

(AS Padmavathy)

To :

Seen and agreed by :

Walter T. de Vries (First Supervisor) email : devries@itc.nl
Arbind Tuladhar (Second Supervisor) email : tuladhar@itc.nl
Mukund Rao (Supervisor from ISRO) email : mukundr@blr.vsnl.net.in

Questionnaire: Assessment of GI[1] market in the context of NSDI (India)

General[§]

1a. Name of Respondent :
Designation :
Mailing Address:

……..……
……..……
……..……

E-mail:
Telephone Number: Fax Number:

1b. How long are you working in this organization? …….

Organizational

2a. Which of the following category describes your Organization best?
( ) Central Governmental ( ) Non Government Organizations
( ) State Governmental ( ) Private
( ) Research & Academic ( ) Others

2b. At which level does your organization have most of its external contacts or customers? Please indicate numbers from1 to 5, **1:** highest number of customers **5 :** lowest number of customers.
( ) International ……. ( ) National…….
( ) Regional……. ( ) State……..
( ) Local…….

2c. What is the mandate of your organization? (Please explain in few words)

…… …… ……..……
…… …… ……..……

2d. Does your organization have intranet / internet facilities? ( ) Yes ( ) No
If **Yes**,
- Is this facility used to sell your products? ( ) Yes ( ) No
If so, how? ……..……..
…… …… ……..……

If **No**, is there any plan to get one? ( ) Yes ( ) No

2e. Is your organization changing towards market orientation? ( ) Yes ( ) No
If **Yes**,
- Which other organizations are producing the similar product that of yours? Please list such organizations.

……..……..
……..……..

[1] GI : Geo-spatial Information, includes all spatial and non-spatial data which has got geographical reference
[§] Kindly note that this first question is ***optional.*** However, if you provide this information, confidentiality will be maintained.

- Which organizations do you see as your major customers? ……..……..
  ……..……
  ……..……

- Does your customers have sufficient funds to pay for your products?……..……..
  If so, explain briefly how? (like what strategies are followed and what actions are taken etc.,) ……..……....
  ……..……
  ……..……
  ……..……

- How much budget is reserved for this purpose? ……..……
  ……..……

2f. Which of the following internal communication means are used in your organization?

( ) Intranet ( ) e-mail
( ) Verbal Communication ( ) Writing on papers
( ) Other (please specify)

Financial Regime

3a. How is your organization currently funded?

( ) Through yearly Government Budget allocations
( ) Partial Government funding and partial recovery of costs through sales
( ) Recover the majority of cost by prices and fees for the products
( ) Making Profits to recover the costs and invest in future projects or products
( ) Others (Please specify)……..……..

3b. How does the budget change every year?

( ) Increasing ( ) Decreasing
( ) No change ( ) Others (Please specify)……..

3c. What is the procedure to get the budget allocated? Please give detail …….

……..……..……
……..……..……
……..……..……

3d. Is it necessary to negotiate every year for your budget allocation?

( ) Yes ( ) No

3e. Do you have a special budget allocation for ICT[2]?

( ) Yes ( ) No ( ) No Idea

Products

4a. How does your organization produce the GI (maps or data)

( ) As a mandate from the government
( ) As per the demand

[2] ICT : Information and Communication Technology includes computer H/W, S/W, Internet etc.,

4b. Please give the details of GI products produced by your organization[Ψ]

Sl. No	GI products	Scale	Cover-age*	Public ation Year	Format		Updation Frequency	Content
					Digital	*Analog*		
Ex : 1.	Topomap	1:50,000		1998		√	5 Years	Admin. boundary, water bodies, transportation network, contours etc.,
2.	Road map	-		2002	√		2 Years	National Highways, State Highways, District roads, non-metaled road etc.,
1.								
2.								
3.								
4.								
5.								
6								
7								
8								

* Coverage could be either Entire country, State or specific project

4c. Is the product list available on your website? ( ) Yes ( ) No

4d. Please give the detail on number of GI products sold and revenue earned for the past three Financial Years[ΨΨ]:

FY	Volume of sales	Revenue earned by GI Product sale(Rs.)
2001-02		
2002-03		
2003-04		

Access and Price :

5a. Does all your products available for the public?

( ) No – all maps are Restricted - for internal use only
( ) Access to government organizations only
( ) Access to all users

[Ψ] Kindly write in page 8 or feel free to attach additional sheets if you need more space.
[ΨΨ] If you cannot provide this detail, please give the trend of revenue earned: ( ) Increasing ( )Decreasing ( ) No Change

5b. If available to the public, under which conditions are the data disseminated by your organization?

( ) Free of cost ( ) Charged such that all cost can be recovered
( ) Marginal charge ( ) Others (Please specify)……..

5c. If charged, how do you fix the price of the product?

( ) Based on Market Value ( ) To get back the service cost
( ) To make profit ( ) Fixed by Government
( ) Others (Please specify)……..

5d. Is there a price list available on your website? ( ) Yes ( ) No

Resources:

Human Resources

6a1. What is the total number of staff of your organization? Please specify the number.

…… …… …….. ……

6a2. How many people of your organization are working in the area of Geo-ICT[3] ? Please specify the number.

…… …… …….. ……

6a3. How many people are working on sales, marketing, and customer relations? Please specify the number.

…… …… …….. ……

Geo-ICT facilities

6b1. Which of the following Geo-ICT facility do you use currently? (Tic the appropriate boxes below)

Hardware
( ) PC Standalone
( ) PC Networked
( ) Workstation

Others
( ) GPS
( ) Internet

Software
DBMS: Micro Soft Access ( )
Oracle ( )
SQL Server ( )
GIS ( )
Image Processing ( )
Others (please specify) ……

6b2. How many servers or websites are directly accessible by external users / customers?

…… …… …… ……

6b3. Please provide your web site address (if you have).

Website : http:www. ……

[3] Geo-ICT : Geo-spatial Information and Communication Technology includes Computers (H/W, S/W), Internet, GIS, Image Processing, GPS etc.,

NSDI Related

7a. In which way your organization could contribute /contributing to the NSDI development? (tick all the applicable answers)

( ) starting cooperation agreements with other organizations
( ) intensifying data exchange possibilities and volume with other organizations
( ) adapting out pricing policy to national policies
( ) adapting our data to fit with national standards
( ) participating in NSDI discussion groups and / or working groups
( ) No participation in NSDI
( ) Other, Please Specify ……

7b. Do you maintain a catalog, metadata or a clearinghouse about your data?

( ) Yes ( ) No

If **Yes**, is this publicly available?

( ) Yes ( ) No

If **No**, why? Explain briefly ……..……

7c. What is the Status of Metadata?

( ) Available with NSDI Standard ( ) Available with other Standard
( ) Being Prepared ( ) Planned
( ) Not aware

Customers

8a. Does your organization have a customers database? ( ) Yes ( ) No
If **Yes**, what for do you use this? Explain briefly ……..……

8b. To whom do you supply the data / information? Please give the detail in percentage break-up.

Government Organizations : ……. %
Private Organizations : ……. %
Non-Government Organizations : ……. %
Academic / Research Organizations: ……. %
Others : ……. %

8c. Is there any increase in the number of customers in the recent years? ( ) Yes ( ) No
If **Yes**, How much?

( ) <10% ( ) Between 10 – 20%
( ) Between 20 – 50% ( ) > 50%

8d. Do the customer expect any new products?

( ) Yes ( ) No

If *Yes*,

What sorts of products are requested now, which were not requested before?
……..
……..

Is it possible to produce this new product within your organization?

( ) Yes ( ) No

If *No,* Is there any initiation to work with private partnership?

( ) Yes ( ) No

If *Yes,* please give details ……..…… …

……..

8e. Did you ever examine the needs and expectations of your customers? ( ) Yes ( ) No

8f. Does your Customers are satisfied with the service you provide? ( ) Yes ( ) No

8g. What is the Customer's Level of satisfaction?

( ) Totally satisfied ( ) Partially satisfied

( ) Unsatisfied ( ) No idea

8h. How does your customers approach you?

( ) Through website ( ) Through e-mail ( ) Through Telephone

( ) Through Direct Visit ( ) Through Post ( ) Through Fax

( ) Other (Please specify)……..

8i. How do you disseminate your products?

( ) Download through website (ftp) ( ) Through magnetic media (CD-ROM, floppy etc.,)

( ) Through e-mail ( ) Through Post

( ) Through hand delivery ( ) Other (Please specify)……..

Coordination and Data Sharing:

9a. Do you need GI from other organization to produce your GI? ( ) Yes ( ) No

9b. What type of information you need to get from other organization?

( ) Satellite Image ( ) Aerial Photos ( ) Base Maps

( ) Thematic Maps ( ) Ortho-photos ( ) Cadastral Maps

( ) Others (Please specify)……

9c. Which scale data suits you best?

( ) 1:1.000.000 ( ) 1:500.000 ( ) 1:250.000 ( ) 1:50.000

( ) 1:20.000 ( ) 1:10.000 ( ) 1:5.000 ( ) 1:2.000

( ) 1:1.000 ( ) Other (Please specify)……..

9d. How long does it take to get data from others?

( ) ≤ 1 Day ( ) One week ( ) One month

( ) Two months ( ) Three months ( ) One year

( ) Other (Please specify)……..

9e. For which purpose do you get the data?

( ) For internal use ( ) For re-sale ( ) Add value and sell

( ) Any other purpose (Please specify)……..

9f. Do you have any partnerships or collaboration with other organizations to provide GI service or for development of new products? If so, explain briefly about the product, with whom and how etc.,

....
....
....

Perceived use of GI:

10a. If the free access to all maps, including SOI maps are made available through relaxed map policy, would you see any new business opportunities? ( ) Yes ( ) No

If ***Yes,***

In which direction? And what sort of products?

....
....

10b. Which area (sector) of GI will boom in the coming years? Please feel free to give your opinion.

....
....

10c. In your opinion - will metadata help to boost the GI market? ( ) Yes ( ) No

10d. What will be the anticipated market with data in digital form and metadata together?
( ) Increase steeply ( ) Increase moderately ( ) No change

10e. Do you think that digital data, metadata and a quick-look browser will fetch the highest market? ( ) Yes ( ) No

10f. What strategy would you follow to boost the GI market?

....

....

****

Annexure 6 : Questionnaire for Private Organisations

Covering letter and questionnaire for Private Organisations

INTERNATIONAL INSTITUTE FOR GEO–INFORMATION SCIENCE AND EARTH OBSERVATION

Padmavathy AS

Department: GIM / PGM, ITC, The Netherlands
E-mail : padma08591@itc.nl; asp@isro.org
Phone : 080-22172447; 080-23417359 Fax: 080-23417455

Date : 25th October 2004

Dear Sir / Madam

Questionnaire: Assessment of GI market in the context of NSDI (India)

I am Padmavathy AS, Scientist from ISRO, currently pursuing my Master of Science in Geo-information Management (GIM) at ITC, The Netherlands. As part of the programme, I am conducting a research on the topic "**Developing and Comparison of Strategies towards Market Driven NSDI in India".**

As you are aware, National Spatial Data Infrastructure (NSDI) is being implemented in a vigorous way in India with the coordinated efforts of organizations like Indian Space Research Organisation (ISRO), Survey of India (SOI), Forest Survey of India (FSI), Geological Survey of India (GSI) etc., The objective of NSDI is to support the availability and access to Geospatial Information (GI) and facilitate the data sharing. It also gives a scope to unfold the economic potential of GI. Apart from the data, NSDI gives a tremendous scope for generation of new applications and services where private organizations can play a major role. This service can vary from providing a simple geo-information derived from the data by adding value or a ready-made solution for a specific problem.

I am exploring the role of private organizations in building and nurturing NSDI to get the fruit from it. In this connection, a questionnaire has been prepared to know the demand, supply and use of GI in one hand and the role of private organizations in another hand.. The results of this questionnaire will not only contribute to this research but will provide useful information to the NSDI also.

The questionnaire contains a total of 39 questions. It may take 30 minutes to complete. I would be every grateful if you could complete this questionnaire and return. Kindly note that the aim of this questionnaire / research is purely for academic interest. The results will be made available on request.

If you like to have any clarification while filling the questionnaire, please feel free to contact me either by phone or through e-mail addresses given above. Thank you for your kind cooperation in completing this questionnaire.

Thanking you, Yours sincerely,

To :

(AS Padmavathy)

Seen and agreed by :

Walter T. de Vries (First Supervisor) email : devries@itc.nl
Arbind Tuladhar (Second Supervisor) email : tuladhar@itc.nl
Mukund Rao (Supervisor from ISRO) email : mukundr@blr.vsnl.net.in

Questionnaire: Assessment of GI[♣] market in the context of NSDI (India)

Organizational

1. Please provide the Name and Address of your organization:

   Phone :----------Fax :---------- e-mail:- ----------

2. Website address: ----------
3. Year of establishment (in India) : ----------
4. How many employees are there in your organization? ----------
5. What is your annual turn-over? ----------
6. What is the revenue earned in the last year? ----------
7. What is your core business? Please list all the GI related activities of your organization.

GI Market – Product/ Services, Customers

8. Please list the GI products/ services provided by your organization.

   ---

9. Which Product / Services do you sell easily? Please give a list.

[♣] GI : Geographical Information, includes all spatial and non-spatial data which has got geographical reference.

10. Which organizations do you see as your major competitors?

---

11. What advantage does your organization has over your competitors?

---

12. Who are all your major customers? Please specify in numbers for the following categories.

International Organizations	(…)	Government Organizations :	(…)
Private Organizations :	(…)	NGO*s :	(…)
Academic / Research Institutes:	(…)	Others :	(…)

13. Did you ever examine the needs and expectations of your customers? ( ) Yes ( ) No

14. Does your Customers are satisfied with the service you provide? ( ) Yes ( ) No

15. What is the Customer's Level of satisfaction?
( ) Totally satisfied ( ) Partially satisfied
( ) Unsatisfied ( ) No idea

16. Which input do you need from other organizations? Please list the input and the source below:

---

17. How much budget is earmarked for this purpose?

---

18. How do you find out the availability of these data? Please indicate (by ticking) the current method used and the preferred method of getting such information.

Sl.No	Mode of Approach	Method Used	Method Preferred
1	Catalogue (paper form)		
2	Phone call		
3	Personal visit		
4	Through Letter		
5	Through email		
6	Through Website		
7	Any Other (Please specify)		

* Non-Government Organizations

19. What type of data do you use? Kindly tick where ever applicable.

( ) Vector data ( ) Raster images
( ) Scanned maps ( ) Rectified images / Orthophotos
( ) Tables ( ) Other (Please Specify)……

20. Which problems do you experience while exchanging GI with other organizations?

( ) Outdated Information ( ) Incomplete information
( ) Delayed delivery ( ) Inaccurate information
( ) Poor customer service ( ) Incompatible data formats
( ) Physical Proximity ( ) Fixed scale and boundary
( ) Others……..

21. Which of the following activities are supported by the Internet/Intranet?

( ) Production ( ) Internal Communication ( ) Advertising
( ) Delivery of Product / Service ( ) Marketing & Sales ( ) Administration
( ) Management ( ) Accounting ( ) Other (Please specify) ……

22. Do you use online e-commerce transactions? ( ) Yes ( ) No

If **Yes**, Please explain for which products and what is the frequency?

……

……

If **No**, kindly state how the transaction are carried out in your organization

……

……

Policy Related

23. Does is your organization affected by the following polices?

a. Access rights ( ) Yes ( ) No

If **Yes**, how?

……

b. Copyright polices ( ) Yes ( ) No

If **Yes**, how?

……

c. Pricing of government GI data ( ) Yes ( ) No

If **Yes**, how?

……

d. Which policy is affecting your business very badly and why?

……

……

24. Which will be the ideal policy environment for your business? Kindly explain briefly how the liberated map policy will boost your business.

……..……..……

……

25. Do you have any IPR♠ or Copyright Policy? ( ) Yes ( ) No

If **Yes**, Please explain briefly……

……

Coordination and Data Sharing

26. Do you have any mechanism to share the data with other organization? ( ) Yes ( ) No

If **Yes**, what mechanism? Please tick the appropriate answer below.

( ) Memorandum of Understanding
( ) License Agreement
( ) Others, please specify……

……

If **No**, why? Tick the appropriate reason.

( ) Threat to organization's business
( ) Avoid legal costs
( ) Compatibility Problem
( ) Avoid competition
( ) It is not in the culture of the organization
( ) Others……

27. In what forms do you receive GI from other organizations?

Sl.No	Form of Data	Current Method	Method Preferred
1	Analog Map (paper form)		
2	Vector Data		
3	Scanned Map		
4	Raster Image		
5	Tabular Data		
6	Reports		
7	Any Other (Please specify)		

28. Which is the most commonly used method for information exchange? Which method is preferred? Tick the appropriate answer.

Sl.No	Methods	Current Method	Method Preferred
1	Internet / Intranet		
2	Email		
3	Magnetic media like CD ROM, Diskette, Tape etc		
4	ftp		
5	Any Other (Please specify)		

♠ Intellectual Property Right

29. Which GIS software do you use in your organization?

( ) ESRI products (ArcView, ArcGIS, ArcInfo etc) ( ) GeoMedia
( ) MapInfo ( ) AutoCAD
( ) Other (Please specify)……

Marketing of GI products/services

30. What is the organizational mechanism for production of GI in your organization?

( ) Co-operation with other organizations ( ) On Customer Request
( ) Private production ( ) Based on a law / Govt. order
( ) Others (Please Specify)……..

31. How is your organization financed?

( ) Through operations of the organization ( ) Supported by Government
( ) Supported by Banks / Financial Institutes ( ) Supported by Donor Agencies
( ) Other (Please specify)……

32. Does your organization have a policy on pricing? ( ) Yes ( ) No

If **Yes**,

- What is your policy on pricing?

……

- Is this policy in line with the general policy of government? ( ) Yes ( ) No

If **Yes**, explain how does this affect your business?

……

……

33. Where do you see the most threat to your company? Tick the most appropriate answers in order.

( ) Competition ( ) Insufficient data
( ) Lack of awareness of the GI potential ( ) Unfair government polices on GI use
( ) Unfair competition by public organizations ( ) Donor projects stagnant the market of GI
( ) Others please specify……..

34. Where do see you see most market potential?

……

……

National Spatial Data Infrastructure (NSDI) related

35. a. What role is your organization playing in developing NSDI in the country?

( ) Coordination ( ) Facilitation ( ) Participation
( ) Support ( ) Observe ( ) None
( ) Other (Please specify) ……

b. Which area do you think you can contribute better? And how? Explain briefly.

……

36. In your opinion, what will be the most challenging factors for

- For NSDI development?
- For your business?

[Name three pressing challenges from the following : 1).Copyright 2).Pricing Policy 3).Political concerns regarding access to data 4).Metadata development 5).On-line Services 6).Limited Bandwidth of Network 7).Creation of Digital Database 8).Maintenance of core data 9).Quality of data 10).Data Standards 11).Budget /Funding 12).Other please specify]

For NSDI	For your business
1……..	1……..
2……..	2……..
3……..	3. …….

37. If the free access to all maps, including SOI maps are made available through relaxed map policy, would you see any new business opportunities? ( ) Yes ( ) No

If *Yes,*

In which direction? And what sort of products?

…….. …….. …….. ……

…….. …….. …….. ……

38. Which area (sector) of GI will boom in the coming years? Please feel free to give your opinion.

…….. …….. …….. ……

…….. …….. …….. ……

39. What strategy would you follow to boost the GI market?

…….. …….. …….. ……

…….. …….. …….. ……

Optional

Name :

Contact detail (phone number, email address):

Would you like to be informed of the result of this questionnaire? Yes / No