FEASIBILITY STUDY
FOR A
NATIONAL SPATIAL
DATA INFRASTRUCTURE
IN
UGANDA
# Table of Contents

**Executive Summary** .................................................................................................................. ix  
**Chapter One** .............................................................................................................................. 11  
  1.0 Introduction ........................................................................................................................... 11  
  1.1 Vision ................................................................................................................................... 11  
  1.2 Mission .................................................................................................................................. 11  
  1.3 Targets ................................................................................................................................... 11  
    1.3.1 Goal One ......................................................................................................................... 11  
    1.3.2 Goal Two ....................................................................................................................... 11  
    1.3.3 Goal Three .................................................................................................................... 12  
    1.3.4 Goal Four ....................................................................................................................... 12  
**Chapter Two: Institutional/Organizational Arrangement** .......................................................... 13  
  2.1 Organizational Approach ........................................................................................................ 13  
    2.1.1 National Mapping Organizations/Agencies ................................................................. 13  
    2.1.2 Industry ......................................................................................................................... 13  
    2.1.3 Other Agencies, Organizations and Institutions .......................................................... 13  
    2.1.4 Policy/Organization Environment ................................................................................ 13  
  2.2 National SDI Initiatives ............................................................................................................ 15  
    2.2.1 Ministry of Land, Housing and Urban Development (MoLHUD) Land Information System Project (LIS) .................................................................................................................. 15  
    2.2.2 GEO-IM ......................................................................................................................... 16  
    2.2.3 Uganda Bureau of Statistics .......................................................................................... 16  
  2.3 National Planning Authority .................................................................................................... 16  
    2.3.1 NPA Research, Innovation, Monitoring and Evaluation Department ............................ 18  
    2.3.2 NPA Decentralized Development Planning Department ............................................. 18  
    2.3.3 NPA Human Resource Planning, Development and Capacity Building ......................... 18  
    2.3.4 NPA Finance and Administration Department ............................................................... 18  
  2.4 Proposed Organization Structure ............................................................................................ 18  
    2.4.1 NSDI Council (ruling body) ............................................................................................ 18  
    2.4.2 National Inter-Agency Spatial Data Infrastructure Committee (NISDIC) ....................... 19  
    2.4.3 Sub-Committee or Working Groups .............................................................................. 20  
    2.4.4 The NPA GIS Coordination Unit .................................................................................... 20  
  2.5 Broad Framework TORs for the First Four Working Groups ................................................. 21  
**Chapter Three: Data Issues** ........................................................................................................ 22  
  3.0 Data Issues ............................................................................................................................. 22  
    3.0.1 Availability of Digital Datasets in the Country ............................................................... 22  
    3.0.2 Policies and Standards ..................................................................................................... 22  
    3.0.3 Inadequate Technology .................................................................................................... 22  
    3.0.4 Problems in the Institutional Framework ....................................................................... 22  
    3.0.5 Availability of Skilled Human Resource ......................................................................... 22  
    3.0.6 Policy Issues .................................................................................................................... 22  
    3.0.7 Other Issues ..................................................................................................................... 23  
  3.1 Standards ............................................................................................................................... 23  
    3.1.1 Proposals ........................................................................................................................ 24
7.0 Implementation Plan for UGSDI ................................................................. 50
7.1 Implementation Stages and Outcome ......................................................... 51
  7.1.1 Issue, Goals and Proposed Actions ....................................................... 51
  7.1.2 Stage 1 ................................................................................................. 51
  7.1.3 Stage 2 ................................................................................................. 51
  7.1.4 Stage 3 ................................................................................................. 52
  7.1.5 Stage 4 ................................................................................................. 52

Chapter Eight: Indicative Financial Requirements ........................................ 53

List of Figures

Figure 1: NPA Structure .................................................................................. 17
Figure 2: Proposed Institutional Framework for the UGSDI ......................... 19
Figure 3: Proposed UGSDI Architecture ....................................................... 45
Figure 4: Proposed Architecture of a Ugandan Geospatial Portal ............... 46
Figure 5: Technical Components ................................................................. 47
Figure 6: Data Flow Diagram ........................................................................ 48

List of Tables

Table 1: Multi-Sectoral Uses of GI ................................................................. 35
Table 2: Communication Categories ............................................................... 40
Table 3: Actions and Timeframes .................................................................. 43
Table 4: Five-Year Implementation Stages for Proposed UGSDI .................. 51
Table 5: Broad Cost Estimates for Implementing the First-Generation UGSDI .. 53
Table 6: Establish the NISDIC ...................................................................... 54
Table 7: Establish the NISDIC Working Groups .......................................... 54
Table 8: Establishment of GIS Coordination Unit ........................................ 55
Table 9: Hardware and Software ................................................................. 56
Table 10: Study Tours and Trainings .............................................................. 57
Table 11: Launch Activities for Initial Conformance and Exchange Operation .. 57
Table 12: Assessment of MDAs ................................................................. 57
Table 13: Social Awareness ......................................................................... 57
Table 14: Communication Framework ......................................................... 58
Table 15: Data-Sharing Framework ............................................................... 58
Table 16: Technical Specifications ............................................................... 58
Table 17: FundamentalDatasets ................................................................. 59
Table 18: Establishment of GIS Units for MDAs and LGs .......................... 59
Table 19: National Spatial Plan ................................................................... 59
Table 20: Documentations .......................................................................... 59
Acknowledgments

This report has been prepared by a team from Geo-Information Communication in Kampala, Uganda, especially Amadra Ori-Okido, Judith Strike, and Ojoatre Sadadi, and at ESRI Canada Ltd in Toronto, especially Lynn Charles Holstein, Paul Belanger, and Gordon Plunkett. It was carried out under the supervision of Tim Kelly, Lead ICT Policy Specialist, infoDev, with funding from the Korea Trust Fund on ICT for Development and It is part of a broader study on “Using GIS/SDI for Monitoring Development Outcomes” report. We wish to thank Samhir Vasdev, for editing and preparing this document for publication, and all reviewers whose suggestions were deeply appreciated.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFI</td>
<td>Computer Frontiers International</td>
</tr>
<tr>
<td>ESRI</td>
<td>Environmental Systems Research Institute</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>FGDs</td>
<td>Focus Group Discussions</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>GCU</td>
<td>GIS Coordination Unit</td>
</tr>
<tr>
<td>Geo-IM</td>
<td>Geo Information Management, Uganda</td>
</tr>
<tr>
<td>GI</td>
<td>Geographic Information</td>
</tr>
<tr>
<td>GIC</td>
<td>Geo-Information Communication</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GoU</td>
<td>Government of Uganda</td>
</tr>
<tr>
<td>GSDI</td>
<td>Global Spatial Data Infrastructure</td>
</tr>
<tr>
<td>IASC</td>
<td>Inter-Agency Standing Committee</td>
</tr>
<tr>
<td>ICT</td>
<td>Information Communication Technology</td>
</tr>
<tr>
<td>ILS</td>
<td>International Land Systems</td>
</tr>
<tr>
<td>ILRI</td>
<td>International Livestock Research Institute</td>
</tr>
<tr>
<td>IPR</td>
<td>Intellectual Property Rights</td>
</tr>
<tr>
<td>KNSDI</td>
<td>Kenya National Spatial Data Infrastructure</td>
</tr>
<tr>
<td>LSSP</td>
<td>Land Sector Strategy Plan</td>
</tr>
<tr>
<td>MEMD</td>
<td>Ministry of Energy and Mineral Development</td>
</tr>
<tr>
<td>MDA</td>
<td>Ministries, Departments and Agencies</td>
</tr>
<tr>
<td>MDGs</td>
<td>Millennium Development Goals</td>
</tr>
<tr>
<td>MoFPED</td>
<td>Ministry of Finance, Planning and Economic Development</td>
</tr>
<tr>
<td>MoLHUD</td>
<td>Ministry of Lands Housing and Urban Development</td>
</tr>
<tr>
<td>MoES</td>
<td>Ministry of Education and Sports</td>
</tr>
<tr>
<td>MoU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>MoW</td>
<td>Ministry of Works</td>
</tr>
<tr>
<td>MoWE</td>
<td>Ministry of Water and Environment</td>
</tr>
<tr>
<td>MoTT</td>
<td>Ministry of Trade Tourism and Industry</td>
</tr>
<tr>
<td>MoLG</td>
<td>Ministry of Local Government</td>
</tr>
<tr>
<td>MoH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>MAAIF</td>
<td>Ministry of Agriculture Animal Industry and Fisheries</td>
</tr>
<tr>
<td>MoGLSD</td>
<td>Ministry of Gender Labor Social Development</td>
</tr>
<tr>
<td>MTN</td>
<td>Mobile Telephone Network</td>
</tr>
<tr>
<td>NEA</td>
<td>National Environment Act</td>
</tr>
<tr>
<td>NSIF</td>
<td>National Spatial Information Framework</td>
</tr>
<tr>
<td>NFA</td>
<td>National Forestry Authority</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-Governmental Organizations</td>
</tr>
<tr>
<td>NDP</td>
<td>National Development Plan</td>
</tr>
<tr>
<td>NPA</td>
<td>National Planning Authority</td>
</tr>
<tr>
<td>PEAP</td>
<td>Poverty Eradication Action Plan</td>
</tr>
<tr>
<td>PMA</td>
<td>Plan for Modernization of Agriculture</td>
</tr>
<tr>
<td>NISDIC</td>
<td>National Interagency Spatial Data Infrastructure Committee</td>
</tr>
<tr>
<td>NIMES</td>
<td>National Integrated Monitoring and Evaluation Strategy</td>
</tr>
<tr>
<td>NUDC</td>
<td>Northern Uganda Data Centre</td>
</tr>
<tr>
<td>OCHA</td>
<td>Office for the Coordination of Humanitarian Affairs</td>
</tr>
<tr>
<td>OGC</td>
<td>Open GIS Consortium</td>
</tr>
<tr>
<td>OPM</td>
<td>Office of the Prime Minister</td>
</tr>
<tr>
<td>PNSD</td>
<td>Plan for National Statistics Development</td>
</tr>
<tr>
<td>PSCP</td>
<td>Private Sector Competitiveness Project</td>
</tr>
<tr>
<td>PSFU</td>
<td>Private Sector Foundation Uganda</td>
</tr>
<tr>
<td>RCMRD</td>
<td>Regional Centre for Mapping of Resources for Development</td>
</tr>
<tr>
<td>KNSDI</td>
<td>Kenya National Spatial Data Infrastructure</td>
</tr>
<tr>
<td>SDI</td>
<td>Spatial Data Infrastructure</td>
</tr>
<tr>
<td>SLA</td>
<td>Service Level Agreement</td>
</tr>
<tr>
<td>TA</td>
<td>Technical Assistance</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td>TTLs</td>
<td>Task Team Leaders</td>
</tr>
<tr>
<td>UBOS</td>
<td>Uganda Bureau of Statistics</td>
</tr>
<tr>
<td>UGSDI</td>
<td>Uganda Spatial Data Infrastructure</td>
</tr>
<tr>
<td>GSP</td>
<td>Geo- Spatial Portal</td>
</tr>
<tr>
<td>USDI</td>
<td>Uganda Society for Spatial Data Infrastructure</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>UNECA</td>
<td>United Nations Economic Commission for Africa</td>
</tr>
<tr>
<td>UNCED</td>
<td>United Nations Convention on Environment and Development</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>URA</td>
<td>Uganda Revenue Authority</td>
</tr>
<tr>
<td>UNCST</td>
<td>Uganda National Council of Science and Technology</td>
</tr>
<tr>
<td>UTL</td>
<td>Uganda Telecom</td>
</tr>
<tr>
<td>VoIP</td>
<td>Voice over Internet Protocol</td>
</tr>
<tr>
<td>WDR</td>
<td>World Development Report, World Bank</td>
</tr>
<tr>
<td>WG</td>
<td>Working Group</td>
</tr>
</tbody>
</table>
Spatial Data Infrastructure is a framework of spatial data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way. It may also mean the technology, policies, standards and institutional arrangements that facilitate the availability and access of spatial data. It promotes Geo-Information sharing which is an essential resource in addressing poverty, disease, environmental degradation and poor infrastructure. Since SDI helps in promoting Geographic Information for decision makers, it means the prospect of better decision making hence improved management, development of national resources and monitoring development outcomes. A sustainable national SDI in Uganda requires access to data, clear vision and goals, good governance, effective network services, indicative financial requirements, human resource requirements and good communication channels among others.

Following the findings of the first interim report it is obvious that in order for the UGSDI to be successful, a clear strategy has to be implemented. This study proposes vision and goals for the UGSDI, institutional/ organizational arrangements to manage the UGSDI and give ways in which the UGSDI will be administered and its operationalization. The Institution arrangement specifically refers to the organizational approach for the NISDIC; this also involves the other structures within the MDAs for example the Ministries that are in charge of specific data production. The national mapping organizations/agencies, industry, the role of the private sector marketing and promotion of national SDI initiatives, it also emphasizes data issues which refers to standards, availability of digital datasets in the country, the policies and standards, inadequate technology problems in the institutional arrangement, availability of trained manpower, policy issues and other issues like metadata which involves thematic datasets, fundamental datasets, and then data clearing house issues.

Policy issues and legal framework will deal with issues like custodianship confidentiality, privacy and liability, pricing, copyright, data access and security, free and restricted access, ownership. This will stretch in to the Capacity building, where by the role of management in capacity development will involve Recommendations for outreach and capacity building options for implementing a SDI training which is also an actor in framework data development. Study visits GIS awareness and introductory courses map awareness course and education program basic GIS, GIS awareness seminars for managers MDAs and multi-sectoral uses of GI.

The communication strategy for UGSDI awareness creation and information dissemination involves the programs, goals of the UGSDI. The overall strategy, communication process objectives, target audiences both Primary and Secondary Audiences, the general talking points in the UGSDI messages will be having specific themes, with opportunities and tactics which facilitate delivery to the targeted audience. Some of the strategies will involve publications, email, website, PowerPoint presentations workshop, seminar, conference, activities and other public, opportunities, face-to-face meetings with key partners and stakeholder groups.

All other communications channels will be utilized as necessary evaluation, identified opportunities and short-term activities, next steps resources needed for implementation, proposed architectures for, information, dissemination, definition of UGSDI domain data contents- the pre requisite, geospatial portal, formulation of domain policy framework - another pre requisite, proposed architecture of a Ugandan geospatial portal, technical requirements
The Implementation plan for UGSDI involves stages and outcomes; these stages are divided in quarters within a period of 5 years, each stage yields an outcome that is used in the next stage, issues, goals and proposed actions are also discussed in this chapter with the expected outcomes.

Lastly, it further illustrates the financial requirements for the establishment of the UGSDI through the establishment of the effective GIS coordination Unit within NPA. It deals with three major components; hardware, software and the training aspect.
Chapter One

1.0 Introduction

Uganda has an area of 241,035 square kilometers and is a ‘land locked’ country with an estimated population of 33.4 million. It is a rural nation with an urban population amounting to 13%.

Uganda’s economy has great potential. Endowed with significant natural resources, including ample fertile land, regular rainfall, and mineral deposits, it appeared poised for rapid economic growth and development at independence.

Having appreciated the benefits of a national SDI, the Government of Uganda has mandated NPA to handle SDI activities. NPA under the Ministry of Finance and Economic Planning has been chosen by the Government of Uganda as the lead agency that will guide the development and implementation of Uganda’s NSDI. The main task of National Planning Authority as defined by its mandate is to manage national and decentralized development planning in Uganda through a participatory approach, with decision-making being shared by all stakeholders. This requires institutional structures that are vertically and horizontally oriented, so that information (spatial data) and decision-making can be easily shared in order to overcome bottlenecks in the development planning process.

GIC and ESRI Canada in collaboration with the stakeholders, from which the current state of play of GI/GIS in Uganda was derived, have proposed a strategy for improving spatial data sharing by developing an NSDI for Uganda. This strategy is designed based on the visions and goals, institutional arrangements, data issues, network services, indicative financial requirements, human resource requirements, awareness and communication issues, indicative implementation programs and other matters as may be agreed with the Uganda Government and other national/international stakeholders.

1.1 Vision

To provide a national infrastructure for access and use of geospatial information in decision making at local, regional and national levels for social economic development.

1.2 Mission

Promote the production, access, sharing and use of geospatial information for sustainable development.

1.3 Targets

1.3.1 Goal One: Increase the awareness and understanding of the vision, concepts, and benefits of the UGSDI through outreach and education.

Enhanced participation in the UGSDI will result from clearly communicating rationales for data sharing in languages appropriate to differing communities.

1.3.1.1 Objectives

- Demonstrate the benefits of participation in the UGSDI to existing and prospective stakeholders.
- Promote principles and practices of the UGSDI through formal and informal education and training.
- Identify and promote the attitudes and actions that help to develop the UGSDI.

1.3.2 Goal Two: Develop common solutions for discovery, access, and use of geospatial data in response to the needs of diverse stakeholders.

Once found, data would be easy to transfer and use in different applications; every data set would have full and complete metadata to ease the process of transfer and use.
1.3.2.1 Objectives

- Continue to develop a seamless National Geospatial Data Clearinghouse.
- Support the evolution of common means to describe geospatial data sets (metadata).
- Support the development of tools that allow for easy exchange of applications, information, and results.
- Research, develop, and implement architectures and technologies that enable data sharing.

1.3.3 Goal Three: Use community-based approaches to develop and maintain common collections of geospatial data for sound decision-making.

Large centralized national data holdings are costly to assemble and maintain. The most accurate and highest resolution data are created and maintained close to the locations where they are used. This goal looks toward developing the organizational relationships and technologies to build distributed locally maintained collections of data.

1.3.3.1 Objectives

- Continue to develop the National Geospatial Data Framework.
- Provide additional geospatial data that citizens, governments, and industry need.
- Promote common classification systems, content standards, data models, and other common models to facilitate data development, sharing, and use.
- Provide mechanisms and incentives to incorporate multi-resolution data from many organizations into the UGSDI.

1.3.4 Goal Four: Build relationships among organizations to support the continuing development of the UGSDI

As much as possible, this goal intends to identify potential new resources and, at the same time, identify and remove difficulties.

1.3.4.1 Objectives

- Develop a process that allows stakeholder groups to define logical and complementary roles in support of the UGSDI.
- Build a network of organizations linked through commitment to common interests within the context of the UGSDI.
- Participate with the international geospatial data information community in the development of a global geospatial data infrastructure.
Chapter Two: Institutional/Organizational Arrangement

2.1 Organizational Approach
The organizational approach focuses on the individuals or actors involved in the publication and discovery of geospatial information, defines their roles and responsibilities that these actors play and states the essential functions that human or computer-assisted services should be able to conduct in the interest of resource discovery for the UGSDI. The major actors are discussed in the next sections.

2.1.1 National mapping organizations/agencies
National mapping organizations/agencies play a key role in ensuring that accurate, up-to-date geospatial framework data are developed and maintained. Such data are key to, among others, the promotion of sustainable economic development, improvement of environmental quality, resource management, upgrading public health and safety, modernization of governments either local, national or regional, and the responses to natural and other disasters. Therefore such organizations play a vital role in facilitating the development of a UGSDI.

2.1.2 Industry
Industry is working to provide technology, data and services in support of UGSDI activities. In particular, industry plays a key role in ensuring that effective information technologies (consistent with standards and specifications being developed by such groups as ISO and OGC) exist and that these technologies support UGSDI requirements. Therefore it is imperative that such organizations play an important, proactive role in the development of a UGSDI.

2.1.3 Other agencies, organizations and institutions
There are many other agencies, organizations and institutions that collect and use geospatial data that along with national mapping organizations/agencies and industry can and should play an important role in UGSDI activities. It is important here that ways be sought to encourage cooperation, collaboration and communication among as many UGSDI stakeholders as possible.

As in any development it is important to understand who the stakeholders are and what roles each will play. For example:

- In most national infrastructures government suppliers are key stakeholders. How they will play in the development and operation of the data access component of the infrastructure depends strongly on government policies regarding data distribution, cost recovery, etc.
- Commercial entities will generally play a strong role as providers of tools and services but may also be suppliers of primary and value added data. It is important to understand the relationship between the commercial sector and the infrastructure as whole, e.g. will the commercial sector have a role in planning the infrastructure? What types of business arrangements will be supported in the infrastructure?
- The final category of stakeholder is the consumer or end-user. Their use of the data access element infrastructure is dependent on a number of factors including: the functionality of the infrastructure tools, the amount and quality of the content accessible, operating policies, infrastructure business model (will consumers be charged for access?), etc.

2.1.4 Policy/Organization Environment
The importance of developing a supportive policy/organizational environment should not be
underestimated. Potential stakeholders will only become active participants if they see advantages for their organizations and if they do not feel threatened by the infrastructure. This policy/organization environment will vary from country to country and will need to be worked out closely with the stakeholders. The buy-in and commitment from senior management of all stakeholders is critical to the success of the infrastructure as a whole and to that of the access element in particular. The Canadian Geospatial Data Infrastructure (http://www.geoconnections.org/) is an example of an infrastructure implementation that has developed an organization based on broad stakeholder participation. Some of the issues that need to be considered in the development of the supportive policy/organizational environment are:

- Distributed/autonomous suppliers.
- The management of the data should be done as close as possible to source. This ensures the accuracy and quality of the data. This is also dependent on the mandate of each data producer.
- Commercial and government stakeholders need to feel comfortable as active participants in the infrastructure. They should not feel threatened by infrastructure business models or policies.
- Multiple levels of “buy-in”; low barrier to entry to encourage participation by as many stakeholders as possible.
- The access component of the infrastructure must provide multiple levels of buy-in from a low cost option with limited benefits, e.g. basic advertising of products and services, to higher cost options that offer increased benefits, e.g. distributed search connections to the stakeholder’s inventory. This allows stakeholders to choose a level of participation that best meets their business and operational objectives. This is especially important in the early operation of the access component as many stakeholders will want to “try” it out and may not be prepared to expend much effort until they see how it works.
- Sustainable long term business models.
- The access component of an infrastructure must provide an environment that supports a variety of stakeholder/ data provider’s business models. The development of a sustainable business model for the operation of the access component is critical to the long term success of the entire infrastructure.

2.1.4.1 Role of the private sector
The role the private sector as suppliers/users of data, services, and technology and as potential operators of the access infrastructure must be clearly defined.

2.1.4.2 Marketing and promotion
The access component of an infrastructure must develop a marketing and promotion plan to build up the level of awareness and participation as quickly as possible. It is important to get a critical mass of suppliers so that potential participants will see the benefits of joining the infrastructure. Potential benefits to suppliers include:

- Economies of data collection, closest to the source
- Reduced operational costs
- New clients (national and international)
- Data reuse (reuse vs. recollection or conversion)
- Common tool and service reuse
- Advertising
- Benefits of “free” portrayal
- Enabling/supporting broad new applications, e.g. disaster management, value addition

As was reported in (http://www.gisdi.org/docs2004/Cookbook/cookbookV2.0.pdf) thousands of organizations spend billions of dollars each year producing and using geographic data. Yet, they still do not have the information they need to solve critical problems. There are several aspects to this problem as discussed below:
Most organizations need more data than they can afford. Frequently, large amounts of money are spent on basic geographic data, leaving little for applications data and development.

Some organizations cannot afford to collect base information at all. Organizations often need data outside their jurisdictions or operational areas. They do not collect these data themselves, but other organizations do.

Data collected by different organizations are often incompatible due to differences in scale and coordinate systems. The data may cover the same geographic area but use different geographic bases and standards. Information needed to solve cross-jurisdictional problems is often unavailable.

Many of the resources organizations spend on geographic information systems (GIS) go toward duplicating other organizations’ data collection efforts. The same geographic data themes for an area are collected again and again, at great expense. Most organizations cannot afford to continue to operate this way.

Framework initiatives will greatly improve this situation by leveraging individual geographic data efforts so data can be exchanged at reasonable cost by government, commercial, and nongovernmental contributors. It provides basic geographic data in a common encoding and makes them discoverable through a catalogue in which anyone can participate. Using Web mapping and advanced, distributed GIS technology in the future, users can perform visual cross-jurisdictional and cross-organizational analyses and operations, and organizations can funnel their resources into applications, rather than duplicating data production efforts.

Uganda has adopted as the terminology for geospatial data infrastructure – Uganda National Spatial Data Infrastructure (UGSDI). This incorporates all the spatial data infrastructure projects being carried out in the country. The National Planning Authority (NPA), a parastatal under Ministry of Finance and Economic Planning has been selected as the coordinating agency. In the past, most SDI related activities had been handled by Uganda Bureau of Statistics with major support from non-government bodies like Geo-IM Working Group. Although the official implementation body, National Planning Authority (NPA) had no previous provision for SDI within its framework until recently with the formation of NISDIC (see Figure 1). The organizational framework as envisaged by NISDIC is shown in Figure 2.

2.2 National SDI Initiatives
In recent years there have been a growing number of significant SDI initiatives in Uganda that can and will act as a stimulus to UGSDI development. Some of these initiatives are highlighted below. These initiatives are now being documented in several ways and this documentation provides a valuable resource for proponents of the UGSDI.”

2.2.1 Ministry of Lands, Housing and Urban Development (MoLHUD) Land Information System Project (LIS)
The Government of Uganda received funds to provide infrastructure and other related facilities to support growth and improve the land registry. The Land Component is among the main components of the PSCPII earmarking the need for updating the land records, secure and rehabilitate the land registers and implement the Land Information System to improve the land tenure security and facilitate land transactions in Uganda.

Maintenance of the National Land Registry and related cadastral maps is under the mandate of MoLHUD. As an ongoing project, the Ministry with support from the World Bank through Private Sector Foundation Uganda is carrying out a review and assessment of the existing records management system and actions, incorporating land registration records, cadastral and other information; and designing the LIS architecture...
and prepare specifications and functionalities for the LIS.

Based on the fact findings, analysis of the current situation and results of the previous studies, proposed measures for the improvement of the situation have been made. These measures include the final design of the system, implementation of the pilot project to test the design, preparation of a detailed implementation plan and once successful, the implementation of the system for the whole country. This is one of the SDI component projects that could be of great impetus to the current proposal for the UGSDI. It could be integrated into the institutional structure of the proposed UGSDI through the nomination of at least a member by MoLHUD to integrate the issues of the ongoing LIS into the Proposed SDI initiative at the NPA/NISDIC. Currently the chairman of NISDIC and one other sitting member are from Ministry of Lands, Housing and Urban Development.

2.2.2 GEO-IM
Geo Information Management (Geo-IM) Working Group is a group of technical persons from UN Agencies, Non-Governmental Organizations and Governmental bodies that aims at discussing and implementing better ways and systems to facilitate the exchange of information, standard procedures on data sharing, standardization and harmonization of datasets among partners, carrying out coordinated and joint assessments. As noted in the 1st interim Report, it is a group which is generally supported by UBOS and UNOCHA; it draws members from the NPA which is the mandated government agency to handle the UGSDI issues and others from the other government agencies that practice the use of GI/GIS/SDI. This WG has for sometime acted as a data clearing house. The latter is within the proposed mandate and responsibility of NPA who are expected to partner with the WG on their activities. As highlighted in the proposed structure for the UGSDI, other MDAs shall have at least a member representing them at the newly formed NISDIC. The selection process of these members within the MDAs shall be based on a rotation system.

2.2.3 Uganda Bureau of Statistics
Uganda Bureau of Statistics is one of the government agencies that is evident in fulfilling its main task “to provide high quality central statistical information services on social, environmental, and economic conditions of the country”. This is heavily dependent on other institutions to produce exchange and update data in a standardized and orderly manner. The success of UBOS has been in other words dependent on the existence of a National Data Infrastructure and institutional arrangements for exchange and dissemination of data. UBOS has also developed on its own, distinctive geo-codes that uniquely identify all administrative areas down to village level for geospatial data acquired in the 2002 census (Karutunga, A. 2002). Due to a need for trends analysis, the GI service under UBOS plans to geo-code all previous data sets backwards through 1990, 1980, and 1970 subject to availability of funds (Muhwezi, 2004). Furthermore, UBOS has conducted two phased GIS review studies in 2007 and 2009. The objective of the review studies was to conduct a situational analysis of the current GIS initiatives and establish a framework for GIS capacity building and enhancement within the Ministries, Departments and Agencies (MDAs) it was also discovered and noted in the 1st interim report that data is being updated after 10years cycle. Currently data for the 2011 census is being updated.

Another key institution that has developed metadata for its GIS datasets is NEMA and it is available at www.nemaug.org.

2.3 National Planning Authority
In accordance with Section 5(1) of the NPA Act (15 of 2002), the NPA Authority consists of a Chairperson, a Deputy Chairperson and three other members appointed by the President of the Republic of Uganda, with the approval of
Figure 1: NPA Structure
Parliament. These form the full time Members of the Authority. NPA has a Secretariat headed by an Executive Director. The NPA Secretariat is organized into five technical departments pursuing specific functions, roles and responsibilities required to achieve the organization’s mission and mandate.

2.3.1 NPA Research, Innovation, Monitoring and Evaluation Department
This department undertakes innovative research related to development planning and management, and also provides leadership into the monitoring and evaluation of development programs and other interventions.

2.3.2 NPA Decentralized Development Planning Department
This department develops, oversees, monitors, and evaluates an efficient institutional framework and strategy for cost-effective and participatory decentralized development planning and management in Uganda.

2.3.3 NPA Human Resource Planning, Development and Capacity Building
This department assesses the current human resource planning and development, as well as institutional capacity building initiatives in place. It institutes coordination and harmonization mechanisms, encourages the participation of all the stakeholders and creates a specific national databank for this function. Ultimately, this process should lead to a national policy on human resource planning, development and optimal capacity utilization, supported by a conducive environment for investing in people for poverty eradication.

2.3.4 NPA Finance and Administration Department
This department is responsible for the design and review of NPA’s Finance and Administration Policies and guidelines, and overseeing their effective implementation.

As was stated in the first interim report, the Government of Uganda has mandated the establishment of SDI within NPA by establishing NISDIC. The Spatial Data Infrastructure Committee is under the authority of the Ministry of Finance, Planning and Economic Development. NISDIC comprises of a ruling body, a committee, sub-committees or working groups under the GIS Coordination Unit. Sub-committees constitute the platforms for more collaboration among stakeholders by pooling resources and harmonizing initiatives to avoid duplication.

Figure 1 outlines the current structure of National Planning Authority which is mandated as the lead agency for the current SDI study in Uganda.

2.4 Proposed Organization Structure

2.4.1 NSDI Council (ruling body)
Composed of the NPA chairperson with about 10-15 appointed members. These appointed members should come from different key ministries, state bodies, geodetic and geoinformatics community. This council provides the overall leadership during the process of creating a national SDI. Its main roles are administration, review of policies and legislation.

The specific tasks of the Council should include:

- Making decisions on the aims, strategies, policy and basic activities of the UGSDI institutional framework;
- Harmonizing the UGSDI activities with the state policy and programs;
- Coordinating and planning the use of the state funds for the UGSDI development;

---

1 http://www.npa.or.ug/staff.php
2.4.2 National Inter-Agency Spatial Data Infrastructure Committee (NISDIC)

It consists of 3 representatives from the Council, 3-5 members from the NPA and the heads of working groups. In the event that there is more than one stakeholder/agency within a ministry, a rotational system should be used for membership representation within NISDIC.

The NISDIC should be an active committee that;

- Implements the UGSDI establishment policies determined by the UGSDI Council;
• Performs the work and tasks delegated to it by the UGSDI Council;
• Coordinates and monitors the activities of the working groups;
• Coordinates the implementation activities of the UGSDI subjects related to their establishment in accordance with the UGSDI Council guidelines.

The NISDIC should report to the UGSDI Council and is expected to work closely with Ministries, Departments and Agencies and other Spatial Data stakeholders in the public and private sectors in execution of its duties.

2.4.3 Sub-Committees or Working groups
It consists of temporary and permanent work bodies responsible for the concept and implementation aspects. Their members should be representatives of the local government authorities at all levels, users and producers of spatial data, research and educational institutions among others. These bodies should be appointed or dismissed by the NISDIC, with approval of the UGSDI Council. The prerequisite for forming a body is a clearly defined mission and a detailed execution plan. A working group can form different sub-groups so that its objectives are met in a timely way.

For example, NISDIC should start by creating 4 working groups (WGs) between 2010 and the first quarter of 2011. They should include UGSDI standards WG, Legal affairs WG, capacity building WG and Dissemination WG. In the second quarter of 2011 three additional working groups should be created: WG for building the UGSDI establishment capacities, WG for linking the UGSDI program and e-Government and one for establishing a business model for the UGSDI.

2.4.4 The NPA GIS Coordination Unit
As GIS shall be introduced as a tool in the organization of NPA, it is essential that the Capacity Development Activities are directed towards the organization. It will include both specialist and non-specialist roles. Within the organizational structure it will be a secretariat that will provide continuous support in the UGSDI development process, coordinate the work of all UGSDI bodies, and provide technical support. Its main tasks will include:

• Setting up and maintenance of the central UGSDI web portal,
• Securing communication support, public relations, services of leading projects, services of quality control, etc.

This organizational structure is based on the models developed by countries like Croatia, Germany and the Netherlands.

Listed below are some of the proposed staff for the NPA GIS Coordination Unit.

i) GIS and UGSDI Coordination Manager: Focuses on stakeholder and in-house GIS map production and use; dataset and GIS capacity inventories; the implementation, monitoring and evaluation of UGSDI; WGs and stakeholder coordination, analysis and monitoring reports of WGs especially those concerning several sectors such as energy, regional development, education, business development, social inclusion, decentralization, etc; UGSDI help desk.

ii) Geo-Information Management and Spatial Analyst: Focuses on spatial analyses; development, management and maintenance of the geo-spatial portal and metadata service catalogue; data dissemination mechanism (s); site updates and checks for consistency, data quality, standards, metadata; creation and presentation of a demo-solution to simulate data-exchange principles; review and analyse reports; UGSDI help desk.
iii) **ICT and Database Developer:** Focuses on administration of the IT Infrastructure of the Unit; develops and manages the UGSDI associated databases/systems; gather technical requirements, develop specifications, define information deliverables and devise ways of their dissemination; draft training materials; UGSDI help desk.

iv) **Communication Officer:** Main contact person; focuses on public awareness creation; organising meetings; writing and dissemination of reports and meeting minutes; manages the contact list database, devise ways of information dissemination; keep abreast and communicate about local, regional and international UGSDI events.

### 2.5 Broad Framework TORs for the first 4 Working Groups

The working groups are technical task forces for the UGSDI. They comprise of experts in different fields and their function is to make recommendations on given terms of references to NISDIC.

- **Standards WG**
  Standards facilitate the sharing of information and computer resources within organizations. They are also assist in representing data efficiently and facilitate the exchange, comparison and analysis of information. The terms of reference for the standards WG include:
  - Framework data (scale)
  - Coding System
  - Reference System (ellipsoid, projection)
  - Exchange format
  - Metadata Standards

- **Legal and Policies WG**
  The task of this Working Group is to consider all relevant aspects related to data policy and to develop proposals on the issues to be addressed in the UGSDI framework legislation. These include:
  - Copyright
  - Liability
  - Privacy
  - Data policies (access, restriction, pricing, enforcement of copyright for original data and secondary data, etc).

- **Capacity Building WG**
  The function of the Working Group on Capacity Building is to provide direction for the UGSDI work in the fields of capacity building, technical assistance and training. Its broader ToRs include:
  - Training
  - Curriculum
  - Research
  - Sensitization
  - Liaison

- **Dissemination WG**
  This working group is charged with the development of a framework for. Below are broad ToRs for this WG to fulfill its mandate:
  - Clearinghouse
  - Metadata
  - Website for UGSDI
Chapter Three: Data Issues

3.0 Data Issues

Implementation of previous SDI projects in Uganda has in the past faced numerous problems. Some of these problems are highlighted below:

3.0.1 Availability of Digital Datasets in the Country

Most of the fundamental and thematic datasets in the country are still in analogue form. Few of them are current but most are outdated. So implementation of UGSDI project will inevitably run concurrently with coordinated revision of the existing datasets and conversion of them to digital form. This is a serious handicap to the UGSDI project. Ministry of Lands Housing and Urban Development through the LIS project has commenced the updating of the land records in order to secure and rehabilitate the land registers and implement the Land Information System to improve the land tenure security and facilitate land transactions in Uganda. This will eventually be integrated into the NGDI spatial datasets.

3.0.2 Policies and Standards

There is no common policy and standard on the production, usage and sharing of Geo-information. This is obviously delaying the UGSDI project in the country and therefore needs to be designed in order to promote efficiency and success of the proposed UGSDI.

3.0.3 Inadequate Technology

The physical linkages which will be the major access to UGSDI systems will be through a range of mechanisms, including telephone lines, Local Area Networks, Wide Area Networks and other Integrated Service networks (Adeoye et al, 2002). Our telecommunication facilities are still problematic and can cause problems to UGSDI project. Hopefully, the introduction of wireless communication network is an asset to UGSDI but the service in Uganda still needs a lot of improvement. Closely connected to this is the electricity power needed to support all the activities of UGSDI. Electricity power supply has remained a problem and in some places simply does not exist.

3.0.4 Problems in the Institutional Arrangement

The Institutional arrangement adopted for now has just been proposed thus the roles of many public and private agencies producing and using GI are yet to be defined. Conflicts of interests exist in so many areas especially the most government agencies that have been participating in Data collection (primary data collection) and must be tackled to ensure successful implementation of the UGSDI project. The structure cannot guarantee cohesive framework for effective coordination of geospatial activities in the country. The proposed organizational framework of National Planning Authority seeks to be flexible so as to satisfy the needs of GI producers and users.

3.0.5 Availability of Skilled Human Resource

Despite the developments taking place in our education and capacity building efforts, availability of properly trained personnel is still a problem in the implementation of the UGSDI project. The training strategy proposed in this report is expected to solve this problem (see Chapter 5).

3.0.6 Policy Issues

There are no formal agreements or processes underway to address privacy, access, use, pricing, and liability. Agencies have autonomous approaches to these subjects, especially in the areas of pricing and copyright. In practice, digital geographic data sets are sold off-line on a single-license basis at prices ranging from 1% to 5% of the production cost. Analogue data sets (photos or maps on paper) are sold at the cost of duplicating them. Private firms mainly produce customized geographic data and charge their clients about
130% of the production cost. In general, this type of data is not available to the public.²

3.0.7 Other issues

- Some of the datasets are 40 to 60 years out of date or are still to be undertaken for the first time. This creates the challenge of updating them.

- Lack of funding or lack of will to collect data or update the current datasets

- Maintenance of up-to-date data in the future and acquiring funding for this and share the costs among users and suppliers is still a challenge.

3.1 Standards

Ideally, metadata structures and definitions should be referenced to a standard. One benefit of standards is that they have been developed through a consultative process (with other "experts") and provide a basis from which to develop national or discipline-oriented profiles. As standards become adopted within the wider community, software programs will be developed to assist the industry in implementing the standard. The consistency in metadata content and style is recommended to ensure that comparisons can be made quickly by data users as to the suitability of data from different sources. The standardisation activities are a logical part of the data repository establishment and maintenance process. To develop a standard is not a time-limited project, but a dynamic process that involves users and different producers of geospatial data. This activity should mainly include: The Feature catalogues development, Dictionary of Terms and definitions in GIS Metadata specifications, administrative boundaries, data model development (see example) acceptance, if applicable international standards.

The linkage to international standards requires that these standards are available. ISO-standards are available through the national standardisation body, OGC-standards can be provided directly from the Open GIS Consortium (OGC). This also requires the involvement of the national body that is in charge of standards that is Uganda National bureau of Standards (UNBS)

SDI standards in this case deals with issues that involve standardizing datasets, metadata, data sharing mechanisms, pricing, hardware and software used. One of the goals of UGSDI is information sharing; therefore, standardization is of vital importance to enable interoperability of information systems. Tools, applications and data effects on each other and therefore, processes for developing standards must consider the interactions. The aspects of standardization that are of importance to UGSDI include;

- Data (production) standards,
- Data presentation,
- Transfer/exchange standards,
- Hardware and software standards

The Standards for GI usage are therefore reflected in three primary themes, namely:

i) **Portability**: this refers to the ability to use and move data, software, and custom applications among multiple computers and operating system environments without retooling or reformatting.

ii) **Interoperability and information access**: this refers to the ability of users to connect and retrieve information from multiple systems.

iii) **Maintainability**: addresses the use of standards to promote long-term and efficient updating, upgrading, and the effective use of computer systems and databases.

These standards should conform to both national and international standards.

² www.gsdi.org/docs2004/Cookbook/cookbookV2.0.pdf
3.1.1 Proposals
The following are proposals for the formulation, maintenance and enforcement of data standards:

- The Uganda National Bureau of Standards should be brought on board to take charge of implementing national standards related to spatial information. Since these standards will be adapted from ISO, we should give them a name for reference purposes. For example Uganda Spatial Information Standards (USIS 1900 Series). In Uganda, the GeoIM Working group has gone a step ahead in standardizing and sharing their datasets. These datasets are the most widely used datasets in Uganda’s GI community and can be found on (http://www.ugandaclusters.ug).

However, most of these datasets are un-interoperable and are geared towards helping the humanitarian community. Therefore, there is need to re-develop the above fundamental datasets and standardize them with conformance to both national (USIS 1900 Series) and international standards (ISO19100 series) so that they may fit in to the system.

- There should be a standards manual and a separate document to describe spatial data specifications and subsequently be developed to help data producers and users to refer to them during production and data utilisation.

- The NISDIC should have a sub-committee or working group to certify the compliance of the standards.

3.2 Metadata
The effective use of existing statistical and geographical data resources depends, to a great extent, on the knowledge of the existence of each particular data. Once created, and properly documented geo-spatial data can be used by multiple systems for different purposes. A number of studies have established that the effective use of data is inhibited by poor knowledge of the existence of data, poorly documented information about the data sets, and data inconsistencies. The location and evaluation of available data sets can be done using metadata.

Metadata is the data about data. It includes details such as the geographical extent of data, quality of data, currency of data and the supplier of the data. These details are described in a metadata structure and they enhance the use of GI in making appropriate decisions. This definition reflects the nature of metadata, that it can be considered also as detailed catalogue containing the identification and description (technical characteristics, extent, origin, accuracy, availability among others) of existing data sets.

The metadata can help the concerned users find, evaluate and use geo-spatial data. This considerably improves the use of existing data sets, contributes to efficient planning of new data capturing activities, avoids the overlap of these activities and saves costs. Thus to organise and make metadata available is a very cost-effective measure to start the process of building a Spatial Data Infrastructure. It is therefore recommended that as one of the immediate activities, the metadata set for all the statistical and geographical data existing within NPA and the other MDAs be created. As part of the UGSDI strategic development plan, the GIS software should be made available to NPA and the MDAs. This software can be used to create the standardised metadata for all existing geo-spatial data sets and access to this can metadata be organised using the internet.

Metadata assists the user to determine how best to use the data. It also benefits the data producing agencies as well, because as personnel changes in an organization, undocumented data may lose their value due to little understanding of the contents and uses by the new staff. Moreover, lack
of knowledge about other organization’s dataset can lead to duplication of effort. The value of a dataset is therefore dependent on its documentation.

Geospatial data producers should provide metadata for each dataset they produce and any subsequent updates. The metadata provided should conform to national and international standards.

The metadata content should include the following information at the minimum:

- Data quality (positional accuracy, attribute accuracy, temporal accuracy, lineage, completeness and logical consistency)
- Geospatial data organization
- Spatial reference (coordinate system, datum, map projection)
- Identification information (name of data, geographic coverage)
- Entity/attribute information (formats, type, measurement units)
- Distribution information (distributor, format, access protocol, procedure).

3.2.1 Fundamental datasets

The fundamental datasets refer to datasets with national coverage needed consistently by more than one user. The UGSIDI Committees should come up with a list of the fundamental or core datasets that will be common and easily accessible to all (see Table 1).

Although different data providers may provide components of the fundamental datasets, the datasets they provide must conform to the national standards so that there is ease in interoperability and integration into other datasets.

This will help different organizations to easily spatially analyze their datasets.

Some of the fundamental categories of datasets for the UGSIDI include:

- Geodetic control
- Digital imagery
- Place names
- Administrative boundaries
- Parcel boundaries
- Transportation
- Hydrology
- Vegetation
- Elevation, Utilities and so on.

3.2.2 Thematic datasets

A thematic dataset is a dataset that focuses on a specific idea or theme. It illustrates a particular subject and contrasted the general dataset, in which the variety of geological and geographical phenomena regularly appears together. The contrast between both of them lies in the fact that thematic datasets use the base data. Thematic datasets also emphasize spatial variation of one or a small number of geographic distributions. They can also be referred to as geospatial datasets that may be required for specific applications and are often derived by adding value to one or more fundamental datasets. There are two categories of thematic datasets:

a) Thematic datasets that are produced only by legally mandated agencies like oil pipeline corridor map
b) Thematic datasets that are produced according to specific user requirements, for example Tourist map, soil map, meteorological datasets, agricultural map etc.

3.3 Data Clearinghouse

A clearing house is a distributed network of geospatial data producers, managers, and users linked electronically. It is a repository structure, physical or virtual, that collects, stores, and disseminates information, metadata, and data. A clearinghouse provides widespread access to information and is generally thought of as reaching or existing outside organizational boundaries. It incorporates the data discovery and distribution components of a spatial data infrastructure (see Figure 4).
For the UGSDI, it will be centered at the NPA and managed by the NISDIC council which will be solely in charge of data issues proposed in the UGSDI.
Chapter Four: Policy Issues and Legal Framework

4.0 Policy Issues and Legal Framework

A spatial data infrastructure (SDI) is a framework of spatial data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way. It may also mean a national network-based solution to provide easy, consistent and effective access to geographical information maintained by public agencies throughout a country that provides and promotes the use of geographical information in support of political, economic and social development.

This involves a number of stakeholders who may be categorized as the; Users, Academic community, Public and private sector, Nongovernmental organizations and associations, government Ministries responsible for data production.

As noted in the First Interim Report, Uganda has no specific legal framework for spatial data sharing. Furthermore, there is no national law on spatial data sharing and pricing. Therefore, it is imperative that a legal framework is initiated to enforce the implementation of national standards as is the case in South Africa. It is essential that the new legal framework be put in place to address such legal issues related to the UGSDI Initiative, and further that there be harmonious linkages with other related government policy documents such as the ICT policy, the draft National Land Policy and the e-government strategy.

The law encompasses all the activities in relation to data production, access and the costs attached to it, who is responsible for the collection of which data and the specific standards to follow, development of the meta data.

4.1 Custodianship

Data Custodians are responsible for the safe custody, transport, storage of the data and implementation of the rules concerning data. While data stewards are commonly responsible for data content, context, and associated rules, they are also responsible for what is stored in a data field, while Data Custodians are responsible for the technical environment and database structure. They may sometimes be referred to as Database Administrator (DBA), or Data Modeler, they also ensure that access to the data is authorized and controlled, Data stewards are identified for each data set to ensure technical processes to sustain data integrity, ensure processes exist for data quality issue resolution in partnership with Data Stewards, technical controls to safeguard data added to data sets are consistent with the common data model, versions of master data are maintained along with the history of changes, change management practices are applied in maintenance of the database they also ensure that data content and changes can be audited.

The custodianship of geospatial information is a crucial component of UGSDI. Since most fundamental datasets are provided by public organizations, it is often necessary to identify an authoritative source of datasets which are produced using public funds as this provides accountability for fundamental datasets.

The custodian should be the person or organization who is responsible for the production, storage, management and distribution of the dataset on behalf of another organization (in this case the government of Uganda). A data custodian is delegated to protect the confidentiality, integrity and availability of the data.
The producer of public funded data should be the custodian and not owner, managing the data as a trustee for the community and the authoritative source of the fundamental dataset in its care.

4.2 Ownership
The owner of a geospatial dataset should be the person or organisation who privately funds data production, storage, management and distribution. Other responsibilities of the owner of the dataset include:

- Quality control and assurance
- Data content and formats
- Validation and maintenance
- Storage and security
- Maintenance and updates of metadata
- Accessibility of the data through supply of the metadata to the Clearinghouse.

4.3 Confidentiality, Privacy and Liability
In the case of confidentiality, privacy and liability of the datasets the following is proposed:

- Data providers should disclose or make available their datasets on request unless it is prevented by law.
- Only geospatial data related to national security should be granted confidentiality. However, confidential data may be shared at the discretion of the custodian.
- A geospatial data custodian/owner should not be accountable for the integrity of data that has been modified by a user.
- A geospatial data custodian/owner should be deemed to possess indemnity against any liability arising from unlawful use of the dataset.
- A user should report, to the provider and the Clearinghouse, any error which in his/her opinion affects the quality of a geospatial data, and should do so in the shortest time possible after discovering the error.

- The user reporting any error should provide sufficient information to enable the provider to identify the record(s) that contain error(s) that make the data unsuitable, and where possible, provide evidence of the error.

4.4 Copyright
There are no clear copyright laws in Uganda. Copyright laws are required to ensure the proper implementation of UGSDI. Other issues to consider include:

- A geospatial data custodian should own the copyright or intellectual property right of the data.
- For value added data, the producer should own the copyright of the new data and acknowledge the source of the original data.
- For integrated datasets, the producer of the data should own the copyright provided that permission has been obtained from the copyright holder(s) of the individual base data.
- A geospatial data custodian and user should, prior to the utilization of any geospatial dataset to which the user has gained access, enter into a licensing agreement with regard to the use of the dataset. The licensing agreement should provide for the following:
  - The duration of the agreement
  - The legal protection of the copyright of the custodian and any other interested party
  - A maximum number of permitted users within the organization where an organization is the beneficiary of the agreement
  - Any other provisions that the parties may deem necessary.
- A data user should not supply data to a third party unless this is covered by a
licensing agreement between the user and the provider.

4.5 Pricing
Most of the datasets used in Uganda are freely shared; however, in the private sector some of them are priced. There is no standard pricing mechanism for datasets produced for the public. Much as the public needs the protection of the law, different prices will always be set for different users. Therefore, a standard affordable price should be discussed and agreed upon. The high cost of geospatial products and services is seen as a barrier to free access by the majority of users. For publicly funded geo-information and services, the aim of pricing policy is not to achieve cost recovery, but to make geospatial information and services more accessible, affordable, and ultimately more effective and efficient. The purpose is to have a uniform policy in the public sector on pricing of spatial information and services.

4.6 Data Access and Security
One of the objectives of the UGSDI is to share data and avoid duplication of efforts. Data sharing is made possible through coordinated and structured access to documentation (metadata) about geospatial data owned by public and private sector organizations.

In Uganda there is one common place or portal (http://ugandaclusters.ug) for storing and dissemination of some datasets. However, this portal is not designed for visualizing, discussion, dissemination and metadata. This makes it hard for the users to recognize, visualize and use the existent datasets or suggest ways of improvement. The datasets shared on this portal are also un-secure, not up-to-date, lack the standardization needed and are geared to serve mainly the humanitarian community.

Transparent access to various geospatial data can provide relevant information for many applications leading to value added services and market opportunities. Access to data is made possible through the development and implementation of a central one-stop geo-spatial portal with a metadata catalogue and establishment of Clearinghouse within a legal framework. However, data access protocols need to be developed in order to define a set of consistent and workable arrangements that can be used by the GI community to streamline access to data and derived information products while recognizing the rights of all parties (custodians and users).

There should be two categories of data access, namely:

a) Restricted access
Only geospatial data related to national security should be granted restricted access, such data should be made available to users by agreement with data owner(s) on a case-by-case basis under conditions stated in a license agreement (e.g. mining petroleum deposits). Note: The UGSDI concept precludes the restriction of geospatial datasets

b) Free Access
There should be free access under a legal framework to other public and private datasets.

Data may be reclassified from one access category to another as circumstances change over time, and this should be subject to the approval of the data custodian and agreement by stakeholders. All archived data should be made available to agreed parties as described in the access protocol.

An access registration system, which should be simple to understand and designed to minimize compliance costs, should be put in place in the form of a search/order form. The form would require the user to specify queries for data with certain properties while providing such
information as name and organization of user, address, intended use of data among others.

The mode of access should be defined in the access protocol and it may include online access (view only, direct to user’s database for example via ftp, brokered – providing specification of data access request to secondary access service, or offline access (hardcopy delivery or softcopy delivery on storage media such as Flash disk or CDROM). In addition, the top clearinghouse should be established at NPA.

Each geospatial data producing agency should establish a metadata database server as a UGSDI node, linked to the top Clearinghouse which will be at NPA.

Reasonable security measures should be put in place to minimize damage to unauthorized access, modification and loss of current and archived data. These include access to;

- Authentication devices,
- Hardware and software devices,
- Computer firewall protection,
- General fire protection,
- Physical security, etc.

Each of the UGSDI nodes should be on an intranet to ensure full security and “closed user” access. The nodes should be linked to the master UGSDI Server – which will serve as the gateway on the Internet for the intranet nodes. The UGSDI Gateway should be a web domain name (e.g. http://www.UGSDI.go.ug) with individual Nodes linked to the UGSDI domain. The UGSDI gateway on the wide area protocol and the UGSDI Intranet would require sufficient bandwidth of a communication backbone.

4.7 Other Policy Recommendations

The following are recommendations for the development of policy:

- GI/GIS projects should include a training component for various grades of human resource (operators, supervisors, managers, etc) in relevant aspects of geo-information.
- The NPA and other stakeholders should carry out public awareness programmes from time to time on UGSDI related issues.
- All institutions of learning offering geo-information related programmes should review their geo-information curricula on a regular basis in order to match changes in technology.
- Impact assessment of geo-information projects on the society should be carried out by the UGSDI stakeholders.
- Government, through the NPA Coordination unit should encourage research on new innovations in geo-information and its applications.
- Continuing Professional Development (CPD) for geo-information practitioners should be mandatory.
- Geo-information stakeholders should be encouraged to build strategic liaisons with reputable local and international partners.

Accreditation of geo-information training programmes based on international standards and practices should be encouraged.
5.0 Capacity Building

Capacity Building is much more than training and includes human resource development\(^3\), this is basically the process of equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform effectively. Organizational development is also one of the aspects of capacity building which deals with the elaboration of management structures, processes and procedures, not only within organizations but also the management of relationships between the different organizations and sectors (public, private and community). It also includes institutional and legal framework development, which involves making legal and regulatory changes to enable organizations, institutions and agencies at all levels and in all sectors to enhance their capacities.

5.1 The Role of Management in Capacity Development

An important barrier to change is an organization’s capacity to adopt new standards and technologies. While the introduction of specialized software is relatively easy, its effective use depends on the technical capabilities as well as organizational support. Awareness creation of SDI components should be considered down to the lowest level and with strong management support and leadership. Capacity development should be a prime concern of senior management. It includes the theoretical issues and the practical (hands-on) capabilities to implement the SDI components.

As job specific technical competencies will be stipulated, it will be necessary to review positional titles, remuneration packages and salaries. The staff rotation system in the Department of Geological Surveys\(^3\) in Zimbabwe is a case of "best practice" in how "brain drain" can be avoided and serves as an example of how staff can be motivated within a "Learning Organization". This system is designed to enhance the capacity of personnel within the department, therefore reducing the need for external recruitment of technical staff.

The personnel resources for SDI in many countries are very limited since most of the GIS implementations being built up are understaffed. A pool of qualified staff has to be created if the projects are to become sustainable. Human capacity development and long term career planning should be of prime concern to senior management. It includes the training, theoretical issues and practical capabilities to implement projects and programs, as well as the working conditions. The working conditions need to be considered not only with respect to salary, but even more importantly with respect to the work climate, motivation and professional perspectives. This will minimize the issue of brain-drain.

Senior management of all concerned institutions (data producers) should consider the development of standards as a priority. They should closely supervise technical work groups and ensure that the desired results are produced. Matters like the standardization of data and the harmonization of classification schemes cannot be left to technicians alone because they entail political decisions. Senior management should be acknowledged as a driving force behind the build-up of a SDI.

\(^3\) HRD consists of any process or activity that, either initially or over the longer-term, has the potential to develop adults' work based knowledge, expertise, productivity, and satisfaction, whether for personal or group/team gain, or for the benefit of an organization, community, nation
Funding and Donor involvement: In order to ensure funding, it may be more persuasive to potential funders to have something to show already (for example, a clearinghouse system) rather than a concept document alone. In addition, justification for the limited cost of this initial development may well be found within existing projects or initiatives (for example, documenting data holdings is a part of sound information management).

Innovative use of resources can ensure that funds stretch a long way. For example, with a 'carrot and stick approach', incentives can be created for the adoption of SDI principles. Using small, non-repeating grants to stimulate the development of the application layer of the SDI can work well where there is broad base of existing expertise that can be encouraged.

GIS implementations in developing countries are often functioning under special conditions that need to be considered during the initiation of a SDI at national or regional level. In many countries the lack of local financial resources means that SDI implementations are not financially sustainable and therefore depend primarily on donor funds. Usually donor support for these projects is provided under certain conditions such as a time limit for implementation after which there are no further disbursements of funds. The future of many of these systems is uncertain beyond the end of international assistance.

Another aspect of donor-funded SDI implementation is that often the projects have been initiated by donors according to their own objectives and little attention has been paid to the requirements and capacities of the host organizations. The result is that there is insufficient coordination of the technical support and funding activities of different donors. In some cases donors may not be willing to work with each other and this can impose limits on the co-operation or data exchange between projects that are funded by different donors. A lack in capacity to coordinate donor activities coupled with competition among the donors themselves can also hamper SDI initiatives.

Under these conditions, the co-operation with donors is a critical aspect of the development of a national SDI. While the existing co-operation should not be exposed to strain, a co-ordinated SDI-based approach would change the priorities for its implementation. This potential conflict could be avoided if donors would be invited as partners to take part in the participative process defining the components of a nationwide SDI.

Reports of different SDI funding mechanisms from Australia and Portugal suggest that the provision of central funds is an important contributor to accelerated SDI development.

5.2 Recommendations: Outreach and Capacity Building Options for Implementing a SDI

A workshop organized with the stakeholders to define and create a national coordinating body, considering its structure in terms of an existing or newly created institution, working groups and/or committees. In countries where GIS implementations are highly dependent on donor involvement in terms of funding and technical expertise, donor representatives should be considered as stakeholders and included in the process of building a SDI. The coordinating body needs to be mandated to manage the required activities and devise an action plan to coordinate the activities. Considerations need to be given to the necessary resources for implementing the strategy, policy or plans and activities, considering staff, technical know-how, material, and funding opportunities such as innovative partnerships.

Formal working groups should be organized around well-defined objectives, strategies, plans,
programs, and actions, are not simply for informal and limited consultations. These working groups would be made up of interested parties and experts to deal with specific aspects of SDI such standards (metadata, exchange), national data sets, policy, clearinghouse and how to assimilate existing technological solutions into the local context.

In order to make this proposed UGSDI a success, there is a need for capacity building within the MDAs. This will include:

- The presence of a concerted human resource development and training approach to recruiting, training and retaining skilled workforce;
- Appropriate training materials in use
- Training provider capacity
- Quality control and certification systems in the training sector
- Sufficient financial resources for training, and many other relevant factors identified in the 2001 SDI study by the Swedish consortium

Who are the actors in framework data development?

- Users and producers of detailed data, such as utilities
- Users of small-scale, limited geographic data, such as street networks, statistical areas, and administrative units;
- Data producers who create detailed datasets as a product or a service;
- Data producers who create low-resolution, small-scale, limited themes for large areas;
- Product providers who offer software, hardware, and related systems; and
- Service providers who offer system development, database development, operations support, and consulting services.

Non-profit and educational institutions also create and use a variety of geographic data and provide GIS-related services. They cover the full spectrum of data content, resolution, and geographic coverage. Depending on the organization’s activities, data use may range from high resolution data over small areas, as in facility management, to low-resolution data over wide areas, as in regional or national environmental studies

5.3 Training

The training of human resource within NPA should include the types of training courses that are directly linked to Spatial Data management, Geographic Information Systems etc. The specialized training for staff of NPA/NISDIC should also be provided for the representatives from other key ministries. The training should include but not limited the issues as follows:

- Different GIS systems and use of GIS software;
- Spatial data integration and analysis;
- Use of satellite imagery and digital maps for cadastral data management, property valuation, planning etc.;
- GPS technique and its use for land survey and cadastre;
- Basics of computer aided property valuation and physical planning;
- Other issues to ensure the efficiency of data processing.

The Professional Training should be provided for the staff to enable them to carry out all the functions of the centre (NISDIC) including the maintenance of the databases.

The Professional Training should involve the staff who already have proper level of education in the area of GIS, computer science. The program should include but not limited to:

- Database Management Systems (including proposed in System solution);
- GIS and spatial data analysis;
- Processing and use of the satellite imagery;
- GPS and data processing;
- Spatial data management and dissemination, metadata.

5.4 Study Visits

The study of experiences of other developing countries and Europe in the field of SDI for decision-making support and monitoring and evaluation is important at all level of central and local governments. Study visits should be planned and held for NISDIC and other stakeholders. The purpose of the visits is an increasing of awareness and familiarization of government official with best examples and practices of SDI implementation and use for essential information processing and presentation for decision-making.

5.5 Course and Education Program

We propose a course and education program with training on four different levels, for the members of NPA.

- Level 1 – GIS awareness creating and Introductory Courses. Introductory courses to introduce people without background in the areas of mapping, GIS and computers to the subjects. Seminars should be held for the key staff and managers who are the key stakeholders.

- Level 2 – short courses that give the participants an overview and basic understanding of the subjects, either as an independent unit, or as a preparation for further training.

- Level 3 – full day courses to develop specialized skills within the different areas of GIS.

- Level 4 – Overseas training for key people specializing in the main disciplines of GIS.

These training courses shall be followed up by on job training in the management of spatial data within NPA. The course components are briefly described below:

5.5.1 Map Awareness

Basic understanding of the nature of a map, whether digital or in paper form is a prerequisite for both producing and using geographic maps and data. The participants should get a general understanding of what maps and map data are. They should be familiar with terms such as map projection and datum, be able to assess the suitability of a map for a given purpose, and be familiar with concepts such as base-maps, thematic maps.

5.5.2 Basic GIS

The power of GIS, in particular, lies in its ability to combine or integrate data of many different types for analysis purposes. In order for this integration to take place, however, the participants need to have a basic understanding of the nature of the system as well as the data. The participants should also get fundamental knowledge about the potential use of GIS, and an understanding of the various GIS functions such as data capture, analysis, storage updating. They shall also get an understanding of data quality as well as data formats and common standards.

5.5.3 GIS awareness seminars for managers

The involvement of managers level into the process of capacity building is a crucial issue for the success of a UGSDI. The demand of GIS services will grow together with the growing of understanding of the managerial level of the basic principles of GIS and its role as an instrument for the socio-economic data processing, analysis and presentation as well as basic knowledge of GIS capabilities in the supporting of decision-making process. Seminars should be held for the key staff
and managers of the main stakeholders MDAs. Best practice of SDI use for monitoring and evaluation of main social and economic processes in the country should be presented in the seminars. The role of reliable geo-spatial information and its availability in the development of civil society as well as modern methods of such information collection, processing and dissemination should be also discussed.

5.6 MDAs and multi-sectoral uses of GI

There are a number of different sectors in different MDAs but there is need to identify a list of the most fundamental sectors that require spatial representation of data and use them as a pilot for other sectors that may be in future need. These sectors are listed according to the priorities and their relevance in the SDI related issues.

Once in place, the UGSDI Policy will provide common understanding and mechanisms for the production, access and use of information among the multi-sectoral GI community. For example, training for priority MDA’s will be undertaken whereby each MDA will have staff from its GIS/Resource Centre/IT department trained in GIS use and applications. The MDAs with GIS professionals in their organization will be recommended to take up GIS extensions to be able to produce analytical products within their mandates, and therefore will require additional training in managing geo-database. Some of these sectors together with MDAs in their category are indicated in Table 1.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Stakeholder</th>
<th>Typical use of GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Kawanda ARI, MAAIF, MAAIF-Livestock, NARO-SAARI, PMA, NAADS, CDO, UCDA, DDA</td>
<td>Cultivation inventory, vegetation cover, soil study, River dams and irrigation, land use monitoring, crop yield monitoring, marine resources.</td>
</tr>
<tr>
<td>Environment and Natural Resources</td>
<td>EA, Metrological center, DWRM, DWD, NWSC, NEMA, NFA, UWA, WMD, OPM/Dep't DPR, MAAIF</td>
<td>Forest mapping, forest inventory, change detection, timber production, water resources, monitoring environmental management.</td>
</tr>
<tr>
<td>Energy And Infrastructure</td>
<td>ERA, MEMD, PEPD, REA, ERT Coordination Unit, RVR, CAA, UTODA, UIPE, UNRA, Alternative Energy, UEGCL, UETCL, UEDCL, ESKOM, UMEME</td>
<td>Oil, gas and electricity exploration, electricity exploitation and distribution, marketing and monitoring transportation, GPS systems.</td>
</tr>
<tr>
<td>Financial Services</td>
<td>EPRC, BoU, AMFIU, CMA, USE, Bankers Association, UIB, Banks Financing and Cooperative Unions, LGFC</td>
<td>Mapping, Modeling customer interaction and economic conditions.</td>
</tr>
<tr>
<td>Information and Communications Technology</td>
<td>KDC, MoICT, Office of 3rd Deputy Prime Minister, TV Stations, Radio Stations, Newspapers and Magazines, Mobile Telecommunication Companies, NITA, Media Council, UCC, UNLB</td>
<td>Research, Circulation, Marketing and advocacy.</td>
</tr>
</tbody>
</table>

Table 1: Multi-sectoral uses of GI
<table>
<thead>
<tr>
<th>Sector</th>
<th>Stakeholder</th>
<th>Typical use of GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health, HIV and Nutrition</td>
<td>NDA, HC and Hospitals, HU, NMS, JCRC, UAC, UVRI, IDI, FPA</td>
<td>Epidemic location, prevention and forecasting, facilities planning and distribution.</td>
</tr>
<tr>
<td>Good Governance</td>
<td>MJCA, MFA, MIA, MoEI, EC, Parliament, IGG, ICG, UJCC, UML, PSFU, NDI- Demgroup</td>
<td>Election incident Reports, Visualization and Analysis of a wide range of data types</td>
</tr>
<tr>
<td>Lands, Physical Planning, Housing and Urban Development</td>
<td>USMD, MoLHUD-Lands, MoLHUD-Urban Development, MoLHUD-Surveys, MoLHUD-Physical Planning, NHCC, UAA, ULA, LEM, ULC, LG and LB, Town and County Planning Boards, KCC</td>
<td>Surveying and mapping, land reforms, urban and regional planning, urban renewal and change studies, feasibility study, land use mapping, land administration.</td>
</tr>
<tr>
<td>Peace And Resettlement</td>
<td>OPM/UNDP</td>
<td>Feasibility of Proposed Settlement Plans, Decision Making</td>
</tr>
<tr>
<td>Population, Gender and Social Development</td>
<td>PopSec, UNYC, NUDIPU, UCRRN, NSSF, MoGLSD, MoPS, UBOS</td>
<td>Decision Support System</td>
</tr>
<tr>
<td>Labor and Employment</td>
<td>PIRT, UIA, BTVET, MoPS, Labor Unions, Enterprise Uganda</td>
<td>Analysis of Employment rates, Decision Making Tool</td>
</tr>
<tr>
<td>Tourism</td>
<td>UWA, UTB, UTA, Arts &amp; Crafts, UIA, Uganda Museum, UCTA, UHOA, AUTAO, UHCA</td>
<td>Road network maps and street guides, tourist centers and hotel location, facilities planning, development and management, Geo-referencing of historical locations, research study, culture preservation and sport development</td>
</tr>
<tr>
<td>Trade and Cooperatives</td>
<td>URA, UEPB, UIA, UMA, PSF, Enterprise Uganda, EPRC, UNBS</td>
<td>Revenue generation, Customs and Immigrations, Taxation</td>
</tr>
<tr>
<td>Accountability</td>
<td>IGG, MFPED, AG, DEI, OPM, Parliamentary Commission, UDN</td>
<td>Plan, Monitor and Coordinate, visual representation of finance issues</td>
</tr>
<tr>
<td>Legislature</td>
<td>Parliamentary Commission, MoLG, Courts of Judicature, ULGA</td>
<td>Policies, Research, Decision Making Tool</td>
</tr>
</tbody>
</table>

Table 1 (cont’d): Multi-sectoral uses of GI
<table>
<thead>
<tr>
<th>Sector</th>
<th>Stakeholder</th>
<th>Typical use of GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Sector Management &amp; Administration and Sub-National Development Planning</td>
<td>MoPS, OPM, LGFC, Public Service Commission, Parliamentary Budget Office, NPA, MoLG</td>
<td>Taxation, land use, new town development, utility services. National statistics, economic Planning, demographic studies</td>
</tr>
<tr>
<td>Regional and International Development</td>
<td>MFA, EPRC</td>
<td>Assessment and Visualization of Development</td>
</tr>
<tr>
<td>Implementation, Monitoring and Evaluation</td>
<td>NPA, OPM, UBOS, OP, EPRC</td>
<td>Planning and Monitoring of development and population growth</td>
</tr>
</tbody>
</table>

Table 1 (cont’d): Multi-sectoral uses of GI
Chapter Six: Communication Strategy for UGSDI Awareness Creation and Information Dissemination

6.0 Communication Strategy for UGSDI Awareness Creation and Information Dissemination

NISDIC will work closely with the MDAs, local governments, humanitarian agencies, academia and private partners during the implementation of the UGSDI. It will provide leadership, guidance, standards and policy to further collaborative activities that will develop, support, and implement a National Strategy for Geospatial Information – the UGSDI (Uganda National Spatial Data Infrastructure).

6.1 Communication Strategy

An UGSDI Communication strategy should be a program aimed at reaching out to the public on a multi level perspective and creating awareness so as to increase the use of UGSDI services and encourage e-governance concepts for national development. Such a strategy is critical in the facilitation of the use of data and services by people. It will seek to facilitate access to relevant data sources and spatial information services by any person as well as facilitate exchange and acquisition of the key datasets with the various stakeholders.

6.1.1 Overall Strategy

It is recommend that NISDIC, in concert with the UGSDI Geo-spatial portal (UGSDI-GSP) and the NPA GIS Communication Unit (NPA-GCU), should embrace a leadership role on behalf of the geospatial community to promote the significance and value of geospatial information and the UGSDI. The NISDIC communications strategy which we are recommending should focus on the benefits of intergovernmental and public/private collaboration to enhance decision-making, to leverage resources, to minimize redundancies and to develop approaches to share geospatial data and information.

As leaders in the effort to build a national geospatial infrastructure, the recommended approach should identify and celebrate best practices and successful partnerships, and encourage shared responsibilities among stakeholders to achieve our common goal of assuring access to reliable geospatial data.

6.1.2 Program Goals

Below are the proposed goals for the communication strategy:

- Together with the public and private sector partners, develop and implement a coordinated proactive outreach strategy supporting the development of a spatial data infrastructure for the Nation.
- Assert NISDIC as the leader in the geospatial community for policy, guidance, and standards, and promote programs that support the UGSDI (For example, UGSDI-GSP as the leading website for discovery and access, and the NPA-GCU as providing the base geography).
- Provide communications support for NISDIC for future directions, teams and activities.
- Identify and publicize best practices and success stories in the development of a collaborative national geospatial strategy.
- Communicate the relevance of spatial data and the UGSDI to a wider community and educate those who may benefit from its value.
- Communicate the benefits of sharing data and data “interoperability” - working together to share information, collaborate, and make information available.
6.1.3 Communication Process Objectives

In order for the communication process to fulfill its goals, the following needs to be established:

- Encourage MDAs, Local Governments and other stakeholders to actively promote the goals of the UGSDI using incentives.
- Encourage state, private-sector and local participation in NISDIC, UGSDI-GSP, NPA-GCU activities and programs.
- Engage the geospatial community in a discussion of the roles, responsibilities and interrelationships of those participating in building the UGSDI and a commitment to contribute to mutual goals, while acknowledging individual roles and missions.
- Increase awareness and understanding of the resources needed to build the UGSDI and the importance of leveraging the existing resources.
- Encourage the sharing of UGSDI “best practices” and “lessons learned” among the members of the geospatial community of practice.
- Work collaboratively with GIS/SDI partners to communicate and improve the understanding of the goals, value and benefits of the UGSDI in the national Budget, Parliament, and key decision-makers.
- Work more effectively with GIS/SDI partners to gain their agencies’ support for the goals, values and benefits of the NDSI.

6.1.4 Target Audiences

6.1.4.1 Primary Audiences
- Ministries, Departments and Agencies (MDAs)
- Local Governments
- Humanitarian Community (UN, Local and International NGOs, Donors and Embassies)
- Public and Private sector non-geospatial community of users
- Budget Office, Cabinet and Parliament
- Private sector geospatial community

6.1.4.1 Secondary Audiences
- Public interest groups
- National security (Uganda Police and Uganda People's Defence Forces)
- Utilities including telecommunications
- Program managers
- Media outlets, e.g. TVs, radios, bill board companies, news releases and publications

This strategy should include the following issues; concept, vision, benefits, legislation, project status, policies, standards and metadata, fundamental services, calendar of events, workshops, seminars or conferences, career opportunities among others.

The strategy gives recommendations on approaches, mechanisms, and tools to use and should identify specific actions to take in a timely manner to accomplish the goal of increasing awareness, understanding, and support. Table 2 below shows the main categories of communication and their level of use to key audiences.

6.1.5 UGSDI messages and issues for discussion

THEME MESSAGE: “Building the spatial data infrastructure for the nation – the UGSDI” roles, responsibilities and relationships.

6.1.5.1 Target Audience: Central Government Partners
- The whole is greater than the sum of its parts: all levels of government must work together to communicate,
<table>
<thead>
<tr>
<th>Key Audience</th>
<th>Benefits</th>
<th>Concept</th>
<th>Vision</th>
<th>Standards</th>
<th>Policies</th>
<th>Metadata</th>
<th>Fundamental Services</th>
<th>Joint Business Ventures and Workshops, Conferences and Events</th>
<th>Technical and Financial needs</th>
<th>Career Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabinet, Parliament and State Budget Office</td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td>● (Meetings, Presentations, Brief Reports)</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>UGSDI Council Members (PS/Commissioners)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
<td></td>
<td>● (Meetings, Brief Reports)</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>MDAs and LGs</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>● (Website, Email, Meetings, Workshops/Seminars, Brochures, Reports, video, Newsletters)</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Private Sector</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>● (Workshops/Seminars, Website, Email, Brochure)</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Humanitarian Community</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>● (Website, Email, Meetings, Workshops/Seminars, video Brochures, Reports, Newsletters)</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Academia</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>● (GIS day, Website, Presentations, Brochures, Reports, Newsletters)</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Communities</td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>● (Car stickers, Talk shows, News, Media publications)</td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

Table 2: Communication Categories

40
• Cooperate, coordinate and collaborate to build the UGSDI.
• Build once; use many times. Complying with standards saves time, money and staff resources.
• Don’t reinvent the wheel: the geospatial data you need may already be in the clearinghouse that is accessed through the Geospatial portal.

6.1.5.2 Target Audience: MDAs and LGs
• Central government’s geospatial programs and resources provide valuable information to meet local needs.
• Combining your local data with national data aids decision-making.
• Sharing of geospatial information across boundaries helps improve service delivery and reduces costs.

6.1.5.3 Target Audience: Humanitarian Community
• The ability to relate places with events is priceless.
• Everything happens somewhere. With a map in-front of you, it’s easy to get a picture of (W)ho is doing (W)hat and (W)here than when you have to read row data.
• Geospatial data aids decision-making. Business and government uses these data in their decision to:
  - Locate new businesses, hospitals, schools and others.
  - Respond to emergencies
  - Plan transportation
  - Establish good governance issues.
• Visualization of demographic data facilitates decision-making.

6.1.5.4 Target Audience: Private-Sector Partners
Everyone has a part to play in building the spatial data infrastructure for the nation. The following is what can be done;
  - Getting involved

- Sharing of data
- Formation of partnerships
- Spread the message
• Geospatial information gives decision-makers the complete picture in a blink of an eye.
  - Here’s how it benefits the nation…
  - Here’s how it benefits you…
• Work together to build the UGSDI through cooperation, coordination, collaboration and partnering.

There is need to focus the message on awareness, value and benefits, and results or outcomes.

6.1.6 Communication Opportunities and Tactics
• Take advantage of existing avenues.
• Take the lead with support and participation of partners.
• Leverage participation and promote each others’ activities.
• Reach out to target audiences for information and collaborative opportunities.
• Investigate opportunities such as providing materials that other organizations and GIS/SDI partners can use to promote the message.

6.1.7 Primary Communication Avenues and Actions

6.1.7.1 Publications
• Review and update existing NISDIC, UGSDI-GSP and NPA-GCU publications.
• Look at new opportunities and what publications are needed to support them.
• Develop high-level UGSDI publications in coordination with Media outlets. Maintain independent publications specific to NISDIC, UGSDI-GSP and NPA-GCU needs.
• Provide information to be included in the publications of other Central Government agencies.

6.1.7.2 Email
• Establish an online joint-effort approach for sharing, drafting and compiling report documents by the NISDIC members.
• Expand and publicize the email list regularly.

6.1.7.3 Website
• Continue redesigning and updating the UGSDI-GSP to support UGSDI unified web presence.
• Provide for links to UGSDI-GSP web pages.
• Create an online discussion forum where users from all MDAs can debate and share UGSDI views.
• News coming events for example other nations experiences

6.1.7.4 PowerPoint Presentations
• Continue to make all NISDIC, UGSDI-GSP and NPA-GCU PowerPoint presentations available online.
• Provide a NISDIC PowerPoint presentation template for use by represented MDAs.
• Create PowerPoint slides on the basic concepts of the UGSDI for use by NPA staff, MDAs and partners.

6.1.7.5 Workshop/Seminar/Conference Activities and other Public Opportunities
• Develop a list of targeted conferences and activities at each (workshops, presentations, booths).
• Coordinate conference activities with NISDIC member agencies and partners.
• Coordinate conference activities with UGSDI-GSP calendar events manager.

6.1.7.6 Face-to-face meetings with key partners and stakeholder groups
• Identify and prioritize.
• Set-up meetings for NISDIC, UGSDI-GSP, NPA-GCU leadership team.

6.1.7.7 All other communications channels will be utilized as necessary
• News releases
• Newsletter
• Car Stickers
• Brochures
• Media Talk shows
• Articles in professional journals and magazines
• Training and education
• Grant programs
• Communication by UGSDI Board, NISDIC, Coordination Unit, and the Geo-Spatial Portal discussions.

6.1.8 Evaluation
• Quarterly review and update of the NISDIC/UGSDI-GSP/NPA-GCU Communications Plan.
• Establish performance indicators and measure progress against them.
• Use customer surveys to see if the performance target(s) has been met.

6.1.9 Identified Opportunities and Short-Term Activities
Engage a professional firm to develop and run the programme.

6.1.10 Next steps
• Develop performance indicators for three program objectives.
• Develop work plan with specific actions, responsibilities and timeframes.
• Consider hiring communications expert for next phase of project.
<table>
<thead>
<tr>
<th>ACTION</th>
<th>PROCEDURES</th>
<th>TIMEFRAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish a 5-minute “NISDIC Headlines” agenda item at the end of each Coordination Working Group meeting.</td>
<td>Distribute headlines by email immediately after the meeting to Coordination Group (CWG) members for talking points.</td>
<td>Begin 1st Quarter Dec/2010 Meeting</td>
</tr>
<tr>
<td>Identify and recommend a list of critical conferences and public events.</td>
<td>Create preliminary list. Share with CWG members. Update regularly.</td>
<td>Finalize 15/01/2011.</td>
</tr>
<tr>
<td>Work with MDAs, Local Governments and other stakeholders for joint presence at conferences and other forums.</td>
<td>UGSDI-GSP &amp; NISDIC meetings. Share booth space &amp; co-presence.</td>
<td>Begin Feb 2011</td>
</tr>
<tr>
<td>Sponsor a “UGSDI Partner” reception at Regional Geo-Spatial conferences (two per year).</td>
<td>Identify two non-geospatial organizations</td>
<td>3rd and 4th Quarter 2011</td>
</tr>
<tr>
<td>Identify UGSDI Partners at conferences and exhibits. Display plaques, car stickers or banners at booths at conferences.</td>
<td>Create NISDIC Member or Partner plaques, car stickers and/or a banner stating “NISDIC Partners: Working Together to Build the UGSDI”</td>
<td>Distribute to members at 1st Half Conference 2011.</td>
</tr>
<tr>
<td>Author a semi-annual article written for agency publications (awareness level)</td>
<td>Identify names of the publications put out by other agencies. Identify editors or contact information.</td>
<td>3rd Quarter 2011</td>
</tr>
<tr>
<td>Develop and stock PowerPoint slides about the UGSDI, NISDIC and key messages.</td>
<td>For use by Governmental Partners in their PowerPoint presentations</td>
<td>Feb 2011</td>
</tr>
<tr>
<td>Develop media kit and distribution strategy</td>
<td>Work with Governmental partners to implement a distribution strategy.</td>
<td>April 2011</td>
</tr>
<tr>
<td>NISDIC/NPA-GCU meets with stakeholders</td>
<td>Set-up meetings and agenda and hold face-to-face meetings.</td>
<td>Begin Feb 2011</td>
</tr>
</tbody>
</table>

Table 3: Actions and Timeframes
• Identify resources needed to implement.
• Investigate creation of an NISDIC Communications Sub-committee or Working Group to guide implementation.

6.1.11 Resources needed for implementation

Short-term

• Funding for banners and plaques
• Funding for reception at the Regional Conferences
• Funding for Communications contractor (10 hours per week?)
• Additional funding for publications and distribution
• Dedicated Staff to implement short-term

Long-term

• Fill NPA-GCU Communications Officer position.
• Additional staff support (for mailing and other non-technical activities)

6.2 Proposed Architectures for Information Dissemination

The UGSDI is visualized as a single window mechanism bridging spatial data users and the national and regional geo-spatial data domain agencies in the country. In order to make the spatial and associated attribute data available to user community, the active participation and commitment with UGSDI is anticipated from various data domain agencies following proposed Metadata and data exchange standards. Thus, the central and stakeholders data domain servers will play a vital role in performing UGSDI operations.

As depicted in figure 3, NSDI in Uganda is foreseen to be a network of domain specific data servers (located at different MDAs, Local Governments and Identified Stakeholders) and a central metadata server (located at NPA GIS Coordination Unit) working in unison to facilitate the data exchange amongst users and data supplying agencies.

The most important driver of the architecture design for the Centralized Data Warehouse (CDW) is that of the mission critical nature of the data. It is absolutely necessary that the data of the CDW be available continuously. It is for this reason that the UGSDI should choose a centralized architecture for the CDW. The data of the CDW is obtained from various sources, through various means.

The different sources (MDAs) remain autonomous and maintain full control over the management and update of their spatial data.

The domain data servers form the backbone of UGSDI data dissemination operations. This section attempts to enlist the processes and mechanisms to be established and various activities to be carried out for implementation of UGSDI domain servers.

The prime responsibility of a typical domain data server is to serve the requisite data to a user based on demand received via UGSDI Meta server. The data supply could be routed through the metadata server itself or it could be affected directly to the user employing various options like media transfer, FTP and others.

6.2.1 Definition of UGSDI Domain Data Contents - The Pre Requisite

Domain data contents to hold the data will have to be defined for the data that would form part of UGSDI Domain servers. This will include all the data that exists in analogue or digital form. Some data, to be committed to UGSDI, may or may not have been created conforming to the published design standards available in the country. It is therefore necessary to keep a flag on such data sets, as these would require more elaborate efforts for making them conform to UGSDI standards. To define the data contents the following tasks will have to be performed:

• Inventory of fundamental data sets and identification of data to be committed to
Figure 3: Proposed UGSDI Architecture
• UGSDI Domain data servers along with the format (GIS or analogue)
  - Datasets available in analogue format.
  - Datasets available in GIS format but not organised as per any published design standards
  - Datasets available in GIS format and organised as per published design standards, if any
• List of innovative data elements
• Identification of mutually exclusive layers and harmonisation of layer legends

6.2.2 Formulation of Domain Policy Framework - Another Pre Requisite
To prevent ambiguity and for smooth functioning of UGSDI Domain servers, explicit policies are required, at each domain, for access privilege and security classification of data. Policy for data quality benchmark for each layer should also be laid down. Guidelines for realization of regular mechanism for data quality evaluation and vetting are to be evolved. For each of the domain server

![Proposed Architecture of a Ugandan Geospatial Portal](image)

Figure 4: Proposed Architecture of a Ugandan Geospatial Portal
nodes, jurisdiction has to be identified in terms of data content and geographical location. The policies should be within the overall UGSDI framework.

- Access privileges for each data content. Various options could be employed include:
  - Selected groups of persons within the repository agency,
  - All users within repository agency,
  - All Government and Local Government agencies in Uganda,
  - Any agency or individual in Uganda and
  - Global access
- Security Classification of each data element for example restricted/ open
- Data quality benchmarks for each layer (quality parameters/ declaratives as per NISDIC guidelines)
- Guidelines for realisation of regular mechanism for data quality evaluation and vetting
- Geographic/ thematic jurisdiction of each domain server

6.2.3 Geospatial Portal
Geospatial portals are expected to play a prominent role in the efforts of many local and national governments in making their geo-data better and more accessible to potential users. Technically the Geospatial portal is the place where the geo-information can be found on the web. Ideally, all governmental geo-information

![Diagram of Technical Components](image-url)
should be available in this portal. More ideally, it should be accessible through the national governmental website.

### 6.2.4 Technical Requirements

The prototype does have some technical requirements. The architecture will be based on a Service Oriented Architecture. There are three tiers; data layer, an application or services layer and a presentation layer. The data can be stored in spatial databases or file systems. The data and metadata are distinguished and stored in separate databases. The National Metadata database will be the result of harvesting the distributed metadata databases through a harvesting protocol. In the services layer, the map and feature services

![Data Flow Diagram](image)

**Figure 6: Data Flow Diagram**
(WMS/WFS) will be present in combination with catalogue services (CS-W). In reality there could be other services as well, but these are less relevant for the prototype. The presentation layer contains the web based client application showing the information to the user. It provides the user with interactivity to perform specific tasks carried out by the underlying services. More components are needed for the generic tasks. Figure 4 is a summary the different components.

- Server with proper Operating system
- Java Virtual Machine
- Internet server (Apache)
- Application server (Apache TomCat)
- Mapserver (Geoserver, Mapserver, ESRI ArcIMS)
- Spatial database (SQL Server, ArcSDE, Postgres, Spatialite) or File based data storage
- (Shape files)
- Services
- WMS/WFS (geoserver (FAO http://www.fao.org/geonetwork))
- CS-W (eXcat)
- Internet GIS Client (ArcGIS, uDig, OpenLayers, Luigi, etc).

Finally, the use of Geospatial portals based on service oriented architecture requires map and data services. OGC services are required to guarantee interoperability. One should be conscious of the versions and standards used as well as the selected software components are compliant to the correct versions of the standards. The Figure 6 below shows data flow diagram showing how raw data flows into the digital data production services process all the way through to the end process where it is delivered to the consumer in its final form. The data production process receives the raw data and performs various tasks, which include parsing, assembling, enhancing, and formatting the data. Once the data has made it through this process, it is put in the data warehouse. The data warehouse essentially ingests the processed data and stores it. Based on a series of business rules specific to each data theme, the data is replicated to its sister data center, and transformed for use in the UGSDI-GSP. As it ages, the data is also archived in a near-line state.

The shared government/commercial/public approach is more typical of existing and well-established infrastructures such as utilities and transportation systems. If Uganda is to develop a true data sharing infrastructure, it is recommended that in terms of robustness and stability and focus more on standards, best practices, and formal professional development rather than specific and ever changing technologies should be considered.
7.0 Implementation Plan for UGSDI

The implementation of the proposed strategy will be one of the major tasks for NPA/NISDIC for the next few years. It will require the involvement and support of GIS strategy development at all management levels within MDAs and many other stakeholders.

The implementation of the proposed capacity building and training strategy is a long-term program that needs to be carefully planned, monitored and supervised at all stages of implementation. Substantial financial resources at each stage of implementation are also required especially on the initial stages to initiate the process and make it sustainable. As it is indicated in chapter two of this report, expatriate expertise will be required.

A stage-by-stage approach is recommended for this strategy for product development, generally the implementation strategy should include the major blocks of activities as follows:

- Human capacity building and training of personnel
- Technical and technological capacity upgrading
- Key data sets decisions and acquisition, and metadata development
- Coordination and Standardization
- Clearinghouse establishment and development

Various applications dependent on geospatial data and related technologies are rapidly assuming mission critical status in today’s nations. The ever increasing convergence of geospatial and web technologies in particular has opened up exciting new prospects for the countries to revolutionize their activity integration while at the same time strengthen their decision support, planning and operational capacities. By more effectively integrating, managing and utilizing these technologies to serve their geographic information needs.

To ensure a successful and sustainable UGSDI, the implementation strategy builds upon existing geospatial data development efforts, provides for highly visible results in the near-term, and sets an appropriate framework for medium and long-term UGSDI development and maintenance.

The UGSDI Coordination office is now confirmed to be hosted by NPA as the government agency Scope. UGSDI aims to improve accessibility and exchange of geospatial data and information between National stakeholders that use and produce geographic data and between the different Non-Governmental Organizations and the Private sector.

The role of NPA/NISDIC's in UGSDI as outlined below can help to facilitate the establishment and coordination of the National Spatial Data Infrastructure and to provide the National UGSDI portal/node, fulfilling national government's policies with respect to issues relying on the use of geo-information, coordination and execution of geo-information disclosure activities for large enterprises, companies or multi-nationals in order to fulfill their Corporate Governance goals, capacity building at national and regional level.

This participatory process will be essential to delivering an effective UGSDI, building upon consensus, good governance, and best enterprise management and information sharing practices that maximize the benefits of geospatial information worldwide in terms of social, economic and environmental development.
7.1 Implementation Stages and Outcomes

7.1.1 Issues, Goals and Proposed Actions

The outcome of the recent UGSDI Consultations in the first interim report has enabled a reassessment of issues that have an impact on the development of a future UGSDI which when coupled with the original findings and recommendations of the 2001 study by Swedish Consortium gives opportunities to reaffirm and/or set new goals for the UGSDI and prioritize the specific objectives and recommended actions needed to address these issues that have emerged.

The indicative five-year plan for the UGSDI that follows is envisaged to take place in four overlapping stages:

- Stage 1: Building UGSDI foundations - short-term (0-12 months),
- Stage 2: Building the Infrastructure - medium-term (12-24 months)
- Stage 3: Institutionalizing the Infrastructure - long-term (>24 months).
- Stage 4: Continuous Improvement of UGSDI Processes.

Beyond the completion of Stage 3 i.e. The UGSDI is assumed to have reached full functionality for the presently available levels of technology and resources within the country.

7.1.2 Stage 1

Main actions

Building UGSDI foundations – it is basically a short-term stage (0-12 months), under this stage, the UGSDI implementation will address the establishment of an effective organizational architecture and definition and development of the underlying policy and standards frameworks. Building system-wide consensus for the adoption and refinement of best practices, this will be essential for developing and formalizing agreed policies and standards.

7.1.3 Stage 2

Main actions

The second stage of the UGSDI implementation focuses on further development of key data layers. This will particularly focus on deciding data custodians, adequate consistent funding, appropriate techniques, and priority areas, standardized Metadata production and the development of catalogue services, this will remain
as a priority throughout Stage 2 of UGSDI implementation, aided by the adoption of relevant policies, standards and tools by both internal and external partners. Numerous of these related SDI ‘projects’ can be expected to continue well into Stage 3 of the UGSDI planning period as well.

The design, development, and testing of site interoperability, data access and maintenance procedures will be important at this stage of infrastructure development. It is proposed that by this stage, NPA should already be receiving updated data and publishing metadata associated with the data archives for which they have accepted responsibility. Remedial action needs to be initiated during Stage 2 if any concerns are highlighted during the testing of the infrastructure.

Expected outcomes:
It is anticipated during this stage that resource mobilization efforts and capacity building negotiations initiated in Stage 1 will have begun to yield serious possibilities for extending the infrastructure to more developing nations and increasing the suite of services available to stakeholders.

Partnerships are also anticipated to yield consolidated improvement in service delivery during this stage of UGSDI development, as standards adopted by the UGSDI increase interoperability and data agreements that enhance accessibility are negotiated incrementally over time.

7.1.4 Stage 3:

Main actions
UGSDI portals therefore need to be adequately equipped, staffed, and maintained to assume operational responsibilities.

Data custodians also need to be in a position to provide operational levels of data maintenance early in this stage of implementation to ensure currency of archives.

Expected outcomes:
This stage will see the institutionalization of the information infrastructure and the dawning of operational geospatial data services across the distributed matrix of data resources that comprise the UGSDI at NPA/NISDIC.

By the time the activities of stage 3 implementation begins, UGSDI agencies and partners will have significantly increased the number and capability of geospatial data portals and other data resources linked within the UGSDI.

Improved access to data and distributed processing resources that leverage value from new data sharing agreements should result, but this will ‘come at price’.

As the number of documented and interoperable geospatial data layers increases and access to the information infrastructure becomes more widespread, the visibility of UGSDI service levels and their responsiveness or otherwise to the user community’s needs will increase.

7.1.5 Stage 4:

Main actions
This is the final implementation stage, it involves UGSDI configuration management whereby the information architecture and technical infrastructure built up over the previous stages are extended and refined over time, as demand for stakeholder services and finances determine.
Chapter Eight: Indicative Financial Requirements

The ABC (Activity Based Costing) approach was used to develop estimate costs for the UGSDI investment. The ABC approach is a useful method to find the real price of the products according to the organizational costs and overheads. Additionally it assigns costs to each activity and removes unnecessary and unprofitable tasks in an organizational process. ABC can be useful for estimating SDI costs as well as cost reduction and spatial data valuation.

The cost estimates for implementing the first-generation UGSDI during its first year include:

- Identification, prioritization and assessment of MDAs plus other stakeholders in their GIS Capacity and dataset Inventory
- Documentations
- Develop a National Spatial (land space) Plan
- Establish GIS Units for MDAs and LGs
- Develop/Update existing national fundamental datasets.
- Develop National common technical specifications
- Establish a Data-sharing framework
- Establish Communication framework.
- Social Awareness raising on, TVs, Radios etc.
- Identification, Prioritization and assessment of MDAs plus other stakeholders in their GIS Capacity and dataset Inventory
- Launch Activities for Initial Conformance and Exchange Operation
- Study Tours and Trainings
- Hardware and Software
- Establishment for GIS Coordination Unit
- Establish the NISDIC Working Groups
- Establish the NISDIC (National Inter-Agency Spatial Data Infrastructure Committee)

<table>
<thead>
<tr>
<th>No</th>
<th>Activity</th>
<th>Estimated Cost (US Dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Establish the NISDIC (National Inter-Agency Spatial Data Infrastructure Committee)</td>
<td>25,000</td>
</tr>
<tr>
<td>2</td>
<td>Establishment of Working Groups</td>
<td>72,000</td>
</tr>
<tr>
<td>3</td>
<td>Establish a Permanent GIS/NSDI Coordination Unit at NPA</td>
<td>81,600</td>
</tr>
<tr>
<td>4</td>
<td>Hardware and Software</td>
<td>204,284</td>
</tr>
<tr>
<td>5</td>
<td>NISDIC / Task Force Study Tour and GIS Unit Trainings</td>
<td>200,000</td>
</tr>
<tr>
<td>6</td>
<td>Launch Activities for Initial Conformance and Exchange Operation</td>
<td>85,000</td>
</tr>
<tr>
<td>7</td>
<td>Identification, Prioritization and assessment of MDAs plus other stakeholders in their GIS Capacity and dataset Inventory</td>
<td>50,000</td>
</tr>
<tr>
<td>8</td>
<td>Social Awareness Raising</td>
<td>23,000</td>
</tr>
<tr>
<td>9</td>
<td>Establish a communication framework.</td>
<td>200,000</td>
</tr>
<tr>
<td>10</td>
<td>Establish a Data-sharing framework.</td>
<td>28,000</td>
</tr>
<tr>
<td>11</td>
<td>Developing Common National Technical Specifications(vector layers, integration of topographic and cadastre, DTM and orthophotos)</td>
<td>5,000</td>
</tr>
<tr>
<td>12</td>
<td>Develop/update existing fundamental datasets.</td>
<td>1,000,000</td>
</tr>
<tr>
<td>13</td>
<td>Establish and/or Strengthen a GIS Units for MDAs and LGs (20)</td>
<td>1,000,000</td>
</tr>
<tr>
<td>14</td>
<td>Develop a National Spatial (land space) Plan</td>
<td>500,000</td>
</tr>
<tr>
<td>15</td>
<td>Documentations</td>
<td>5000</td>
</tr>
</tbody>
</table>

**TOTAL COSTS for Activities in the Detailed Strategic Plan**  
3,478,884

Table 5: Broad cost estimates for implementing the first-generation UGSDI (time period of 1 year)
### Table 6: Establish the NISDIC

<table>
<thead>
<tr>
<th>Activity Specifics</th>
<th>Total Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish the NISDIC (National Inter-Agency Spatial Data Infrastructure Committee): NISDIC Meetings to (brainstorm and establish the NSDI Vision and Objectives, the NSDI road map, institutional framework, communication strategy… etc)</td>
<td>25,000.00</td>
</tr>
</tbody>
</table>

### Table 7: Establish the NISDIC Working Groups

<table>
<thead>
<tr>
<th>Activity Specifics</th>
<th>Total Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish a Standardization Working Group to discuss and develop (Coding System, Reference System, Exchange format, Metadata Standards).</td>
<td>12,000.0</td>
</tr>
<tr>
<td>Establish a Legal Affairs Working Group to discuss and develop (Copyright, Liability, Privacy, Data policies).</td>
<td>12,000.0</td>
</tr>
<tr>
<td>Establish a GIS Education Working Group to discuss and develop (Training, Curriculum, Research, Sensitization, and Liaison).</td>
<td>12,000.0</td>
</tr>
<tr>
<td>Establish a Communication Working Group to discuss and develop (Awareness, Sensitization and Outreach, Publicity, Advocacy, Project Reports, Project Status Seminars, Workshops and Events).</td>
<td>12,000.0</td>
</tr>
<tr>
<td>Establish a Dissemination Working Group to discuss about (Clearing House, Metadata, and geo-spatial portal for NSDI).</td>
<td>12,000.0</td>
</tr>
<tr>
<td>Position Specifics</td>
<td>Total Costs (USD)</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Spatial Analyst/UGSDI Coordinator.</strong> <em>(Focuses on geospatial data analysis and production; on stakeholder and the implementation, monitoring and evaluation of NSDI; WGs and stakeholder coordination, analysis and monitoring reports of WGs especially those concerning critical sectors such as energy, regional development, education, business development, social inclusion, decentralization, etc; NSDI help desk.)</em></td>
<td>28,800.0</td>
</tr>
<tr>
<td><strong>GIS/Information Management Officer</strong> <em>(Focuses on in-house GIS map production and use; dataset and GIS capacity inventories; digitizing, data compilation, and image compression; development, management and maintenance of the geo-spatial portal and metadata service catalogue; data dissemination mechanism(s); site up-dates and checks for consistency, data quality, standards, metadata; review and analyse reports; NSDI help desk.)</em></td>
<td>24,000.0</td>
</tr>
<tr>
<td><strong>ICT and Systems Developer</strong> <em>(Focuses on administration of the IT Infrastructure of the Unit; develop and manage the UGSDI associated databases/systems; gather technical requirements, develop specifications, define information deliverables and devise ways of their dissemination; draft training materials; NSDI help desk.)</em></td>
<td>14,400.0</td>
</tr>
<tr>
<td><strong>Communication Officer</strong> <em>(Main contact person; focuses on public awareness creation; organising meetings; writing and dissemination of reports and meeting minutes; manages the contact list database, devise ways of information dissemination; keep abreast and communicate about local, regional and international NSDI events.)</em></td>
<td>14,400.0</td>
</tr>
<tr>
<td><strong>Spatial Analyst/UGSDI Coordinator.</strong> <em>(Focuses on geospatial data analysis and production; on stakeholder and the implementation, monitoring and evaluation of NSDI; WGs and stakeholder coordination, analysis and monitoring reports of WGs especially those concerning critical sectors such as energy, regional development, education, business development, social inclusion, decentralization, etc; NSDI help desk.)</em></td>
<td>28,800.0</td>
</tr>
</tbody>
</table>

Table 8: Establishment of GIS Coordination Unit
<table>
<thead>
<tr>
<th>Hardware and Software</th>
<th>Total Costs (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servers (Data, Web, Application…)</td>
<td>30,000.0</td>
</tr>
<tr>
<td>GIS software + Extensions</td>
<td>18,000.0</td>
</tr>
<tr>
<td>Image processing Software</td>
<td>8,000.0</td>
</tr>
<tr>
<td>Visual Studio 2010 Ultimate Edition</td>
<td>14,000.0</td>
</tr>
<tr>
<td>SQL Server 2008 R2 Standard</td>
<td>10,100.0</td>
</tr>
<tr>
<td>4 PC workstations (3 -21 inch monitors and 1 -29 inch)</td>
<td>6,000.0</td>
</tr>
<tr>
<td>6 UPS Backups (3 Servers and 3 PCs)</td>
<td>10,000.0</td>
</tr>
<tr>
<td>An Inverter System Capacity-10 Pcs</td>
<td>10,000.0</td>
</tr>
<tr>
<td>4 Laptops</td>
<td>5,500.0</td>
</tr>
<tr>
<td>4 USB External Disks (500 GB)</td>
<td>500.0</td>
</tr>
<tr>
<td>2 Plotters (HP Designjet T2300 eMFP and e-Print &amp;Share)</td>
<td>20,000.0</td>
</tr>
<tr>
<td>Plotter Cartridges (HP 72 130-ml Matte 6 Colors Ink Cartridge Set)</td>
<td>500.0</td>
</tr>
<tr>
<td>1 Digital Sender</td>
<td>1,000.0</td>
</tr>
<tr>
<td>1 Scanner</td>
<td>200.0</td>
</tr>
<tr>
<td>2-A2 and 1-A4 Colored Printers</td>
<td>7,000.0</td>
</tr>
<tr>
<td>Colored Printer Cartridges</td>
<td>5,000.0</td>
</tr>
<tr>
<td>3 Handheld GPS Units</td>
<td>38,484.0</td>
</tr>
<tr>
<td>Other Software (ETL/OLAP Software, Security Software, Metadata Editor and Repository tool, Design Software, Reporting Suite)</td>
<td>20,000.0</td>
</tr>
</tbody>
</table>

Table 9: Hardware and Software
### Study Tours and Trainings

<table>
<thead>
<tr>
<th>Description</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional and International tours to SDI conferences or Workshops for NISDIC / Task Force</td>
<td>100,000.0</td>
</tr>
<tr>
<td>SDI related Trainings for UGSDI Co-ordination Unit Staff</td>
<td>100,000.0</td>
</tr>
</tbody>
</table>

Table 10: Study Tours and Trainings

### Launch Activities for Initial Conformance and Exchange Operation

<table>
<thead>
<tr>
<th>Description</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish reliable existing key master dataset, perform consistency, data quality, data structure modification and begin the process of data exchange.</td>
<td>85,000.0</td>
</tr>
</tbody>
</table>

Table 11: Launch Activities for Initial Conformance and Exchange Operation

### Identification, Prioritization and assessment of MDAs plus other Stakeholders in their GIS Capacity and dataset Inventory

<table>
<thead>
<tr>
<th>Description</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local travel costs (fuel) to MDAs for GIS/SDI capacity assessments and technical support.</td>
<td>8,000.0</td>
</tr>
<tr>
<td>Gather pilot data for use in visualization, standardization, specifications and policy making.</td>
<td>18,000.0</td>
</tr>
<tr>
<td>Stakeholder consultations and workshops (2)</td>
<td>24,000.0</td>
</tr>
</tbody>
</table>

Table 12: Assessment of MDAs

### Social Awareness Raising on, TVs, Radios etc.

<table>
<thead>
<tr>
<th>Description</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV and Radio Commercials and Sensitization programs (2 yrs)</td>
<td>5,000.0</td>
</tr>
<tr>
<td>Paper Media (2 yrs)</td>
<td>17,000.0</td>
</tr>
<tr>
<td>GSDI Africa Newsletter Subscription fees</td>
<td>1000.0</td>
</tr>
</tbody>
</table>

Table 13: Social Awareness
### Establish Communication Framework

<table>
<thead>
<tr>
<th>Activity</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet Bandwidth</td>
<td>100,000.0</td>
</tr>
<tr>
<td>Telecommunications UGX/Yr (3 people)</td>
<td>100,000.0</td>
</tr>
</tbody>
</table>

Table 14: Communication Framework

### Establish a Data-sharing Framework

<table>
<thead>
<tr>
<th>Activity</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of a Geo-spatial portal</td>
<td>8,000.0</td>
</tr>
<tr>
<td>Establish a Metadata Service and Catalogue</td>
<td>20,000.0</td>
</tr>
</tbody>
</table>

Table 15: Data-Sharing Framework

### Develop National Common Technical Specifications

<table>
<thead>
<tr>
<th>Activity</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of National common technical specifications for vector layers 1:50,000 with national coverage, starting from available data.</td>
<td>1250.0</td>
</tr>
<tr>
<td>Development of National common technical specifications for topographic database (1:1000/2000, 1:5000/10000, 1:50000/100000, 1:750000), streets, addresses etc.</td>
<td>1250.0</td>
</tr>
<tr>
<td>Development of National Technical specifications for the integration of topographic and cadastral data and for land use DB 1:50,000 and 1:75,000</td>
<td>1250.0</td>
</tr>
<tr>
<td>Development of Technical specification for Digital Terrain Models(DTM) and digital orthophotos and implementation of the DTM with national coverage</td>
<td>1250.0</td>
</tr>
</tbody>
</table>

Table 16: Technical Specifications
Develop/Update existing national fundamental datasets

<table>
<thead>
<tr>
<th>Dataset Description</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative boundaries (vector) 1:50,000</td>
<td>50,000.0</td>
</tr>
<tr>
<td>Orthophotos scale 1:50,000, WGS84 (elaboration of already existing photos)</td>
<td>50,000.0</td>
</tr>
<tr>
<td>DTM scale 1:50,000, WGS84</td>
<td>50,000.0</td>
</tr>
<tr>
<td>DEM scale 1:50,000, WGS84</td>
<td>50,000.0</td>
</tr>
<tr>
<td>Place Names Layers 1:50,000 (with available data)</td>
<td>50,000.0</td>
</tr>
<tr>
<td>Transport Network Layer 1:50,000 (with available data)</td>
<td>50,000.0</td>
</tr>
<tr>
<td>Other datasets (Topography, Aerial Photos, Agriculture, Education, Health and Nutrition, Geodetic, Hydrology, Land-Cover /Use, Population, Protected Areas, Economic, Food Security, Emergency NFIs, Protection, Soils, Livelihood, Water-Sanitation-Hygiene)</td>
<td>700,000.0</td>
</tr>
</tbody>
</table>

Table 17: Fundamental Datasets

Establish GIS Units for MDAs and LGs

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIS/SDI Capacity building through (GIS basics, data acquisition, updates and maintenance) training and seminars.</td>
<td>100,000.0</td>
</tr>
<tr>
<td>Staffing, Internet, Hardware and Software for 20 GIS Units</td>
<td>900,000.0</td>
</tr>
</tbody>
</table>

Table 18: Establishment of GIS Units for MDAs and LGs

Develop a National Spatial (Land Space) Plan

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create committees and sub-committees</td>
<td>200,000.0</td>
</tr>
<tr>
<td>Reviewing existing spatial plan, policies and strategies.</td>
<td>50,000.0</td>
</tr>
<tr>
<td>Reviewing status-quo of demographics, social, economic infrastructure.</td>
<td>50,000.0</td>
</tr>
<tr>
<td>Taking Environmental Impact Assessments</td>
<td>150,000.0</td>
</tr>
<tr>
<td>Report writing.</td>
<td>50,000</td>
</tr>
</tbody>
</table>

Table 19: National Spatial Plan

Documentations

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>TOTAL COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printing and Binding</td>
<td>2,000.0</td>
</tr>
<tr>
<td>Papers (A0, A2, A4)</td>
<td>3,000.0</td>
</tr>
</tbody>
</table>

Table 20: Documentations