Chapter 0

SDI Africa: An Implementation Guide Preamble

This handbook has been compiled as a cooperative effort of the Economic Commission for Africa (ECA), the Global Spatial Data infrastructure Association (GSDI) and EIS-Africa, with the collaboration of the International Institute for Geoinformation Science and Earth Observation (ITC). The objective of compiling this handbook is to assist African countries to improve the management of their geo-spatial data resources in a way that effectively supports decision-making by governments and ensures the participation of the entire society in the process.

The role of Geoinformation in Africa's development

Geographic information or Geoinformation (GI) provides the common language and reference system to establish linkages and balance between economic, environmental and social capital in order to improve upon the basis for societal response. Access to spatial data, and the policies governing that access, are crucial in shaping policies, programmes and projects.

Geoinformation forms an essential part of the knowledge available in modern information and communications science. It is required at all levels of administration, the economy, and science and by the public at large. It is the basis for planning in numerous fields. It helps governments and communities plan for homeland security, ensure critical infrastructure, protect the environment and deal with public health and safety issues as well as day-to-day resource management decision-making.

The Plan of Action of the World Summit on Sustainable Development (WSSD) recognized that the implementation of Agenda 21 and the achievement of the internationally agreed development goals, including the Millennium Development Goals (MDG) and the plan itself, requires the development of "information systems that make the sharing of valuable data possible, including the active exchange of earth observation data". This is equally true for the realization of objectives of NEPAD. Planners and policy-makers will require a vast amount of geographic information to address the majority of the aspirations articulated by these goals and initiatives. There is a recognized need to facilitate access to public information and participation, to provide affordable local access to information, to integrate existing information systems on land-use practices, among other measures, to ensure public participation in decision-making.

Challenges and opportunities in Africa

At the moment, geo-spatial data and information in Africa are under-used. There are a number of factors that undermine the ability of a country or a group of countries to use spatial information effectively in the planning process. These factors include lack of awareness by decision-makers,

low stock of base data, uncertain data discovery, access and exchange mechanisms, lack of interoperability among datasets, and insufficient human and technical resources[1].

Countries in the region probably need to revise their strategies for information management and adopt new criteria that ensure the inclusion of geographic information by governments and the society in all development decisions. Happily, new developments in geographic information management offers unprecedented opportunities for the interaction between producers and users, for the integration of GI into day-to-day activities of institutions and individuals, and have brought substantial changes in the concept itself of what spatial information is, and, consequently, in the way it is produced, stored, accessed, disseminated and used. Geographic data holdings are now regarded as national assets and not just as costly expenditures.

The Internet has brought new dimensions in information and knowledge management. Among its dramatic benefits, it allows selected data and information to be shared among users within countries and around the world. The Internet has extended its reach and applications to spatial information services. In the developed countries, Internet technology has been found invaluable for users to identify and locate geographic data at widely dispersed sites, and for producers to disseminate their services and data and to assess users' needs.

Spatial Data Infrastructures

The resources for the collection, management, dissemination, and use of geo-spatial data and information are being treated as part of the substructure or foundation of a society, resulting in the concept of Spatial Data Infrastructures (SDIs) with emphasis on co-ordination and partnerships to deliver spatial data and information products to decision-makers in an easy to use form. SDIs are increasingly recognized as an indispensable part of the national infrastructure of countries that need to be established and maintained as are other elements of the infrastructure. They are a robust response to the challenges that governments and societies confront in the use of spatial data and its transformation into information and knowledge that are needed for decision-making. SDI encompasses the policies, technologies and institutional arrangements involved in delivering spatially related information from many different sources to the widest possible group of potential users [FGDC]. They enable an unconstrained and transparent access to geoinformation by all members of society.

In Africa, the establishment of NSDIs have been pioneered by a number of organizations and groups, encompassing UN organizations, professional associations and the private sector, notably EIS-Africa, GSDI, AARSE, FIG, ICA, ITC, ESRI, UNEP and ECA. A number of awareness raising and capacity building seminars and workshops have been organized regionally and nationally in the last two years to make understand what these infrastructures are, how are they build, how they work, and why they are important. Preparations of many others are underway.

The delegates at the second meeting of the Committee for Development Information (CODI), a legislative body of the UN ECA, whose functions have subsumed those of the United Nations Regional Cartographic Conferences for Africa, noted that there was a compelling need to build a Regional SDI that would provide for African countries the capacity to acquire and process spatially referenced information. In this regard, the Committee adopted a resolution urging member States to

[1] EIS-Africa position paper (2002) identifies five factors that determines a country's ability to use geo-information effectively: existence of core data sets; the accessibility of documentation about existing geo-information; the adherence of geo-information to accepted standards; policies and practices promoting the exchange and reuse of geo-information; and sufficient human and technical resources to collect, manipulate and distribute geoinformation. The paper identifies the collection of these factors as *Spatial Data Infrastructure* (SDI)

give priority to establish their NSDIs with all the necessary components. In subsequent regional conferences (FIG/HABITAT/ ISK, Nairobi, Oct. 2001; AFRICAGIS-, Nairobi, Nov. 2001; UNGIWG, Washington, June 2002; GSDI6, September 2002) representatives from member States, academia, professional bodies, and other sectors, have endorsed these recommendations of CODI or have made similar appeals to member States. However, there is no single source of information or instruction on how to proceed to set up a national spatial data infrastructure.

The African SDI handbook

GSDI, EIS-Africa and ECA, with the support of ITC, agreed in mid 2002 to work together to collate and compile the information and instructions dispersed in various sources into one document, making them specific to Africa, providing a road map on how to build SDIs. The original TOR reads as follows:

> *A document, in the form of guidelines on concrete steps to implement SDIs in Africa, targeted to all those that have a key role to play in promoting, adopting, developing or implementing spatial information infrastructure in their home countries. These include administrators and managers of topographic and resource mapping departments and agencies, legislators and policy-makers, and major users of Geoinformation products.*

However, it was soon realized that it would be difficult to develop a 'how to' step-by-step guide, as SDI development does not lend itself to algorithmic processes. Another realization was that in the preparation of the document great care should be taken to avoid repeating or duplicating previous efforts, but rather to build upon and add value to them. In particular, the handbook should complement the GSDI's SDI cookbook[2] whilst at the same time be geared to African perspectives, and written by Africans as much as possible.

This guide is envisaged as a living document. While static version will be made available in print and on CD-ROM, emphasis will be on publishing on the web to facilitate continuous updating as techniques and procedures change and new material becomes available. In addition to providing very practical instructions for developing the various components of a vibrant SDI, the guide will act as an on-line library of resources relating to SDI development.

Selected experts from Africa and abroad, possessing a wide knowledge and experience in advancing GI development at national, regional and international levels contributed to the various chapters of the guide. They provided their country experiences, solutions and opportunities on the different issues the handbook addresses. The editors wish to express their appreciation to them for their valuable and enthusiastic cooperation.

[2] A publication of the Global Spatial Infrastructure Association. See http://www.gsdi.org/pubs/cookbook/cookbook0515.pdf

Chapter 1

INTRODUCTION – THE GUIDE APPROACH

Government agencies have tended to act separately for the collection, storage, and dissemination of data and information. Efforts and attitudes have been agency focused, and the provision of integrated data products and services to the geospatial data and decision-making community typically is inefficient in terms of timeliness and cost (Fig.1). Countless workshops (see related past conferences) have resulted in recommendations for standards, data sharing, and better communication to avoid duplication. The need is well recognized. However, what appears to be lacking is practical information on 'how to proceed'… 'how to change the way of doing business.' Talk is easy.

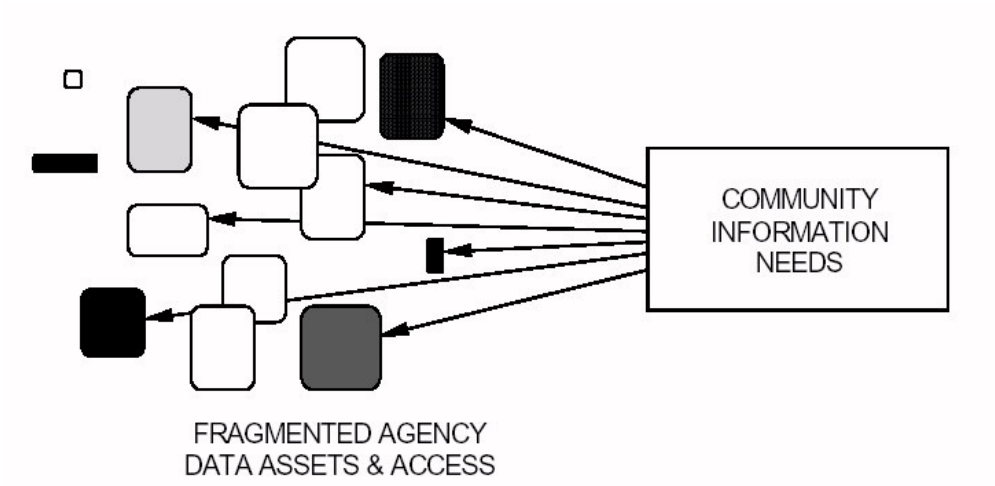

Figure 1: Community access to geographic information: *without SDI*
(adapted from CANRI 1999)

Spatial Data Infrastructure (SDI) reverses the agency focus. Partnership and communication are the heart of SDI. As civil servants, local communities, universities, NGO's, and private companies in Africa adopt GIS as a tool, they collectively can increase pressure on government agencies for improved functions, products, and services. Information and statistics establish a basis with which to assess conditions of the country and judge performance; they can provide the means for accountable and transparent governance. SDI is one piece of the challenge of having a national monitoring mechanism to measure progress in the promises made by those who govern, to build trust and participation of citizens.

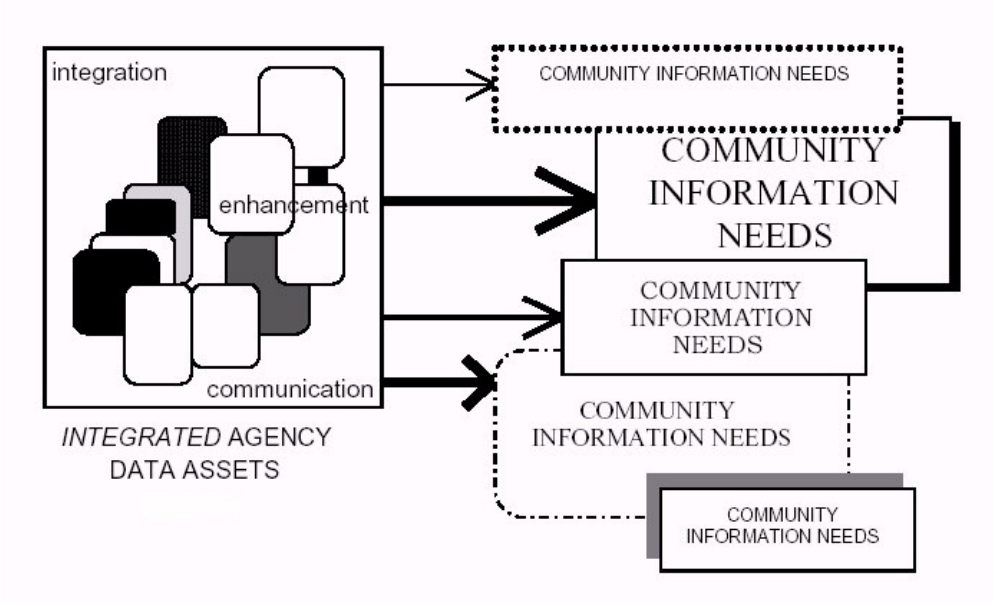

Figure 2: Community access to geographic information: *SDI 'enabled'* (adapted from CANRI 1999)

The SDI Guide for Africa aims to provide a blue print for SDI implementation. Real experiences, examples, and documents are presented from African countries and other countries around the world. It is meant as a 'virtual reference kiosk' for information managers, data technicians, and technology innovators who are interested in building information infrastructure in their country. It is important to note though that SDI development is not formulaic -- at least not the institutional, policy, and financial aspects. It is more like chess, where one has options as to which piece to move, and during the course of the game, certain moves are more strategic than others.

(graphic source: http://www.ahajokes.com/crt213.html)

The technical aspects of SDI components (see *Chapter - SDI Explained*) are much more straight-forward and lend themselves to a model for implementation, as the SDI Cookbook lays out. We encourage you to review the SDI Cookbook for details about technical SDI components. It's more difficult from an institutional standpoint to say, "Step 1, step 2, step 3, do this… and, thus, you'll have SDI." Forming an inter-institutional committee or organization, developing a work plan, identifying working groups and tasks, holding workshops to raise awareness and build support, developing data policy, drafting a decree or law in support of the inter-institutional committee or organization, etc. -- all of these are important steps. But they aren't necessarily sequential. One can start on one aspect and get stymied. So, one tries another tactic. The institutional elements in part depend on the status of the technical steps, since the technical steps are the more tangible (show-able) products. We have often advocated getting a clearinghouse up and running as a means to demonstrate the benefits of SDI, and thus 'breed' support for the institutional aspects. However, this does not mean that Clearinghouse development must be initiated before the establishment of a national committee or the drafting of a framework document. These can be parallel activities. In fact, it's a juggling act of parallel activities in a phased approach

(see *Chapter – Implementation*). Moreover, one must be opportunistic, taking into account what projects, and hence funding, one can leverage for SDI development. SDI development, in effect, is a tactical challenge.

The different conditions and personalities in your country form unique dynamics, and these influence the SDI approach that emerges. A first step in SDI implementation is assessing the current conditions (see *Chapter – Assessment of Geospatial Sector*). Some countries spend longer time in the planning stage, developing a coherent conceptual model of the SDI and its components before starting implementation. Others are more pragmatic and start with whatever is already available and develop as they go along. Some institutions have an easier time obtaining funding from the central government for activities or some countries have large external projects that support environmental management (see *Chapter – Financial Aspects*). One SDI model does not fit all. As you read through this guide, review the different recommendations, documents, and links, and then assemble them in a way that makes sense to your situation.

As much as possible, the materials in the guide come from African contributors. There is a slant towards contributions from government representatives, partly because government agencies have been the primary producers of data; also, government leadership is essential to the SDI development process. The following African contributors have been active in transforming their respective governments:

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Furthermore, in addition to the country specialists who contributed information, a number of colleagues provided constructive input to the chapters during an Ad Hoc meeting convened at UNECA in February 2003. The following people read through the materials and provided edits and additional information:

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The guide includes annexes and online 'example documents', e.g. policy statements, relevant legislation, protocol's, MoUs between data providers and users/data sharing agreements between institutions, freedom to information legislation, copyright law, standards developed, training materials produced, workshop proceedings, equipment procurement procedures and policies, geospatial projects inventory, charters and constitutions of coordinating bodies or structures, and ideas for funding SDI development. The Guide also includes links to other Guides that, while not necessarily focusing on SDI development, provide insights on organizational change, policy development, e-readiness, financing, etc. (see *existing related guides*).

This compilation of materials hopefully will help you in developing your own course of action, and ideally, the examples will help you 'leap frog' through the SDI development process.

We encourage you to provide feedback and to contribute to the on-going updating and improvement to the materials.

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Chapter 2

SPATIAL DATA INFRASTRUCTURE (SDI) EXPLAINED

Introduction

Spatial Data Infrastructure (SDI), also termed Geospatial Data Infrastructure (GDI), is essentially the enabling environment, that supports easy access to, and utilization of, geographical data and information, thereby ensuring the inclusion of all members of society in decision-making based on spatial information. Even more succinctly, we may define SDI as the mechanisms for efficient production, management, dissemination and use of geospatial information. A broad overview of the components of SDI is provided in this chapter.

While most people who are reading this guide are likely to have an understanding of SDI, it may often be necessary to explain the concept to others, who may not have a technical background. These could include managers who need to be persuaded to understand the advantages of spatial considerations in development with a view the to changing the way that things are done, or those who will make decisions concerning the allocation of resources to SDI. This chapter then aims also to provide explanations that may be useful in communicating SDI and related concepts to people who have not had hands-on experience in managing and manipulating digital geographic information.

Explaining the concepts underlying the rationale for spatial data infrastructure

Before explaining what SDI is to someone who has not had exposure to the use of digital geographic information, it may first be necessary to explain what is meant by *geospatial information* or *GIS,* in such a way that the rationale for SDI is understood.

What is geospatial information?

Perhaps the simplest explanation is that geospatial data or information tells one something about a location on earth. For example, a settlement has a location and occupies a definable area, within which there may be water sources, farming areas, schools, market places etc. Information about each of these features, e.g. the settlement's total population, what crops are produced in a farming area, is also considered geospatial information, as it is information about the location. The spatial relationships between these features within the settlement area can be readily assimilated when depicted on a map.

Box 1: Misconceptions regarding geographic information

Misconceptions abound concerning what actually constitutes geographic information. This lies at the heart of a statement made by a postal service official who said " We have a list of addresses to which mail goes in a particular area. We don't need a GIS." Underlying this assertion is the misconception that the address itself tells one where something is. This is actually not the case: the postal workers know where the properties associated with each of the addresses are located, and hence are able to deliver mail to the correct location. Of course this may have been learnt from actual visits to the properties, rather than from having the luxury of being able to look this up on a paper or digital map, or even being provided with the co-ordinates of each property using a GPS.

An understanding of the spatial relationships between features is valuable in guiding planning and development. The importance of having geographic information is illustrated by the role it played in directing responses to the Mozambique floods of 2000: the extent of the flooding was assessed through the use of remotely sensing images. The physical extent of the flood, as depicted in these images, was overlaid on an existing geographic database, in order to evaluate the extent of the damage and to focus humanitarian assistance.

One can provide information about a location either by using a co-ordinate system to define positions on the earth (technical jargon for this is "spatial referencing by (geographic) co-ordinates"), or by linking the information to named locations (technical jargon for this is "spatial referencing by geographic identifiers"), such as the name of a settlement, the position of which may in turn be defined through reference to a co-ordinate system.

Note that in practice several terms are used synonymously to denote geospatial information: these include *spatial information*, *geographic information, geographically-reference information,* or *geo-information*.

Why the talk of "geospatial information" instead of talking about "maps"?

In the past geographical information was mostly presented in the form of paper maps, with which most people are familiar. Increasingly today, geographic information is being captured in digital form and used through a Geographical Information System (GIS). This change has changed the conception of what Geographic information (GI) is and has introduced new challenges in handling GI.

What is a GIS?

A Geographic(al) Information System, or GIS, may be described as a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data associated with particular locations. Practitioners often refer to the "total GIS" as including operating personnel and the data that go into the system. The way in which the digital geographic data are structured makes it possible to use a GIS to perform complex analysis.

Has the advent of digital GIS technology made dealing with spatial information more complicated than it was in the old days dealing with paper maps?

A note on both the challenges and possibilities brought about by the use of digital technology to capture and manipulate geographic data may also contribute to developing an understanding of why spatial data infrastructure is needed. Here perhaps an analogy with word processing may be helpful.

Before the advent of the word processor, inserting a sentence on the 3rd page of a 10-page document captured using a typewriter was a major undertaking, often necessitating the retyping of most of the document. Word processors took the pain out of the editing of documents. Likewise, the editing or correcting of geographic data is made dramatically easier by being able to edit a digital database, rather than having to recreate a map. But using the word processor brought other advantages too: for instance, one can easily perform a search for occurrences of a particular word or phrase in a long document. And digital documents can be reused – cut-and-paste functionality allows one to construct "new" documents rapidly, through integrating portions of existing documents. The ability to merge documents from different sources also facilitates collaboration in creating documents, where various people might be tasked with putting together different parts of a document. All this applies too to the capturing of digital geographic data.

But it is precisely in the possibilities offered by the ability to ***reuse existing documents*** (or geographic data) and work ***collaboratively on a greater scale***, that new challenges arise. Anyone who has had to put together a document from several documents, authored by different people, must have encountered the need to adjust the fonts, paragraph numbering etc. More subtle than these

cosmetic changes needed to make the document appear coherent, and also more difficult to undertake, is ensuring that the ***terminology and the way in which terms have been used*** by the various authors, is ***harmonised throughout the new document***. The various documents to be integrated may be in different ***file formats***.

These kinds of issues are also encountered when ***digital geographic data from different sources is brought together***: This is the challenge that has been brought by the greater availability of digital technology to manage geographic information.

The way to avoid these kinds of difficulties, associated with bringing together a variety of documents or data sources, is by anticipating the aspects that will need to be harmonised afterwards. The ideal situation involves ***obtaining an agreement before work begins***, regarding how the authors (or data capturers) will construct a component of the document (or dataset).

Geographic datasets are in general far more complex, time-consuming and costly to collate, than the capturing of words electronically, using a word processor. Therefore ***harmonizing geographic data from a variety of sources*** is also then far more complex, costly and time-consuming, than adjusting styles in a document.

Although apparently complex, it should be emphasised that this kind of harmonization is achievable. Examples of this include the Country-at-a-glance initiative, undertaken in Ghana (see Box 2) and the integration of topographic data, cadastral data and demographic data derived from

Box 2: The Ghana — Country- at-A-Glance

The Ghana — Country at A Glance (G-CAG) was developed as a synoptic, inter-operable, and geographical database at the equivalent mapping scale of 1:000 000, to assist in national-level environmental management and planning. It evolved as a logical extension of the Environmental Information System Development (EISD) component of the Ghana Environmental Resource Management Project (GERMP).

One of the main aims of the initiative was to use it as an introduction to the detailed data sets that are available at the custodian organisations. A major task was to harmonise the various data sets data to a general standard, yielding a homogeneous output. Apart from having a higher geographical resolution, the original data sets also contained more complex information. It was also a way to formalise and standardise data format and distribution processes. The CAG may be considered as a reference for existing databases in the country, their contents and where to obtain them. This will prevent organisations from re-creating already existing data sets and promote inter-organisational co-operation.

The G-CAG database was designed to harmonise identified data layers and features required to conduct environmental analysis. Various institutions within the EISD framework, with the appropriate mandates, had produced each of the various types of information independently. The main part of the data was derived from detailed 1:250,000 databases generated by these institutions. Important data sets from other sources are also included. The database contains 51 geographically referenced and harmonised data sets covering 11 geographical themes.

From a practical project management standpoint, in terms of time and resources, the actual data manipulation was undertaken by one designated organisation with the capacity and skill sets required for such an undertaking. However, the various stakeholders first agreed upon the broad principles that would govern the process, and strategic as well as decisions on approach. All information was thoroughly checked by the custodians and approved before inclusion in the final database. Original input data was either derived directly from databases available at the custodian organisations or from international data sets. In the latter case the data was validated and approved by a national organisation having specialist competence in that particular field before inclusion.

the 1996 census conducted in South Africa, in order to demarcate electoral wards and plan where voting stations would be established in the general election of 1999.

The advantage of having a digital (geographic) dataset, as discussed above, can be summarized as followings:

- Easy storage
- Easy dissemination
- The facilitation of data exchange/sharing
- Faster and easier updating and correcting information
- The ability to integrate data from multiple sources and
- The customisation of products and services.

While advantageous to adopt, the usage of this new technology poses new challenges to the user community. For example, from the view point of the data producers they are now required to provide more detailed metadata (see below for an explanation of metadata). The end user is now required to have the technical knowledge necessary to assess from the metadata, how appropriate the data set is for his or her own use.

Explaining SDI

What is "SDI"?

There are numerous definitions available for SDI; please refer to Appendix 2.1 for a listing of some definitions which have been used. The fact that there are so many views or definitions is an indication that there is not a universal understanding of exactly what SDI entails, which in turn is rooted in the fact that different countries, or even different sectors within a country, may have differing needs. Consequently, the motivation for SDI development may vary from country to country (see examples of this in Chapter 6, Getting Started). Note that some of these definitions emphasise various *components* of SDI, while others place emphasis on the *purpose* of developing SDI. However, the gist of all these definitions of SDI comes down to the fact that SDI is the framework of elements/factors that are needed by a community, in order *to make effective use of spatial or geographic data*.

But these definitions, or even a list of the components of SDI, will not necessarily resonate with someone who has not had practical experience in assembling spatial information, in order to address a particular problem. It may be helpful to use other ways and examples to explain SDI.

- One might employ *a story or scenario*, effectively providing an "operational definition" of what is meant by SDI.

Using a scenario related to a topical issue could be particularly persuasive, as could be using a past event, where difficulties might have been encountered in assembling information necessary to solve a particular problem.

As an example, linked to the illustration of how geographic information was used following the floods in Mozambique, one

Box 3: The need for SDI

There has been significant rain falling for some days, and there is no indication of the rain abating in the near future. Flooding is a distinct possibility to be faced. It would be good to know what the risk of flooding is, and where people are living who should be evacuated, and what routes could be used to reach these people and transport them away from the area of danger. This implies the need for several kinds of information: where the river courses are, the elevation of the area near the rivers, where people live, and where there are roads. Does this data exist, and if so, would the data "owners" be prepared to provide this information to develop a disaster mitigation plan? Unless there is a central point to which one can go to find out what information is available, merely finding this out will take quite some effort and time. Next, assuming that somehow it is discovered that there are relevant datasets available, one needs to obtain the information from disparate sources, then integrate and process the information. In the course of this, one might discover that position of the road network depicted and the river courses clearly do not "fit" the real picture. More investigation, taking more time again, is called for, to discover how the co-ordinate systems used to reference these data differ, so that they can be aligned….

might stimulate thought using the "story" in Box 3.

- The development and use of *an analogy* with some *other kind of infrastructure* may also be helpful.

This may assist both in explaining the notion of SDI, as well as the need for coordinated development of and investment in SDI at a national level.

The explanation rests on an understanding of what is meant by infrastructure; a definition of infrastructure is as follows: *the basic systems and services, such as transport and power supplies, that a country or organization uses in order to work effectively* (from the Cambridge Advanced Learner's Dictionary). Other infrastructures often referred to include the *health* infrastructure, *educational* infrastructure or *telecommunication* infrastructure. *Spatial data infrastructure* can be seen as an infrastructure in the same sense: just as the ability to access and use the road network is necessary for undertaking a variety of economic activities, so too is the ability to access and use geospatial information necessary to plan and work effectively.

In general, there is considerable investment by government in developing these infrastructures, and the country's government will put in place measures to ensure coordination in the continual development of the infrastructure, which is likely to involve many players, simply because of the scale of the development required.

In general too, the development of many national infrastructures required interventions to bind infrastructures, which evolved independently on a smaller scale, into a single connected, coherent infrastructure. An example of this is the simultaneous development of *railway lines* with different gauges by different companies connecting various centres: to exploit the railway infrastructure optimally required that the gauges be standardized. Further, the "owners" of the various portions of railway infrastructure had to come to agreements on the use of "their" infrastructure by other service providers, and even details like timetables for use of the lines had to be agreed upon.

- Another angle on *explaining* SDI, is to cast it in the light of effective *management of resources.*

Considerable investment may go in to the gathering of information, which implies that information is a resource which needs to be looked after, in much the same way as other large capital investments need to be maintained, e.g. a bridge that has been constructed, in order to ensure continued use, to provide value commensurate with the initial expenditure. SDI thinking goes about ensuring that the cost-benefit analysis associated with creating an information resources in the first place was carefully thought through, as well as about having plans in place to ensure that the information resources continues to be useable and useful.

- In economic terms, one might also describe the impact of SDI as to *reduce the transactional costs* associated with the use of geospatial information.

Unless geospatial information is readily available in a format suitable for immediate use, there may be significant costs associated with obtaining it (consider the time spent in locating data, and a possible cost associated with the delay in obtaining it) or manipulation to get it into a form in which it can be used. A coherent SDI reduces these transactional costs, thereby contributing to efficiency.

"Why talk about SDI when we simply need data?"

There are times when one might encounter a push to create a centralized one-size-fits-all spatial database or "databank", to "solve" all the information needs of a country. To counter this it may be helpful to point out that the existence of geographic data and information does not alone ensure that it is used in decision-making and rational choices regarding the allocation of resources. Several factors come in to play, if information is to be used and reused:

- To be used, people need to ***know that the data exist***, and ***where to obtain it***.
- Then, they need to be ***permitted to access and use*** the data.

- Further, they need to know something of ***the history of the data capture***, in order to ***interpret*** it correctly, ***trust*** it and be able to ***integrate*** it meaningfully with data from other sources.
- One may even depend on certain ***other data sets***, in order to make sense of data, e.g. the listing of the population of various municipalities will be of limited use, unless one also knows where the municipal boundaries are.

Components of Spatial Data Infrastructure

As mentioned above, several factors determine a country's (or region's) ability to make effective use of available spatial or geographic information, namely:

- Clearly defined ***core (or base) spatial data*** sets,
- The adherence of geographic datasets to known and accepted ***standards***,
- Accessible documentation about existing geo-information (***metadata***),
- ***Policies and practices*** which promote the exchange and reuse of information, as well as
- Adequate ***human and technical resources*** to collect, maintain, manipulate and distribute geo-information.

These elements of SDI are elaborated on in the sub-paragraphs that follow. These sections also incorporate analogies, which once again may prove useful in providing explanations to people without a strong geographic information background.

Geospatial data development – building data for multiple uses

What data do we mean here?

Data sets, which may be used for many different purposes and in many different applications, are often referred to as *base* data, *core* data, *fundamental* data or *reference* data. A discussion on the distinctions sometimes made between reference, core, foundation and framework datasets may be found in chapter 2 of the SDI Cookbook.

This commonly used data would not in general require specialist subject knowledge of the field. For example, a dataset describing roads could be relevant to both disaster response applications, as well as the planning of where a new school should be located, while the principle user might be agency directly involved in maintaining and developing the road infrastructure (and most likely, developing and maintaining the road data set).

How does one know what data sets are core data sets?

This links to chapter 3 of this guide, namely identifying data needs. In undertaking a data needs assessment, certain data sets will emerge as being widely needed, for a variety of purposes, by many agencies. These then are the core data sets. It makes sense to prioritise their development, because they will be used widely.

To give an analogy, the letters A to Z can be regarded as core datasets of English language, which can be combined and re-used many times to provide different words, following standard spelling rules.

For example, in Nigeria's (draft) National Geoinformation Policy (see Appendix 2.2), the following fundamental or core datasets are identified:

a. Geodetic control database
b. Topographic database/DEM (at the scale of 1:50000 pending availability of 1:25000 national coverage)
c. Digital imagery and image maps
d. Administrative boundaries' data
e. Cadastral databases
f. Transportation (roads, inland water ways, railways, etc.) data
g. Hydrographic (rivers, lakes, etc.) data
h. Land use/land cover data
i. Geological database
j. Demographic database

The policy also states that this list of fundamental datasets will periodically be revisited, in order to make adjustments if necessary, in accordance with evolving national needs.

Who should develop a particular data set?

Even if there is agreement beforehand between a number of agencies, that a particular data set is needed by all of them, and that they will in fact share this data, the responsibility for development – and maintenance – of the data set needs to reside with a particular agency or organisation, the *data custodian*. The ideal would be to assign this responsibility to an agency, which is absolutely dependent on this data for its operations, and which could generate this data, as part of its business process. This means that it is likely that the agency will prioritise the development and updating of this data.

For example, a study conducted in Uganda in 2001 lead to concrete recommendations regarding the custodians of certain datasets, even though these agencies might not undertake the actual data capturing themselves. For instance, it is recommended that the Ministry of Local Government be the custodian for datasets on administrative units, while the Forest Department take responsibility for data pertaining to protected areas.

How does one ensure that many different users can use the data developed?

There are a number of factors that contribute to the possibility of multiple uses of the data.

- Consultation with potential data users, prior to data development, can ensure that data is developed which will meet their requirements.
- Standardization of the data developed, is basic to its correct interpretation and the integration of data from various sources. An analogy here is the ability to put various parts together, which may have been machined in different places, to assemble a car, or even simply to replace a part with another, and still have a working vehicle (or better still, have a vehicle in better working order than before). The key here is that the parts have been manufactured to comply with certain standards.
- Metadata (information about the data – see below) will of course be needed.
- Perhaps almost too obvious to be taken into account at times, is the fact that there has to be a way of distributing, or providing access to, the data, to all parties who would like to do this e.g. can access be provided online, through a Web Mapping Service? Or can the data be transferred via the Internet (e.g. ftp)? Or, is it possible to transfer this via CD-ROM?

Note the point that the factors listed above have a remarkable correspondence with the components needed for SDI – not an accident at all.

Geospatial information standards and standardization

It is likely that any organisation will encounter a need to obtain — or wish to share — information beyond their current information community, at some point in the future. As mentioned above, the ability or lack of ability to do this easily, or at all, depends partly on the nature of the datasets. Through standardization, one facilitates the use of a wider range of data. In developing standards for geographic data, one should look beyond the immediate information community of which one forms part, to standards in place or in development in other sectors, neighbouring countries or even regions.

How are standards developed?

The development of formal standards through national standards bodies as well as through international standards organisations (e.g. ISO and IEC – see boxes 5a and 5b) is achieved through a consultative process, generally requiring the honing of consensus on the nature of the standard under development. At a sub-regional level, there is an initiative towards sub-regional standardization being taken through SADCSTAN (see http://www.sadcstan.co.za, checked 28 October 2003), set up in terms of a Memorandum of Understanding signed by Ministers of Trade and Industry for SADC countries. The national standards bodies are members of SADCSTAN. Most often, stakeholders and role-players would constitute a committee and/or working group, to develop a standard or set of standards. Also built into both national and international standards systems, is the fact that a standard is not static, but there is an obligation to review all existing standards on a regular basis.

Informal standards also tend to evolve through a consensus process involving the players who stand to benefit most from adherence to a particular standard.

How are standards implemented?

The implementation of new standards may take some time, as there is a cost associated with implementation, and actual changes may need to be made to data or information adhering to "old" standards.

To encourage the adoption and implementation of standards, the process needs to be made as easy as possible. For example, the supply of software, which "forces" adherence to a standard, can accelerate the uptake of a standard. The best example here relates to the widespread adoption of the FGDC's Content Standard for Digital Geospatial Metadata (see http://www.fgdc.gov/metadata/metadata.html, checked 28 October 2003): the main driver for this was the availability of a free, easy-to-use capturing tools. Another example is the widespread use of ZIP software for compressing files.

What kind of standards does one need to implement?

Box 3a: About ISO's development of standards

ISO denotes the International Organisation for Standardization, based in Geneva. International Standards are developed through a consultative process involving its members, which are the standards bodies of various countries. Other organisations (e.g. international scientific organisations, UN bodies) may join as liaisons. The development of standards in particular areas is the work of a Technical Committee (abbreviated to TC). In the case of geographic information (or geomatics), the TC is TC 211. All standards numbered, e.g. ISO 9000 series and ISO 14000 series are well known. Standards pertaining to geographic information will fall in the range 19100 to 19199., and are hence referred to as the ISO 19100 series (or family) of standards. The home page of TC 211 is http://www.isotc211.org /, although the documents relating to standards under development are accessible only to members of the TC. African countries which are members of TC 211 at present (March 2003) are: Mauritius, Morocco, South Africa, Tanzania and Zimbabwe.

Increasingly, the way in which the data is stored, which may be software dependent, is no longer a major stumbling block to the sharing and integration of geographic data. More important is having an understanding of *what* the data represents, and *how* it does this. For example, unless there is a standard understanding of what is meant by "forest", there may be a misinterpretation of land cover data, as an area labelled as covered by "forest" may to someone else appear to be covered by "shrub land". Some crucial aspects to look at include the following:

- *Geographic referencing:* in order to be able to bring together (technical jargon often used for this is "overlay") different datasets, which cover the same (or adjoining) areas, one needs to know how the position of features has been defined, that is, one needs to know the projection and datum, and details of the co-ordinate system, to ensure the correct spatial relationships between features in different datasets. The AFREF project aims to develop standardised spatial referencing systems for Africa (see Appendix 2.3)
- The *data content*: what features are included in the dataset, how are these defined, and what is the relationship between them? A *data dictionary* (or *feature catalogue*), which accompanies a dataset, may ensure that the data is correctly understood, but unless the features are standard, it will not necessarily enable meaningful results to be obtained in combination with another data set.

Box 3b: About OGC's development of standards

OGC, or the Open GIS Consortium, is primarily a grouping of industry partners, developing specifications for geographic information. Several different membership options are available for organisations wishing to join and participate in OGC. At present, there are no distinctly African members of OGC. OGC's home page is at http://www.opengis.org/ , and provides information on their programme of work, products which claim conformance to OGC specifications and the specifications themselves, once they are finalised. There is a close relationship between OGC and ISO/ TC 211, resulting in an effective joint development of certain standards.

- The *resolution* or *scale* of the geographic data: in general, only datasets of comparable scale or resolution may be combined for the purposes of analysis.
- *Metadata*, or data about data: all the above might be carried in the documentation about a dataset, but for ease of understanding and comparability, this information is recorded, i.e. the metadata, should be recorded in a standard way.

Metadata – describing geospatial data

Why is metadata needed?

The recording of *metadata*, or *data about data*, serves a number of purposes. Information about a dataset may be necessary in order to

- locate appropriate data,
- evaluate whether the dataset meets one's requirements,

- extract the relevant data and
- actually make full use of the data in an application.

There is a helpful discussion on metadata in Chapter 3 of the SDI Cookbook. There are many useful references on the benefits of recording metadata, to both producers and users of the associated data.

What metadata is needed?

Different information about the dataset is needed to support each of the above. Again an analogy may be helpful: for example, a few simple characteristics of a book (the title, author, year and place of publishing etc) may be recorded in a library's catalogue, to facilitate locating and obtaining a particular book. The dust-jacket of a book itself often contains more information on the content of the book as well as information about the author, which is useful in order to evaluate whether the book is suited to the would-be reader's requirements.

How should the metadata be structured?

Mention has already been made of the fact that it is useful to record metadata in a standard way, to enable a potential user to make a more rapid evaluation of whether the dataset will meet his or her needs, that is, there is need for the *content* of a metadata record to be standardized. Internationally, people who work with geographic datasets have been at the forefront of developing standardized metadata content.

However, metadata needs also to be structured in a way that supports automated indexing, searching and retrieval of information, if it is to be made accessible through digital catalogues on the Internet. This is most often implemented through the provision of a standard metadata capturing tool.

Examples of metadata pertaining to a spatial datasets may be found in Appendix 2.4.

Cataloguing geospatial data

Why catalogue geospatial data?

The capturing of metadata relating to geospatial datasets is necessary, but not sufficient on its own, to ensure wider knowledge of a dataset, and hence wider usage. This metadata needs to be made available to potential users, together with search facilities, which enable a user to identify the datasets that most closely match their requirements.

What is meant by a "distributed catalogue"?

There are many producers of datasets, and once they have captured the metadata relating to datasets they create and/or maintain, the metadata collected needs to be accessible to a potential user. However, someone looking for data would want a "one-stop-shop", that is, they would rather not have to look in many different places for metadata. This is made possible with a "distributed catalogue", which makes it possible for a user to query collections of metadata, which reside on many different servers. This means that the publishers of metadata can maintain and post metadata to their own server, rather than having to transfer records to a server running the catalogue service. From the FGDC Clearinghouse in the USA, for example, it is possible to access metadata records on servers in Ethiopia, Kenya, Senegal and South Africa. A trivial analogy is provided by Internet search engines such as Yahoo or Google, which direct the searcher to Web-pages according to their search criteria, which are housed on servers all over the world.

Providing access to geospatial data via the web

What is the purpose of Web mapping?

It is extremely useful to be able to see geospatial data portrayed in the form of a map. If one has the appropriate GIS software, it is possible to obtain the dataset from the producer and map the information. With Web mapping, it is not necessary to have to obtain a data set and use own software to portray this as a map, beyond an internet browser. If through a catalogue one locates a dataset of interest, this may also be viewed over the Web. Note that often merely being able to view geospatial data in the form of a map may be all that is required in order to plan or make a decision. This greatly increases the number of potential users of geospatial data, as this group is no longer limited to those who have the relevant GIS software and expertise to be able to manipulate digital geospatial datasets.

How can maps be provided through the Web?

Many software products are available to publish geospatial data in the form of maps through the Web. A significant contribution of OGC has been to define specifications for web mapping interfaces. This has opened to way for the visual overlay of geographic information residing on different servers. Examples of this in action may be found at http://clearinghouse5.fgdc.gov/multiviewer/viewer.php?type=africa (checked 28 October 2003).

Data policies and legislation

Why are data policies and legislation important?

Many readers will have had first-hand experience of someone refusing to share data, where technology was certainly not a barrier. Various explanations for the refusal might be offered, but these would often come down to either an explicit restriction on providing the data to other parties, or to an absence of policy relating to provision of the data altogether.

What kinds of policies are relevant to SDI?

A wide range of policy may impact on the ability to use geospatial data. These include:

- Policy or legislation relating to *the right* (or otherwise) *to access information*: sometimes countries have legislation that defines the rights people have to obtain information held by both public and private sector bodies (e.g. South Africa's Promotion of Access to Information Act, Act 2 of 2000). This is obviously a factor, which promotes the interchange and distribution of geospatial information.
- *Pricing* policies: pricing policies may provide for a low or negligible cost associated with the acquiring of geospatial data which has been captured using public funding, or for full or partial cost recovery. Higher prices of data are likely to limit its distribution, but the absence of a homogenous policy in relation to cost recovery by public agencies can inhibit the flow of information even more.
- Policy relating *to the use of spatial data*: the position regarding ownership of *copyright* on geospatial data, as well as *liability* in relation to decisions taken on the basis of geospatial information, may also affect the use and reuse of geospatial datasets.
- Legislation and policy relating to other areas may have implications for SDI development: this is perhaps best demonstrated by examples. For instance, in many countries, legislation relating to the obligation to undertake Environmental Impact Assessments relating to developments in planning implies a need for the availability and use of geospatial information. In Uganda, the

obligation to produce a State of the Environment Report at regular intervals implies a need for certain geospatial information to be made available. South Africa's Local Government Municipal Demarcation Act (see Appendix 2.5) requires bodies to provide to the Municipal Demarcation Board information needed for making rational decisions regarding the boundaries of local authorities.

Chapter 5 of this guide provides a more in-depth study of the policy element of SDI and the development of policy.

Partnership and leadership

Why is partnership an important component of developing SDI?

As a single agency is unlikely to have all the resources, or even skills and knowledge required to undertake the development of all aspects of SDI, the partnership of agencies and organisations is called for. Not only does the establishment of a partnership of organisations working together to create SDI mean that a greater amount and wider range of resources can be brought to bear on its development, but having organisations working together at the outset, is vital to ensuring that SDI develops in a way that will support all the partners in their use of data. It may be appropriate to involve both public and private partners, as well as academia and individual experts in a consortium approach to developing the SDI needed by a country. An example of a public/private sector partnership is the development of the 1:50000 Digital Topographic Maps in Kenya. In this case the National Mapping Agency (Survey of Kenya) and World Agro Forestry Centre (ICRAF) pooled resources in the collection of the data required to produce the 1:50 000 map.

The importance of partnerships in developing SDI is sufficiently important to merit an entire chapter in this guide – see chapter 4 on the institutional framework for developing SDI.

What kind of leadership is needed?

While it is argued above that the co-operation of many partners is needed to achieve SDI, it is also important to ensure that activities to develop aspects of SDI remain co-ordinated and focussed. An overarching vision or goal to which all partners subscribe is important, such as Senegal's *Plan Géomatique National*. The designation of a lead agency from among the partners, with dedicated resources to be able to provide co-ordinating mechanisms, is likely to expedite the development of SDI. In the case of Nigeria, the (Draft) National Geoinformation Policy designates the National Space Research and Development Agency (NARSDA) as the lead agency, which will co-ordinate the activities of a National Geospatial Data Infrastructure committee. An additional leadership role is to keep partners inspired, and to promote continuously the vision or goal of SDI development activities.

Chapter 3 ASSESSMENT OF THE CURRENT STATUS AND ENVIRONMENT OF THE GEOSPATIAL SECTOR

Introduction

While most readers of this guide may have some appreciation of the effort involved in assessing the technical and institutional status of the GI community, their own organisation's SDI-readiness, the overall status of spatial data development in the country, some may be wondering whether tried methodologies exist to do so in a systematic way, and whether lessons can be learned from experiences in other countries. An assessment of the current status and the external environment of the geospatial sector is the first stage in the process of SDI strategic planning.

In this chapter, we use some elements of the strategic planning methodology developed by the International Service for National Agricultural Research (ISNAR: www.isnar.nl). We also illustrate how such assessments have been conducted in practice by drawing on examples from the GI sector in India. India is a microcosm featuring some of the oldest survey institutions in the world, world class civilian remote sensing expertise, some of the best software engineers as well as some of the most severe development problems. Past issues of the GIS Development Magazine www.gisdevelopment.net/magazine are the sources of the examples.

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

Simple example of strategic planning

We shall illustrate the concept of strategic planning using the simple example of planning for the purchase of a family computer. If I wish to purchase a family computer, I shall probably go through the following stages of strategic planning:

(i) Assess my current status and analyse my environment

Current status

- I need a computer and do not want to use the internet café around the corner anymore
- I don't have a computer
- The kids think the idea of a family computer is wonderful

Environmental Analysis

- Overcrowding of the internet café and irregular opening hours is inconvenient
- My organisation is not in a position (nor will be in the next four years) to provide a computer for use at home.
- Inflation makes investment in a computer an attractive proposition.
- Friends and neighbours have been buying new computers.

(ii) *Determine my desired future and undertake a gap analysis*

Desired Future

- I need a computer at home and strongly favour buying it.
- Having the latest model of Apple would be lovely.

Gap Analysis

- There are many brands and prices available.
- The latest model of Apple sure is expensive; I cannot afford a new Apple.
- A new Toshiba seems affordable.
- A used Apple is a possibility, but my spouse wants a new computer
- Repairs are expensive and used computers need more repairs. I would prefer a new economy model rather than a luxury used model.

(iii) Develop a Strategic Plan

- Buy a new Toshiba.
- I have about half of the money. I will borrow the rest from my uncle.

(iv) Implement the Strategic Plan

- Family travels by bus to Toshiba dealership.
- Spouse wanted a flat screen, but none available in country, so settles for bulky monitor.
- Children want a popular computer game; costs extra
- Children insist on loud speakers and own email address; costs extra.
- Take a taxi to drive home with the computer.

(v) Monitor and Evaluate

- See how well the computer performs, and let the neighbours know.
- Monitor kids' time on the Internet, repairs, overall cost of maintenance.
- Factor in unplanned benefits (can bring work home if needed).
- Factor in unplanned liabilities (neighbourhood kids using my kids' computer games too long).
- Evaluate whether to keep or sell the computer; if sell, do we replace? With what?

The example is inspired from a strategic planning exercise related to the purchase of a family car and included in the ISNAR learning module "Strategic Planning". The full learning module is highly recommended to readers of this guide interested in learning or teaching strategic planning. The module can be downloaded from www.isnar.cgiar.org/activities/training/request.htm.

Strategic planning for SDI

Individuals plan strategically before making decisions that affect their daily life. An organisation conducts strategic planning when it is at a turning point in its history. A variety of events can trigger the process: increased pressure on the organisation to identify alternative funding sources, the desire to respond to changing stakeholders' needs or to the need to engage in a meaningful dialogue with other stakeholders & donor agencies. In general, strategic planning is useful when program, financial and staff decisions have to be made:

- *Strategic decisions* – Should the organisation grow? Merge? Shrink? Change its mission?
- *Program decisions* – Should programs be expanded? Should two or several programs be integrated? Should new services be offered?
- *Financial-feasibility decisions* – Should new investors and donors be sought? Should funding sources be more diversified and how? Should new approaches to fundraising be identified?
- *Staffing decisions* – Should staff with different skills be hired to support the mission? Should staff be retrained?

Several mapping organisations have conducted strategic planning since the early nineties, mainly triggered by the thrust for public administration reform, popularised in the early nineties by the American authors of the bestseller "Reinventing government". The planning process is the same as in the example in the example of Section 3.2. Figure 3.1 shows the basic five stages involved. It is important to note the iterative or cyclic nature of the process based on the outcome of the monitoring and evaluation stage.

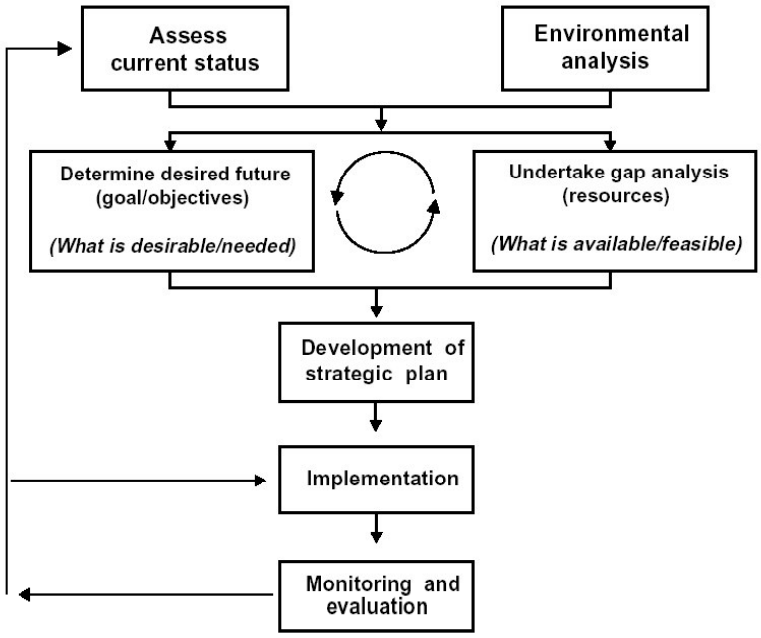


Figure 3.1 Strategic planning. From ISNAR (1998)

These planning exercises increasingly revealed that strategic decisions for the organisation are sound only if they explicitly acknowledge the *need for coherence with strategies of other agencies and organisations in the geospatial sector.* In other words, the focus is shifting from "strategic planning for a single organisation" to "strategic planning for the geospatial sector or industry". This new planning paradigm may be called "SDI strategic planning".

Organisations nowadays explicitly adopt the Spatial Data Infrastructure paradigm as the overall context for the generation and sharing of their spatial data assets. Here is an example of a vision statement, recently adopted by a mapping agency in Germany, which acknowledges explicitly the organisation's linkage with SDI: "The mapping organisation is the competent producer and service provider for core geoinformation in the country. The organisation is a central node of the Spatial Data Infrastructure of the country. The organisation will become a market oriented enterprise with a sustained commitment to the benefit of society". The first stage of SDI strategic planning is the assessment of the current status (i.e. strengths and weaknesses of the GI community) & the analysis of the external environment (i.e. opportunities and threats). It is the topic of Chapter 3.

Who performs the assessment?

Who performs the assessment and how long it takes depends on the specific country. In India, the assessment process was spearheaded by civil society, academia and private sector, took place in magazines, conferences and fierce public debates and lasted for years until the Indian SDI Strategy and Action Plan was launched and endorsed in 2001. In Germany the government commissioned consultants to produce a market survey within the framework of the country's SDI project in order to investigate the economic aspects of the geospatial data market and the institutional barriers impeding market growth.

Environmental analysis

When conducting an assessment it is often better to begin by understanding the external environment, rather than by assessing strengths & weaknesses. Otherwise, we may tend to focus too much on our own problems and fail to move on to the analysis of our environment. Key dimensions of the external environment include the national priorities & programs, legal framework & data policies, stakeholder analysis, ICT infrastructure in the country, and last but not least, an understanding of how SDI advocates in other countries have succeeded to attract political support.

National priorities and programs

One of the most useful places to start an environmental analysis is by scrutinizing the national priorities and programs in the country. Is the formulation and implementation of a National Information Technology Policy a major central government priority? Is central government –as was the case in India- interested to implement policy initiatives to achieve wide spread application of IT in all possible areas in the shortest possible time in concert with industry and entrepreneurs in the country? If this is the case, piggy-bagging an SDI initiative on such a thrust should be relatively straightforward.

Here is an example: On May 22, 1998, the Indian Prime Minister appointed a National Task Force on Information Technology and Software Development to formulate the draft of a National Informatics Policy. The Task Force was chaired by the Deputy Chairperson, Planning Commission and co-chaired by the Chief Minister of Andhra Pradesh & the Former Union Minister of State, Science & Technology. The committee submitted its first report on July 6, 1998. Twenty days later, the President of India ordered that all 108 recommendations of the IT Action Plan, submitted by the Task Force, be notified to all the Ministries and Departments of the Government and that necessary

instructions and amendments to the laws be issued expeditiously fully reflecting the spirit of the recommendations. Several recommendations, if implemented in their spirit, can foster SDI development in the country. Here are some of the recommendations of the task force directly related to SDI:

Box 1: Recommendations of the National Task Force on Information Technology and Software Development
www.gisdevelopment.net/magazine

….It is suggested that the Government of India should set up a Central Repository of data elements in government. The Repository could perhaps be setup with the National Informatics Centre. Each data element should be owned by a single agency. The Revenue department in each state could own for example data on Citizen name and address. Each agency should provide a comprehensive listing the Central Repository of its captured data elements, and the platforms and databases where such data elements reside. This will help all agencies to refer to the Central Repository while developing their own applications, thus ensuring standardisation across government. This will also help in achieving reduction in duplicated data collection, unnecessary form filling besides providing improved data quality and convenience to the public….

…Currently there are restrictions on making digitised Survey of India maps available for public use. The restrictions have been imposed in view of the reservations of the Ministry of Defence. In the present scenario when high resolution satellite systems are easily available for electronic surveillance there is need to rethink this policy so that digitised geographical information is made readily available for development of Geographical Information Systems and for use in value added applications. The Survey of India should make available digitised base maps with a threshold scale, free of copyright restrictions. This would stimulate the market for development of value added applications and create new products and services. Similarly the National Remote Sensing Agency should also make available remote sensing data for easy access by the public. With the development of the INTERNET in the country, both the Survey of India and the National Remote Sensing Agency, should use this medium for transferring appropriate digitised geographical information to the public domain…

The Indian "National Spatial Data Infrastructure: Strategy and Action Plan" was conceived and launched shortly thereafter, on February 6, 2001, in an effort that can be considered a landmark development in Indian geoinformatics in terms of top government participation in the process. In Africa, the New Partnership for African Development (NEPAD) may provide a powerful rationale for SDI development. Although NEPAD is still too young to have concrete programs, some of the key initiatives that have been identified, have great potential as contextual reference for SDI initiatives:

Box 2: NEPAD initiatives
www.nepad.org

- Peace, security, democracy and political governance initiative: Conditions for sustainable development, namely peace and security, democracy and political governance.
- Economic and corporate governance initiative: Conditions for sustainable development, namely improved state capacity to promote economic growth and development.
- Bridging the infrastructure gap: All forms of infrastructure, regional and continental, including information and communication technologies, energy, transport and water and sanitation.
- Human resource development initiative:The human resource priority includes poverty reduction, education, reversing the brain drain, and health.
- Capital flows initiative: This includes topics related to capital flows, such as increasing domestic resource mobilisation, debt relief, ODA reforms and private capital flows.
- Market access initiative: This covers market access issues such as diversification of production, agriculture, mining, manufacturing, tourism, services, promoting the private sector, promoting African exports, and the removal of non-tariff barriers.
- Environment initiative: This includes initiatives to develop a coherent environmental programme.

Legal framework and data policies

When analysing the external environment, it is important to take a look at existing (and non-existing) laws and policies relevant to SDI, such as those described in Section 2.4.6. Has legislation relating to the right to access information been enacted, is it pending or non-existent?

Figure 3.2: Access to Information Laws around the world. Source: Privacy International May 2003
www.privacyinternational.org/issues/foia/foia-survey.html

Figure 3.2 gives an overview of countries with Access to Information Law enacted (green), countries with pending legislation (yellow) and no law (white).

More often than not, SDI-conducive laws and policies are felt by the havoc they can wreak to society and to the information industry *if they do not exist and/or are poorly formulated and implemented*. We shall illustrate how SDI advocates describe the impact of the absence of such policies by means of two examples:

The first example comes from India, where a passionate and well documented crusade against government restrictions to spatial data access has taken place in the past few years. SDI advocates (NGO leaders, private companies, academics) deplored the continuing caging of maps of India despite decades of discussions, deliberations, representations & recommendations, in numerous seminars, conferences and top-level scientific meetings. They lobbied for de-restriction of maps, for removing secrecy from aerial photography and for an integrated strategy for geographic information, issues already raised in the early seventies, but still confronting GIS

Box 3: Enough is Enough
www.gisdevelopment.net/magazine
… Despite all, we all know that we can't shy away from the problems. We have to give it a try, once again. If the GIS industry has any intention to flourish in India it has no other choice but to face the issues affecting its growth. The issues are serious and so are their implications. Data availability, accessibility, quality, documentation and dissemination have remained critical issues for all of us. People are not aware what information is available, and where it can be sourced. There is a woeful absence of any system for the systematic documentation of data and meta-data. As if these are not enough, there exists a strong tendency to keep data secret. To tap the potential benefits, policy interventions in the data related issues are a must. In this context, not only is it important to examine the current existing

policies but also to recommend policy initiatives necessary to promote the development of a *Spatial Data Infrastructure*….

The second example is from Germany, where unlike other SDI initiatives, the ultimate goal of the SDI is to stimulate the geodata market, by connecting the value chains of users, service providers, service enablers, integrators, data producers and infrastructure providers. In this case, the government itself commissioned the MICUS (2000) study to identify institutional barriers to the development of the geodata market. The report acknowledges that only 15% of the geodata market potential has been tapped in Germany and emphasizes that the success of SDI will primarily depend on the (market) demand for geographically related services and information products, following the removal of barriers related to pricing, rights of use, procurement transparency etc.

Box 4: Boosting of the geospatial data market in Germany, MICUS 2001
www.newmedianrw.de/downloads/Geodatenmarkt_MICUS_NRW_2002.pdf
Geospatial data products have great market potential. If the appropriate framework conditions are created then a constantly increasing level of market growth can be achieved by the end of 2003. This means the creation of a stable branch of economic activity with qualified jobs. The geospatial data market in both North Rhine Westphalia and Germany as a whole is presently not sufficiently well developed. The offers are predominantly of a technical nature, specific solution-oriented applications are scarce. On the demand side the potential market participants have not yet recognised what geospatial data applications can achieve. As a consequence only low levels of turnover will be achieved in most application areas. The development of the market will, in particular, be blocked by six entrance barriers:

- A central problem is the non-uniform data range of the public providers whose data is seldom extensive and up to date.
- All in all there is not a sufficient level of transparency with respect to where which forms of data can be procured.
- The procurement of basic geospatial data is frequently laborious and expensive.
- Various different exchange formats and high demands upon the hardware lead to technical problems.
- The prices for basic geospatial data are too high.
- The regulations relating to rights of use are too complicated.

Stakeholders

A stakeholder analysis is an important source of information. SDI stakeholders include producers, commercial users and value-adders of spatial data, suppliers, access to information advocates, the media, the academic community, professional and scientific associations, foreign governments, donors & funders and the IT industry at large. An often forgotten but extremely important stakeholder group are the employees in one's own organisation. It is important to assess the stakeholders' perceptions of the issues and challenges involved in building SDI components, the resources they may contribute to SDI development, their own mandates as well as existing & potential conflicts between stakeholders. It is also useful to identify the level of influence (strong, medium, little) your stakeholders are likely to have to SDI development.

Which stakeholders are "our best friends" depends on who is driving the SDI development in the country. In the Indian scenario, awareness for the need for SDI seems to have developed as the result of a veritable revolt of civil society (NGOs, academics and private sector) against a rigid government establishment.

Box 5: Asking for the Moon
www.gisdevelopment.net/magazine
… In India, there is a lot of discussion going on about involving NGOs, research institutions and the private sector in decision making by the government. But can anyone tell me that how can one help you in decision making unless one has the data to study and analyse your problem? The whole business of data collecting agencies, still runs on the British instituted dictum Data - of the government, for the government, by the government. *The system does not identify the billions of population outside the government as a stakeholder.*

Our political system has cautiously avoided the public participation in policy making. That is why, before coming out with any major directive on a subject, the government rarely tries to consult the concerned associations or NGOs, which it funds directly or indirectly. Only the lack of participatory governance in the country could have led to the disastrous situation we have today in the field of mapping. Despite having institutions like the Indian National Cartography Association (INCA) and Indian Society for Remote Sensing (ISRS), we have had ridiculous map policies for more than two decades! This is the ample proof of how seriously the professional societies and their recommendations are taken by the government….

In India, we are more likely to find "our best friends" in the NGO, private sector and academia. In other countries, awareness for the need for SDI was driven by visionary government officers and/or a vocal private sector. In Germany, we are more likely to find "our best friends" in the government and private sector.

Polling the stakeholders' views on the data products and services of one's own organisation is an additional important element of stakeholder analysis. Following up on the polling outcome by adapting the organisation's strategy is even more important. It shows that polling is not an empty exercise, but a sincere attempt to understand the value of our products and services and improve our performance. Table 3.1 provides an example of a stakeholder survey, which is relevant for Africa considering the thrust to develop now the African Reference Frame (AFREF).

The table summarises the replies of stakeholders of the Geodetic Survey Division (GSD) of Canada to the question "How integral are GSD activities to delivering *your* organisation's mission?". The stakeholders include industry, academia, federal and provincial government departments, foreign governments and the managers of the Geodetic Survey Division.

Table 3.1: Responses of primary stakeholders to the question "How integral are Geodetic Survey's activities to delivering your organisation's mission?" from Booz, Allen and Hamilton (1995) Note: Very important = 4, Not important = 0

Geodetic Survey Division (GSD) Activity	**Industry**	**Academia**	**Federal Gov't**	**Provincial Gov't**	**Foreign Gov't**	**GSD Managers**
Spatial Reference Frames	4	4	4	4	4	4
Geoid Modelling and Refinements	4	4	4	4	4	4
Active Control System	3	2	4	3	4	4
Traditional Control Network	1	0	1	1	0	0
Standards and Related Services	4	3	3	3	0	4
Geodetic Information System	3	2	2	2	0	1
Marketing Support to Industry	4	2	3	1	0	N/A
Consulting and Publications	0	1	3	1	1	1

The shift in the stakeholders' perspective towards space-based positioning with the Active Control System technology, that is consistent with the International Terrestrial Reference Frame (ITRF) is truly remarkable. The Geodetic Survey Division consequently adapted its strategy to:

- Complete and implement the Canadian Active Control System (ACS)
- Leverage the National Spatial Reference Infrastructure-related intellectual capital of the GSD in partnership with the Canadian geomatics industry, provincial agencies and other government departments so that partial cost recovery or cost sharing is achieved

- Develop and implement a strategy to make the transition away from traditional geodetic control activities over a period of several years
- Communicate GSD's plans to stakeholders for their inputs

ICT infrastructure

The **Internet** and the **WWW** together constitute the cyberspace, a computer generated public domain with no territorial boundaries or physical attributes and in perpetual use. The internet is the world-wide *physical network* of computer networks. The WWW is a hypertext –based internet *service* used for browsing internet resources, such as text, files, graphics, sound and moving pictures. Although the internet architecture is global in theory, the reality on the ground is different. Lack of a telephone line, a computer and a modem exclude billions of *developing country users*. Congestion problems encourage internet providers to charge for internet use and to use the proceeds to fund increases in the providers' server capacity, thereby *excluding economically weak users*.

Exclusion due to technical and economic reasons make the internet a de facto club for the rich despite the theoretical hype. At a global scale, the bulk of internet connectivity in Mb/sec is between USA and Europe and to a lesser extent between US and Asia/Pacific. Africa has very thin lines reaching Europe and the USA. This situation forces local internet providers to purchase expensive international links to reach provider backbones in the north, thus raising the cost of access to users in poor countries. Cost increases from this source are additional to those that may arise from regulatory deficiencies and monopolistic market structures. See Figure 3.3.

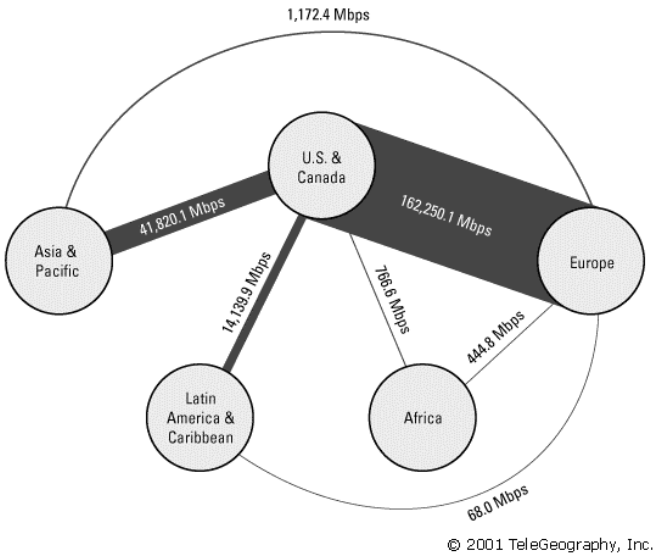


Figure 3.3: Global Internet connectivity. From TeleGeorgraphy 2001.

The "Global Information Technology Report: Readiness for the networked world 2001-2002" ranked a total of 75 countries -representing more than 80% of the world's population and 90% of its economic output- based on their potential to participate in the networked world of the future. The Networked Readiness Index (NRI) distinguishes between factors that determine the usability of the network (the enabling factors) and variables that reflect the extent of network use. Here are some indicative rankings for some developed countries and some developing countries, including the only 5 African countries that made it into the study. See Table 3.2.

Table 3.2: Networked Readiness Index for some of the 75 countries around the globe

Country	Networked Readiness Index (NRI)	Comments
United States	1	Highest world NRI
Netherlands	6	
Switzerland	16	
Germany	17	
South Africa	**40**	Highest African NRI
Mauritius	**51**	
India	54	
Egypt	**60**	
China	64	
Zimbabwe	**70**	
Nigeria	**75**	Lowest world NRI
All other African countries can be assumed to have NRI lower than Nigeria		

Securing political support

Understanding our environment is not a passive exercise. It can and should be accompanied by lobbying for changing the status quo and for attracting political support. Sensitising government about the impact of inadequate or absent laws and policies on governance itself, on private sector development etc requires sustained and sometimes aggressive lobbying over several years.

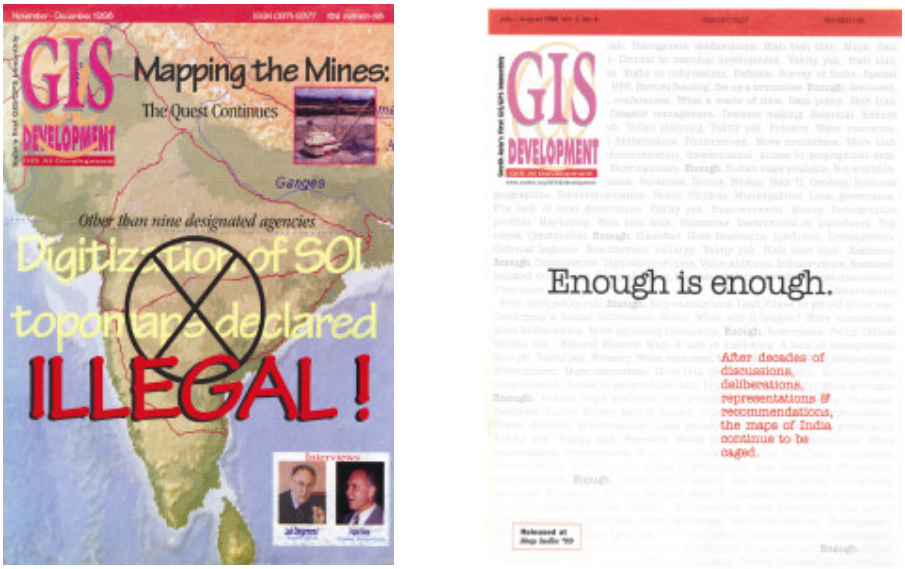


Figure 3.4: Lobbying for removal of data access restrictions in India: GIS Development Magazine, Issues of Nov-Dec 1998 and Jul-Aug 1999

The GIS Development magazine in India has launched one of the most spirited and effective campaigns in this respect by giving a high visibility discussion forum to the best minds in the country over the past few years. See Figure 3.4. A wise element of the strategy of the publishers of GIS Development was to focus on the damage done to the advancement of science and technology in India, by restricting the access to spatial data to the countries researchers, a fact that no politician in her right mind can afford to dismiss as irrelevant.

Box 6: Asking for the Moon
www.gisdevelopment.net/magazine
… Most of us would have come across stories about the harassment faced by researchers wasting their most productive years in running around for data in the government departments like Survey of India, Central Ground Water Board, Central Water Commission etc. In fact, out of a normal five year doctorate course in any natural science stream in India, on an average, the scholar spends at least half of his time running around for collecting the basic data required for research. By not releasing the data for the research, these data agencies play a major role in ensuring that India never comes up to the frontier of science and technology in the world….

And here is the wise response of a senior government official at the Indian Department of Science and Technology: "Till recently, due to compulsions of national security all geographical data in digital form came under "restricted" category and was available to only government organisations. This seriously restricted the application of digital technology to real life problems of development. The government has recently relaxed some of the provisions. It is now possible for nine agencies of the government to digitise Survey of India unrestricted topographic maps on 1:50,000 scales and provide application-specific, value added information. *However, I am aware that scientific user community and other user community is not satisfied by these provisions. There is an urgent need to assess the user requirements on a more rational and scientific basis so that efforts can be made to respond to these requirements by suitable policy formulations consistent with the sensitivity and defence provisions of the country.* Demands for digital data is growing very fast and we need to devise ways by which these demands can be adequately met. Our policy formulators will have to be consistent with the global trends and also take into account the rapid technological advances taking place in the field of IT technologies".

Current status

Key dimensions in the assessment of the current status (i.e. strengths and weaknesses) include an overall benchmarking of the status quo with respect to the international scenario, an inventory of the custodians of spatial data assets in the country, an understanding of the historical evolution of the geospatial sector (including the colonial legacy), a geodata needs assessment at a manageable level (municipal, community level) and last but not least an identification of the capacity building needs.

Comparison to other countries

Comparing our own country's SDI development with others has two advantages as a tool of internalising the international environment: It benchmarks the level of development for use in further strategic planning and it can be a powerful tool when negotiating with other stakeholders and donor agencies. Table 3.3 summarises such a comparison between the Indian GI scenario and internationally. "International" refers here to the USA, major European countries, Canada, Australia, Japan, Korea, Qatar, Indonesia and Malaysia. It is important to note that this comparison was conducted before the Indian NSDI Strategy and Action Plan was launched officially on February 6, 2001 in India.

Table 3.3: A Comparison between India and International Scenario.

Parameters	**India**	**International***
Mechanics of Data Access	Paper data sale through SOI offices.	Clearinghouse nodes, websites, E-commerce etc.
Private Sector involvement in Data generation, dissemination	Nil	In most of the countries
Digital data availability	No	Yes. Now vector data being also provided in addition to the raster data
Public domain datasets (available for free)	Nil	Few in most of the countries. US is an exception.
A strategy for National Spatial Data Infrastructure	No	Yes
Metadata	No	Process going on in most of the countries.
Data Clearinghouse	No	Yes in many of the countries
Data standards	No	Yes
Core data accessibility	No	Yes
Access to govt. information	No	Yes
Data dissemination policy	No	Yes
Data pricing policy	No	In some of the countries
Driving force for Spatial Data Infrastructure	No focussed programme. One of the agendas of Indian Remote Sensing Programme / IT Task Force	Focussed initiatives for geographic information
Information economy	Poor	Rich
Freedom of Information	No	In some of the countries

Custodians of spatial data

Table 3.4: Custodians of spatial data in India in 2000 (Source: www.gisdevelopment.net/magazine)

	Data Type	Name of Agency (ies) involved	Ministry of	Paper Data	Digital Data	Web Site	Use of web site for data dissemination
1	Meteorological data	Indian Meteorological Division	Science and Technology	Y	N	N	N
2	Environmental data	Central Pollution Control Board (CPCB)/ National Environmental Engineering Institute (NEERI)/WWF /Forestry Survey of India	Environment and Forests	Y	N	N	N
3	Mapping data	Survey of India	Science and Technology	Y	N	N	N
4	Remote Sensing data	National Remote Sensing Agency	Space	Y	Y	Y	Y
5	Information on buildings (at national or local level)	Local Government	Rural Areas and Employment /Urban Affairs	N	N	N	N
6	Cadastral Registers	State Government	Rural Areas and Employment /Urban Affairs	N	N	N	N
7	Geological data	Geological Survey of India (GSI)	Mines	Y	N	N	N
8	Botanical data	Botanical Survey of India	Agriculture	Y	N	N	N
9	Agricultural data	National Bureau of Soil Survey, All India Soil and Land Use Survey	Agriculture	Y	N	N	N
10	Thematic Mapping	National Atlas and Thematic Mapping Agency	Science and Technology	Y	N	N	N
11	Census data	Census of India	Home	Y	N	Y	Y
12	Watershed data		Agriculture	N	N	N	N
13	Data on River Basins	Central Water Commission	Water Resources	Y	N	N	N
14	Oceanographic data	National institute of Oceanography	Ocean Development	N	N	Y	N
15	GI Laws	Defence	Defence	N	N	N	N
16	Ground Water data	Central Ground Water Board	Water Resources	N	N	N	N
	Statistical data	CSO (Central Statistics Organisation)	Planning and Implementation	Y	Y	Y	Y
17	Information Systems	National Informatics Centre	Planning Commission	N	N	Y	Y

Data sets, which may be used for many different purposes and in many different applications, are often referred to as base data, core data, fundamental data or reference data. The responsibility for development – and maintenance – of the data set needs to reside with a particular agency or organisation, the data custodian. It is important to identify the custodians of base data in a country, together with some basic indicators relating to data type and data access practices.

Historical evolution

"Anyone wishing to see what is to be must consider what has been: all the things of this world in every era have their counterparts in ancient times". Understanding the historical evolution of the geospatial sector – as well as of other "hard" infrastructures, such as roads, electricity, railways etc-

in a country is an indispensable exercise for SDI implementers. Here are some thoughts of an Indian GI thinker, not only reflecting on the history of mapping in India but also asking the important question "where do we go from here".

Box 7: The other part of the map
www.gisdevelopment.net/magazine
I remember my grandma telling me a story. There was a demon who created havoc in a kingdom. The demon did evil things and the king did not know how to deal with it. The only ray of hope was that the king had a part of the map of the area where the demon resided. However, the other part of the map was missing. There were chances, if the king gets the remaining part of the map, the demon may be located and eventually may get killed. The story is not yet complete. The demon is yet to be killed but where is the map?

…India was mapped to exploit and glorify the imperial power of British. However, the efforts to map this country with such accuracy was no easy task. John Keay, in his book 'The Great Arc' writes in foreword, "The Great Arc was hailed as 'one of the most stupendous works in the whole history of science'. It was 'as near perfect a thing of its kind as ever been undertaken'. …If the impression given is less of a scientific set-piece and more of a monumental example of human endeavour, then so it was. This 1600 miles of inch perfect survey took nearly fifty years, cost more lives than most contemporary wars, and involved equations more complex than any in the pre-computer age." … Whether this mapping enterprise was undertaken to cater the need of imperialists or it was a typical scientific adventure of mankind or it may be the combination of both, people may have different opinions. But, the fact remains, when the British left this country, India was mapped considerably. They knew this country much more than us. Hence, they used the information for their purpose. No problem. They anyway did not come to this country for charity. The more important question is what happened thereafter?

The search continues…
Last year some time in December, when I was interacting with some of the students at the University of Allahabad, I started the discussion by asking if anyone had seen the map of Allahabad city. The answer was no. In fact, even myself, despite spending my entire formative years in Allahabad, I have yet to see the map of Allahabad city. A historical city known for its religious and political activities, doesn't have a map? And even if it does, I don't know where it is and who has it?

Geodata needs assessment

Departments, Agencies, and other organizations have responsibilities assigned to them by legislative bodies. Each of these organizations translates these responsibilities into specific activities, products, and services. Geospatial software and spatial data are tools and resources that organizations rely on to product effective products and services (or geospatial applications) to meet mandated legislative responsibilities. There are several approaches to initiate a geospatial data needs assessment. One practical approach is referred to as an "application oriented approach". This approach is based on *geospatial applications*, and the data that is used to support these applications.

This section outlines a procedure to identify and evaluate the data needs of organizations based on the activities, or products and services, produced by the organization. Through this procedure, the overall geospatial data needs assessment is identified and measured, by taking into account the "user-demand" for spatial data applications. The process typically involves several steps:

1. ***Identify the Stakeholders and form Workgroups if necessary:*** The stakeholders may include Departments, Agencies, and other organizations that use geospatial data and analysis tools to generate products and services. The list of Stakeholders may be extensive. One strategy that can be used to effectively streamline the geospatial data needs assessment is to form different Workgroups that are comprised of a single representative from each Agency or Organization. This individual becomes the point of contact for the Agency during the needs assessment process, and might be responsible for compiling information about his/her agency, and reporting back to the Workgroup.

Workgroups can be organized by "themes". For example, organizations working with natural resource issues (National Park Service, Department of Forestry, etc.) could constitute one Workgroup, while those organizations that are associated with infrastructure / development may be members of a separate Workgroup. Workgroups could also be organized by levels of government (Federal Agencies and Departments could comprise a Federal Work Group, while Local Agencies and Departments would participate in a separate Local Work Group). In addition, NGO's could participate in a separate NGO Work Group, or they could be members of a thematic Work Group. The organizational structure of workgroups will be contingent on the context of each country.

2. **Agency GIS Application (product/service) Inventory**: The second step is to identify the geospatial products and services associated with each of the stakeholders. Each organization is asked to identify the geospatial business applications within the organization. The spatial data assets that are associated with each of these business applications (a product or service) should then be listed. Examples of business applications (or products / services) could, for example, could include:

   - Road mapping,
   - Forest Fire Risk Analysis,
   - Wildlife Habitat Assessments,
   - Watershed Planning,
   - Transportation Planning,
   - Forest Cover Monitoring,
   - Land Management,
   - Tax Mapping,
   - Business Location Analysis,
   - Water Quality Monitoring,
   - Tourism Facility Mapping…

   The applications and associated data layers may be acquired through informal interviews and conversations, or they can be compiled by agencies on a simple survey form (see Figure 3.5). A single Agency or organization may support several geospatial applications. Only the data layers that are currently available to support the application should be included in this inventory. Spatial data layers currently under development can later be added to the survey when they are actually integrated to support the application.

GIS Application Survey Worksheet

Application Name: **Watershed Planning**
Agency: Department of Forestry

Part I: Identifying existing data layers associated with the application

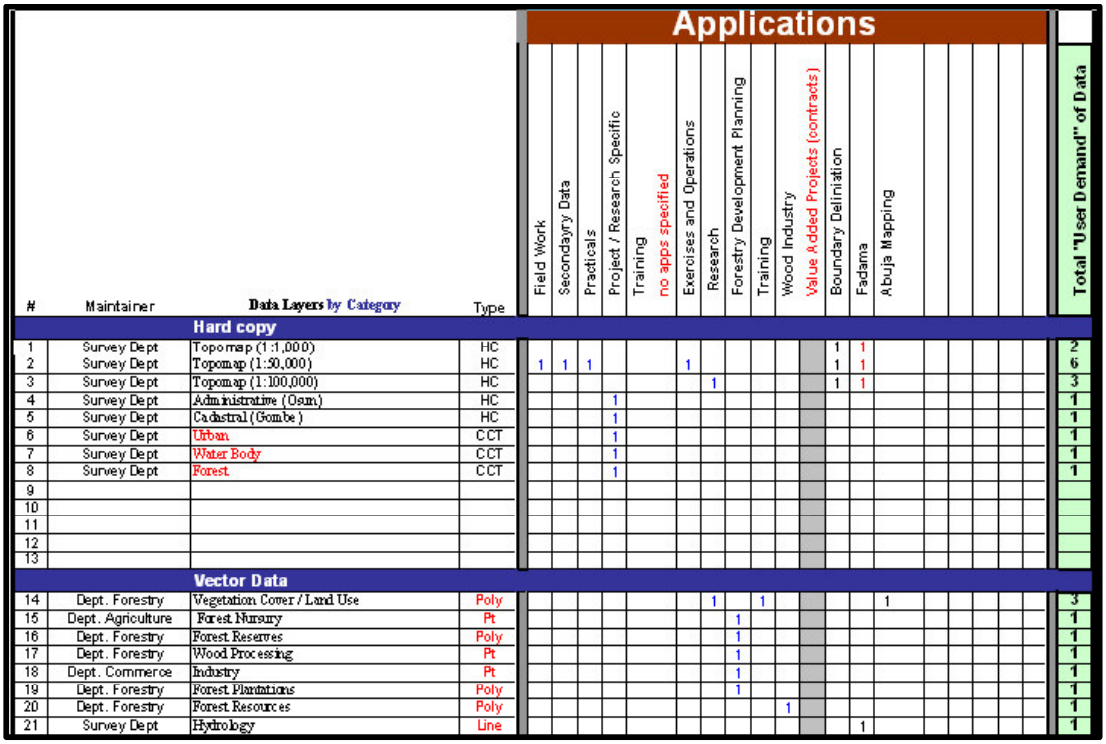
#	Data Layer Name	Digital or Analogue	Type	Origin/Maintaining Agency
1	Hydrology (1:100,000)	Digital	Line	Survey Dept.
2	Watershed Boundaries	Digital	Poly	Dept. Forestry
3	LULC (1:250,000)	Digital	Raster	Dept. Forestry
4	Soils (1:100,000)	Digital	Poly	Geological Dept.
5	Well Locations (GPS)	Digital	Point	NGO-Cath. Relief
6	Roads	Digital	Line	Survey Dept.
7				

Figure 3.5: Example of an Application-based Survey Form

Follow-up conversations may be required to clarify submissions on the survey form.

3. **The Application Matrix**: When the initial documentation of GIS applications associated with each agency has been documented, and when the identification of the spatial data assets to support these applications have been identified, the information can be entered onto an organized spreadsheet resulting in a matrix of applications related to spatial data resources. Applications, the responsible agency, and application specifics (i.e. mandate type or organization level) can be listed along the X-axis. The spatial data resources and related information (data type, maintaining organization, etc.) critical to supporting each application can be documented along the Y-axis. In the matrix each spatial data layer is identified by its common name and the agency, which is responsible for maintaining the layer. Finally, the "application demand" of each data layer can be determined simply by counting the number of applications that a spatial data layer supports. Clearly, certain applications can be assigned different weights, which can be allocated to the data assets associated with these applications. This can be is based on individual contexts.

   Once all of the applications have been identified for a given agency, and the data assets associated with each application have been documented, an Application Matrix can be developed. The purpose of the Application Matrix is to develop *a collective perspective of user demand*, for data, based on the products and services that are generated in order to support legislative mandates.



#	Maintainer	Data Layers by Category	Type	Field Work	Secondayry Data	Practicals	Project / Research Specific	Training	no apps specified	Exercises and Operations	Research	Forestry Development Planning	Training	Wood Industry	Value Added Projects (contracts)	Boundary Delinlation	Fadama	Abuja Mapping	Total "User Demand" of Data
Hard copy																			
1	Survey Dept	Topomap (1:1,000)	HC													1	1		2
2	Survey Dept	Topomap (1:50,000)	HC	1	1	1				1						1	1		6
3	Survey Dept	Topomap (1:100,000)	HC								1					1	1		3
4	Survey Dept	Administrative (Osun)	HC				1												1
5	Survey Dept	Cadastral (Gombe)	HC				1												1
6	Survey Dept	Urban	CCT				1												1
7	Survey Dept	Water Body	CCT				1												1
8	Survey Dept	Forest	CCT				1												1
9																			
10																			
11																			
12																			
13																			
Vector Data																			
14	Dept. Forestry	Vegetation Cover / Land Use	Poly								1		1					1	3
15	Dept. Agriculture	Forest Nursury	Pt									1							1
16	Dept. Forestry	Forest Reserves	Poly									1							1
17	Dept. Forestry	Wood Processing	Pt									1							1
18	Dept. Commerce	Industry	Pt									1							1
19	Dept. Forestry	Forest Plantations	Poly									1							1
20	Dept. Forestry	Forest Resources	Poly											1					1
21	Survey Dept	Hydrology	Line														1		1

Figure 3.6: An Example of an Application Matrix

There are several benefits of developing an application matrix. These benefits include:

- Identifying critical needs based on "application demand". One of the principal goals in developing an application matrix is to identify, across the "geospatial application landscape" priorities for data acquisition based on the *collective needs of all participating organizations and agencies.* These priorities should be based on the collective need of geospatial products and services in as many different agencies and organizations as possible. Ideally, priority data layers should support as many different applications from as many different agencies and organizations as possible. The Application Matrix may evolve into an essential component of an overall strategic plan.
- Communication Support for Program Needs: The Matrix can be used as a support mechanism to lobby for funding from the appropriate authorities. Typically, an application matrix will show a number of different agencies and organizations that may require the development of a further geospatial data assets to support a multitude of legislative mandated products and services. Furthermore, an Application Matrix often reflects a "Collective Need" of agencies that may be associated with different Ministries or Secretariats. The Matrix can serve to show how funding for a particular data resource will support many different governmental products and services. An argument may also be made for partnerships between the agencies or ministries that would receive the majority of the benefits from the acquisition of new data assets.
- Visual documentation: The application matrix provides visual documentation of the geospatial landscape for a locality or a country. It opens the door for discussion for geospatial managers and other analysts, and promotes the sharing of experiences, and expertise. It may provide a visual forum for GIS Managers and Users to "think out of the box" as they gain a better understanding for the Application and data landscape.

This could include: the sharing of application expertise or software codes, identifying more efficient methods to collect data, etc.

- Providing different approaches to assess geospatial data needs: The matrix provides a means of analyzing applications and evaluating geospatial data needs either "horizontally" (across dissimilar agencies and organizations at a particular level of government) or "vertically" (across dissimilar agencies and organizations at multiple levels of government).

4. **Agency Follow-up Surveys**: Digital follow-up surveys (or follow-up questions on the initial survey) can be distributed to agencies and organizations to acquire additional information about each business application. This information may include more specific information about geospatial applications and supporting data layers. For example, a follow-up survey may ask agencies and organizations to identify the applications that could be improved by having access to better geospatial data resources. In some cases agencies use spatial data resources that are less than ideal for a specific application or objective, because there is no other spatial data resource available. Therefore, the follow-up survey may ask agencies to identify the applications, which could be improved by having access to better data. Furthermore, agencies and organizations may be asked to identify the specific data layers which, if improved or developed, could more effectively support the application. Such a follow-up survey may be included as an additional item on the Agency Application Survey (step #1).

6. Identify any data layers that are not currently available to support your application, but that could support this application if they were available.
Note: do not include raw imagery products data products [i.e. Landsat, DOQ's, etc]. Do include "value added" data products [i.e. land use, land cover, topography] that may be derived from raw imagery.

#	Layer	Usable Scale (not ideal, but it would work)	Ideal Scale (in a perfect world)	Coverage/Extent (dropdown menu)
1	Disturbed Urban Areas	Scale: 1:100,000	Scale: 1:12,000	Countrywide
2	Land Use	Scale: 1:100,000	Scale: 1:12,000	Countrywide
3	Land Cover	Scale: 1:100,000	Scale: 1:12,000	Countrywide
4	Impaired Waters	Scale: 1:100,000	Scale: 1:12,000	Countrywide
5	*Floodplains*	Scale: 1:100,000	Scale: 1:12,000	Countrywide
6		Scale:	Scale:	
7		Scale:	Scale:	
8		Scale:	Scale:	
9		Scale:	Scale:	
10		Scale:	Scale:	

Figure 3.7: An Example of a Follow-up Survey.

It should be noted that the application matrix is a "living document". This document is never complete, as it will require periodic review and updating as new geospatial products and services become operational, and as new data layers to support both new and existing applications are developed. The development of an accurate Application Matrix will certainly not ensure the overall success of an SDI. However, if accurate and fairly evaluated, the Matrix can provide a strong foundation upon which an overall strategic plan can be developed.

Capacity Building

A definition of capacity building

As mentioned in 3.1, SDI strategies will have to be "translated" at the end of the day into strategic plans and capacity building programs for individual organisations. In the past, these organisations have produced fundamental geoinformation in the conventional sense in the form of maps and reports.

Capacity building refers to improvements in the ability of organisations to perform agreed tasks in co-operation with other organisations in a SDI environment. It encompasses the development of individual human resources as well as organisational and institutional strengthening. See Figure 3.8. Capacity building has received increasing attention in the international development community during the past decade. It is broadly considered a prerequisite for good governance. It has become the rallying cry of donor agencies and international development think tanks, in an era of declining foreign aid. Any serious discussion of capacity building must start by answering a fundamental question: What should these government organisations be responsible for in the ICT era?

Detailed answers to this question are the outcomes of political, historical and cultural processes at a country level; in fact they should be (at least partly) the outcomes of the capacity building process itself. Here, we provide a general answer to the question, which represents the broad consensus of the scientific community to date:

- *Ownership of fundamental data:* In general, government at all levels requires unrestricted and efficient access to *reliable*, timely, up to date fundamental geoinformation to govern. Who collects the geoinformation is a matter of efficiency and local circumstance. In all cases government controls the standards and specifications, pays for the data development out of tax revenue and therefore remains the owner, which secures unrestricted access at all times.
- *Obligation to facilitate access to fundamental data:* Governments have an obligation to facilitate access and promote the broadest possible application of fundamental geoinformation, by means, among other things, of well considered pricing policies. This includes an obligation to provide the description of the data to enable all users, including the private sector and civil society organisations to make a judgment about fitness for use.

	PURPOSE	FOCUS
CAPACITY BUILDING FOR GEOINFORMATICS	Human resources development	Supply of GI (technical) personnel
	Organisational strengthening	Strengthen the management capacity of organisations; institutionalise geo-ICT solutions (systems and processes) as well as strategic management principles
	Institutional strengthening	Strengthen the capacity of organisations to develop & negotiate appropriate mandates and modus operandi as well as appropriate (new) legal and regulatory frameworks

Figure 3.8: Purposes and foci of capacity building for SDI

Durable solutions in capacity building can only be achieved if we can accept that it requires knowledge development in all partners. Local experts and external ones must develop in each other a shared capacity, which will lead to viable and timely solutions. Hence the notion that "western expertise" can provide turn-key systems must be deliberately overtaken by more sensitive arrangements based on the equivalency of the knowledge of the partners in the capacity building projects.

Assessment of educational capacity for SDI

The definition in the previous section provides us with a useful lens through which to assess the existing educational capacity for SDI in a country. We may organise the assessment around two questions:

1. What is the status of GI (technical) personnel in terms of the capacity to:

- understand the role of, and be able to develop data products and services in different application fields,
- select and apply appropriate methods for geospatial data collection and processing
- use GI science and earth observation technology to generate, integrate, analyse and visualise spatial data,
- understand the principles of databases, data models and to use database query languages,
- work in multidisciplinary teams engaged in production projects involving spatial data collection, database management and data dissemination?

2. What is the status of GI management personnel in terms of the capacity to:

- develop a business strategy that encompasses the definition of content & quality of core spatial data products, pricing, value added services & distribution strategies and the requirements for strategic alliances with private and public sector,
- operationalise the business strategy through the design of geospatial data production processes needed to provide the chosen products and services
- develop a technology strategy that encompasses choices on GI system reliability, flexibility, interconnectivity, and partnerships with technology firms to obtain the required capabilities
- discern the need for regulatory and policy changes and negotiate new mandates in concert with others?

The assessment of educational capacity for SDI will eventually lead to a comprehensive strategy to provide the requisite GI technical and management personnel in the country. Here is an example from India where the need for these new professionals is recognized at the highest level in government.

Box 8: The Indian Science and Technology Policy 2003
http://www.dst.gov.in/doc/stp2003.doc
"…The transformation of new ideas into commercial successes is of vital importance to the nation's ability to achieve high economic growth and global competitiveness. Accordingly, special emphasis will be given not only to R&D and the technological factors of innovation, but also to the other equally important social, institutional and market factors needed for adoption, diffusion and transfer of innovation to the productive sectors. […] A comprehensive and well-orchestrated program relating to education, R&D and training in all aspects of technology management will be launched. To begin with, Indian Institutes of Management (IIMs), Indian Institutes of Technology (IITs) and other selected institutions will be encouraged to initiate these programs…"

Chapter 4

ORGANIZATIONAL STRUCTURE AND INSTITUTIONAL ARRANGEMENTS

Introduction

The concept of Spatial Data Infrastructure, as shown in the precedent chapters, is geared to building together, as data users and producers community, a common data resource, a collective data asset, with its management tools and rules. An operational SDI through a clearinghouse mechanism makes it possible for the potential users, at country, sub-regional, continental or global level, to find out which data exist, where, and how to have access to, and under which conditions to make use thereof, with a view to deriving from the analysis of such data, a meaningful information for decision making. Seen from a country perspective, the various data do not need to be centralized in one location for the purpose of the SDI. They will be kept in as many locations as there are data contributors, over a distributed computer networks. The possibilities to query the corresponding matadatabase, and perform analytical operations and transactions on the actual data over the network, according to agreed upon rules and procedures are part of the facilities offered by the SDI.

This entails a form of organization. The target audience of an SDI is so large and the potential uses so diverse that consensus building through a participatory approach is essential for its design. Involving both Government agencies and institutions from the civil society, this participatory approach leads to a consensus-based definition of the goal, objectives and output of undertaking the SDI development, and the related activities. To this end, participatory analysis background is provided in annex.

This chapter, deals with the organizational structure for the SDI, with an emphasis on the inherent institutional arrangements it is based on.

Organizational Structure

A typical organizational structure will comprise the following elements:

1. A Ministry in Charge.

Depending on the internal structure of the Government, this could be the ministry in charge of the main development sector of which Geoinformation, Surveying and mapping, Remote Sensing, are a sub-sector, or sectors (e.g., NICT, Environment, Mining, Defence, etc.). To provide a stronger support at policy level, the ministry in charge of the SDI could be the Office of the Prime Minister, or that of the President. The Ministry in charge will ensure that the SDI concept is understood and supported within the governmental and parliamentarian spheres (political advocacy), that the administrative requirements for its development and operation are met (administration advocacy) , and that the Government is providing the required financial resources, and helping to mobilize the external ones (financial advocacy and provision)

2. A Lead Agency

The Spatial Data Infrastructure needs an institution in charge of coordinating the actions regarding the development and operation of the entire structure. The Lead agency will usually be an institution having a mandate related to geospatial data management. It will play a Secretariat role with regard to the others organs mentioned below, facilitate administratively the functioning of the SDI, provide office space and related facilities for its operation, manage its resources, undertake the networking management functions and linkage with the other SDI initiatives

3. A forum or a network of data producers and users

Usually, a forum of all the stakeholders will be designated as the decision making body regarding important issues related to the SDI development and management. Although such decisions are still to be endorsed by the government, the Forum will be the place where innovative ideas are turned into decisions for implementation, subject to high policy level approval. The Forum is also the symbol and the instrument of participation essential for the involvement of all the stakeholders in the SDI process.

In some instances a Network of data producers and users will be set up and constitute the policy organ of the SDI, including a forum of the network as a periodic event. The Forum or the Network is essential in the amalgamation of various geo related professions and as a pressure group to move the SDI forward.

4. A Steering Committee

This organ represents a sample of the community of stakeholders and works towards the achievement of the objectives of the SDI, by analysing the outcome of the activities undertaken by the lower level organs and making recommendations to the Forum or the Network, and by facilitating the implementation of the decisions once taken by the latter.

5. Technical Working Groups

Working Groups are usually formed to focus on specific problem areas of the SDI's development and operation. They help deepen the analysis of the issues involved and identify the best solutions, such as drafting standards, policies, suggesting capacity building programs, etc.

Examples of SDI Organizational Structure in Africa

In practice the organizational structure of the SDI will be influenced by factors such as:

- the relative weights of the government(s) and/or the private sector in the dynamics of the national socio-economy,
- the level of awareness of Geospatial information usefulness,
- the diversity of the stakeholders involved,
- the relative influence of particular interest groups,
- the type of information policy prevailing,

These considerations had an impact on the way SDI development was initiated, or some sub-systems thereof built in a few countries in Africa. Summaries of organizational structures taken from such countries are provided in annex.

Institutional Arrangements

In the SDI context, at country level, institutional arrangements are key to:

- easy access to the national data asset components owned by, or in custody within government, NGO, and private sector agencies,
- ensuring the maintenance of these data, and their related metadata,
- avoiding duplication of efforts and resources invested in data collection,
- developing appropriate standards,
- compliance with the national standards (and international standards),
- identifying and developing core datasets,
- etc.

In summary, these arrangements are essential for creating and maintaining the synergies required around the SDI process. The same applies to sub-regional level SDIs.

A data policy (object of the next chapter) will create the enabling environment for the institutions to contribute, on a legal basis, to easy access to the data asset of the nation. In essence, an institution will commit itself to applying national standards for its data collection and their transformation for the sake of their usability by other users, to documenting its data asset following agreed upon metadata standards, to contributing through these metadata to a data discovery mechanism, to updating regularly its data and their related metadata, and to allowing external users to access these data under general and specific conditions; the specific conditions being under the control of the contributing institution. In return, the contributing institution will have access to the invaluable national data asset for the purpose of its various activities.

A few example taken from Africa (Senegal, Tunisia, Kenya, Burkina Faso, Namibia) are provided in Annex to show how institutional arrangements were negotiated (some are on-going).

Lessons and Challenges

The recent introduction of the SDI concept in Africa is taking place in a environment where GIS applications are penetrating number of development fields (Environment, Agriculture, mining, climate, disease control, town planning, etc.). This is an opportunity for Africa to avoid the risk of a technological chaos, and its related feeling of frustration: a failure resulting from an uncontrolled and uncoordinated development of isolated GIS applications, without a possibility to integrate the various datasets built in such an anarchy environment.

One lesson learnt from the experience of countries where SDI implementation started in Africa, is the fact that the SDI usually developed from an information need to address a

particular issue (land management in South Africa, Environment management in Zambia, Burkina Faso, Namibia, Benin, etc.)

Another lesson is the fact that the institutional issues are more difficult to address than the technical or technological ones. The former are related to corporate interests or their ambitions of domination that can undermine the cohesion and smooth functioning of the SDI structure.

The big challenge is the sustainability of the SDI, due to the following risk areas:

- reduction of financial resource allocation by the government,
- end of donor support where SDI was initiated as a "project"
- risk of low interest if developed as a sub-component of an NICT program

Another important challenge inherent to the African context is the capacity of the local populations to effectively make a wide-spread use of the SDI facilities, due to the limitation of the NICT coverage, combined with the deficiency of expertise.

ANNEX I: PARTICIPATION ANALYSIS

Participation analysis appears to be one of the most important steps leading to an even SDI organizational structure. Indeed, participation is key to the development of a system that is accepted and used by the majority of people. The participation analysis, first steps of the situation analysis, is based on the fact that "organizations, authorities at different levels, and interest groups have different motives and interests. It is of fundamental importance to analyse the interests and expectation of the various participants both early on in the planning process, and later during the implementation of the project[1]".

The participation analysis consists of

- Identifying all parties involved in the SDI development by:
  1. writing down all persons, groups, and institutions affected by the SDI environment;
  2. categorizing them, e.g. interest groups, individuals, organizations, authorities, etc.
  3. discussing whose interests and views are to be given priority when analysing the problems, and by specifying gender.
- Taking a closer look at some of the groups by:
  1. selecting the most important groups;
  2. making a more detailed analysis of these groups, e.g. in terms of:
     i. Problems: the main problem affecting or facing the group (economic, ecological, cultural, etc.);
     ii. Interest: the main needs and interests as seen from the group's point of view;
     iii. Potential: the strengths and weaknesses of the group;
     iv. Linkages: Main conflicts of interest, patterns of cooperation or dependency with other groups.
- Setting priorities by:

  deciding whose interests and views are to be given priority when the analysis of problems is carried out.

In practice, conducting a good participation analysis shows that, beyond the identification of all involved parties, there are equally important outputs such as the problems affecting the groups, their interests, their strengths and weaknesses, their conflicts of interest, the dependency with other groups, etc.

Recently, during an international workshop in Accra involving geoinformation specialists and researchers, the participants put in practice the theory of participation analysis, "problems analysis" , "objectives analysis" . the discussions on the issue of public access to geospatial

[1] The Logical Framework Approach (LFA), handbook for objectives-oriented planning, NORAD, January 1999

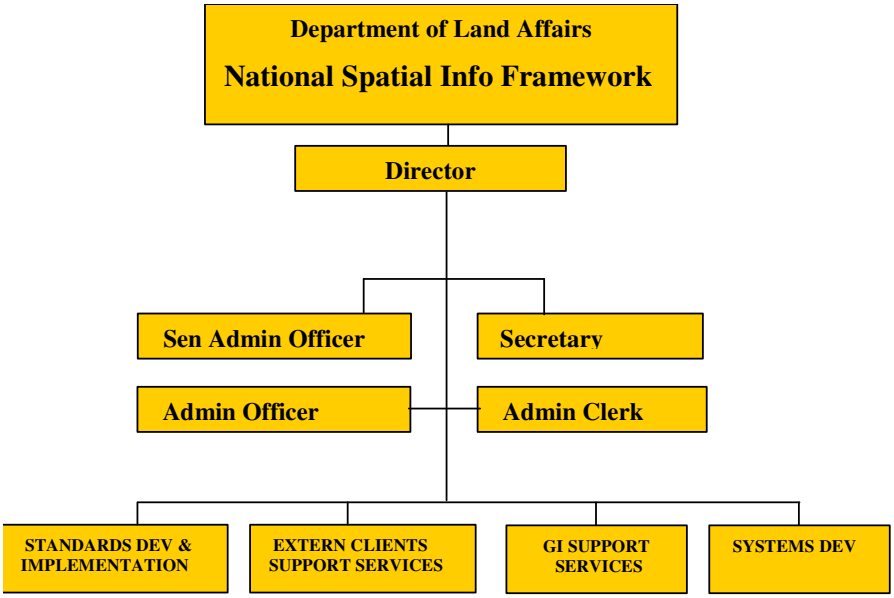
information resulted in the fact that some influential groups within the stakeholders represented felt that some of their interests may be threatened by the public access to their data. Their fears and concerns included risk of misuse of their data by third parties, loss of their data ownership. This highlights some misconceptions and a serious deficiency in SDI knowledge and understanding.

ANNEX II: EXAMPLES OF SDI ORGANIZATIONAL STRUCTURES TAKEN FROM AFRICA

South Africa

National Spatial Information Framework (NSIF) —November 1997.

Organisational Structure of NSIF



NLIS mandate

To facilitate the sharing of available land information in the public and private sectors through exchange mechanisms, in accordance with accepted standards.

NSIF membership

- Chief Surveyor-General,
- Surveyor General Pretoria,
- Director: National Mapping
- Surveyors, geographers, planners, IT technologists

Working Groups or Task Teams

3 task teams, on:

- Policies
- Standards

- Marketing and education

South African Spatial Information Infrastructure (SASII) — 2002

SASII object

To promote, in the public interest, easier and more economical access to spatial information which is relevant to the Republic's socio-economic developmental needs:

SASII Objectives

- To promote effective management and maintenance of spatial information;
- To promote the utilisation and sharing of spatial information in support of spatial planning, socio-economic development and related activities;
- To create, within a legal framework, in particular through this Act and the Promotion of Access to Information Act, 2000, an environment which facilitates co-ordination and co-operation among all stakeholders regarding access to spatial information;
- To eliminate duplication in the capturing of spatial information; and
- To promote universal access to such information

Membership of the Committee for Spatial Information membership:

The Committee is composed of representatives of

- All departments of state
- All Provincial Governments
- One rural municipality
- One urban municipality
- One GIS Association
- One GIS tersiary education institution
- Public Finance Management experts
- State data custodians

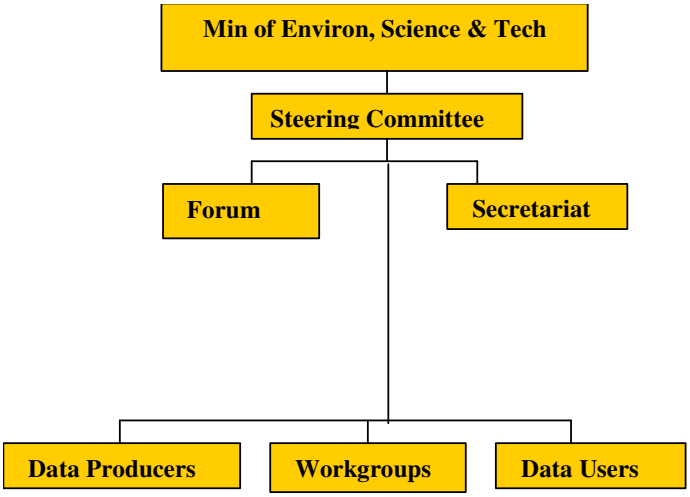
Working Groups or Task Teams

Sub-Committees to be defined by the Committee for Spatial Information

Ghana

National Framework for Geo-Spatial Information Management (NAFGIM) — April 2000

Organizational Structure of NAFGIM



NAFGIM objectives:

Seeking to co-ordinate the development of the necessary conditions for:

- the electronic networking of the spatial data and information producing and using organisations in Ghana and elsewhere.
- the avoidance of duplication in the production of spatial information and the assurance of increased value and quality of the information that is available to government and the development community.
- increased sharing and exchange of data and information.
- easy discovery, access and the wider use and re-use of spatial information through the development of:
  - standardised description of data and information
  - common policy for data and information access and use
  - framework data and information comprising themes that are continually needed and used by managers for the integration of their own data.

Membership of NAFGIM Steering Committee

Responsible for the formulation of policy, promotion and advocacy for sustained development. It is composed of:

- 37 governmental institutions including EPA, ministries, universities, Army, etc.
- 10 Commissions including Land, Energy, Electoral, Minerals, etc.)
- 6 Association and private companies including Sambus Ltd, RUDAN Ltd, Conservation International Ghana, National Association of Local Authorities of Ghana (NALAG), etc.

Working Groups or Task Teams

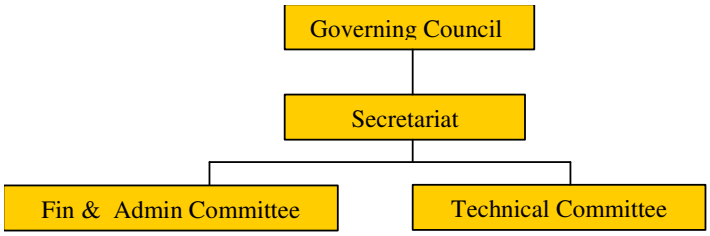
Two Working groups:

- Standards
- Policy

Zambia

Environmental Information Network and Monitoring System (EINMS) – 1997
EINMS Forum – 2000

Structure of the EIN Forum (as recommended by the consultants team)



Mandate of the EINMS

- Seeks to develop 5 EISs based on the most deserving needs on environment and NR in Zambia,
- Seeks to develop a FORUM to provide consensus on building the five EISs
- Provides a technical secretariat for the FORUM and the development of the 5 EISs.

Mandate of the EIN FORUM:

To reach agreements on mechanisms for sharing information among data centres and users, fostering consensus among stakeholders, and facilitating data and environmental information exchange

Objectives of the FORUM:

- To support decision making processes for sustainable environmental management at community, national, regional and global scales, by acquiring, collating, analyzing, storing and disseminating information and data.
- To promote easy access by users to environmental information and data irrespective of where it is actually stored, regardless of the format used.
- To facilitate and support networking between environmental and among institutions and individual members.

Membership of the FORUM

- Agriculture
- Mining
- Water
- Wildlife

- Health
- Land
- Education
- Energy
- Transport
- Communication
- Social Welfare
- Trade & Commerce

Working groups or Task teams

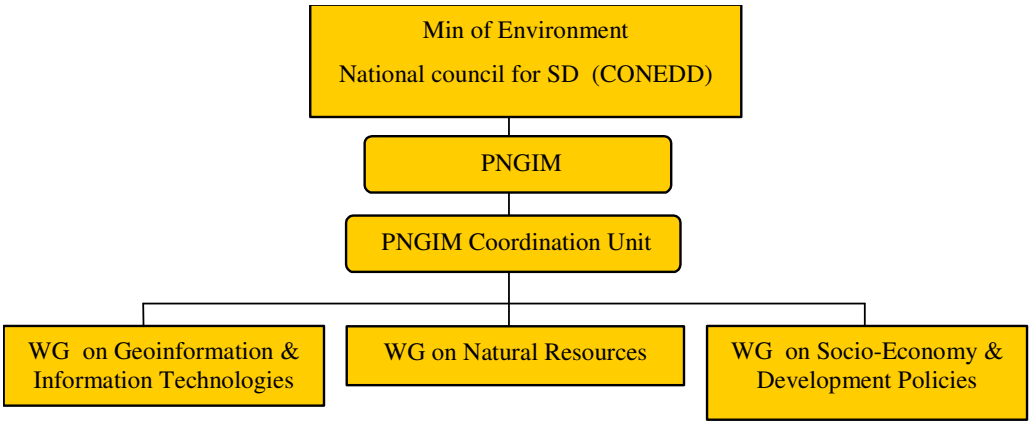
Two Committees:

- Financial and Administrative Committee
- Technical Committee

Burkina Faso

Programme national de gestion de l'information sur le milieu (PNGIM) – Feb. 1993
(National Program on Environmental Information Management)

Organizational Structure of PNGIM



Mandate of the PNGIM

- To set up an efficient system allowing easy access to environmental information ;
- To improve the relevance, quality and availability of environmental information;
- To contribute to the strengthening of national institutions' operational capacity to collect, process, and disseminate information
- To serve as a platform for consultation on cartographic and thematic standards, spatial and non spatial databases;
- To strengthen and promote the integration of GIS and new information and communication technologies into environmental management

- To facilitate full involvement of BURKINA FASO in all international initiatives concerned with data collection and analysis for environmental management purposes;
- To promote the national expertise and capacity building in Environmental information systems ;
- To sensitize the decision makers on the importance of Environmental Information Systems for NRM and environment protection ;
- To ensure national NRM-related policies monitoring and evaluation
- To develop for the decision makers integrated decision support tools applicable for addressing environment-related issues;
- To define guiding principles and policy orientations for a better management of environmental information;
- To ensure quality control on data provided by the members;
- To assess for approval the report and workplan of the PNGIM's Coordinating Unit; ;
- To raise funds for financing the activities in the scope of its mandate

Mandate of the PNGIM's Coordinating Unit:

- To pan and oversee the activities of the PNGIM ;
- To link the PNGIM network members using the most appropriate communication means;
- To contribute in fundraising and mobilization of the required financial resources for implementing the PNGIM's activities ;
- To support logistically and technically the implementation of PNGIM activities , including supporting the members of the network when possible;
- To ease the flow of information and organize the required exchange between the stakeholder
- To initiate the required measures towards a harmonized data production
- To encourage synergy building among network members;
- To make the PNGIM actions visible and capitalize on its achievements;
- To co-ordinate the production of the annual national SOE report in BF ;
- To co-ordinate actions in setting up and managing the Monitoring and Evaluation of the National Program of Action to combat the Desertification PAN-LCD
- To promote and update the information asset of the other conventions (CCC, CBD) and the national policies

PNGIM membership

- Sixteen governmental institutions, including national mapping agency, statistics bureau, University, etc.
- Ten additional governmental agencies and major projects proposed as potential members

Working groups or Task teams

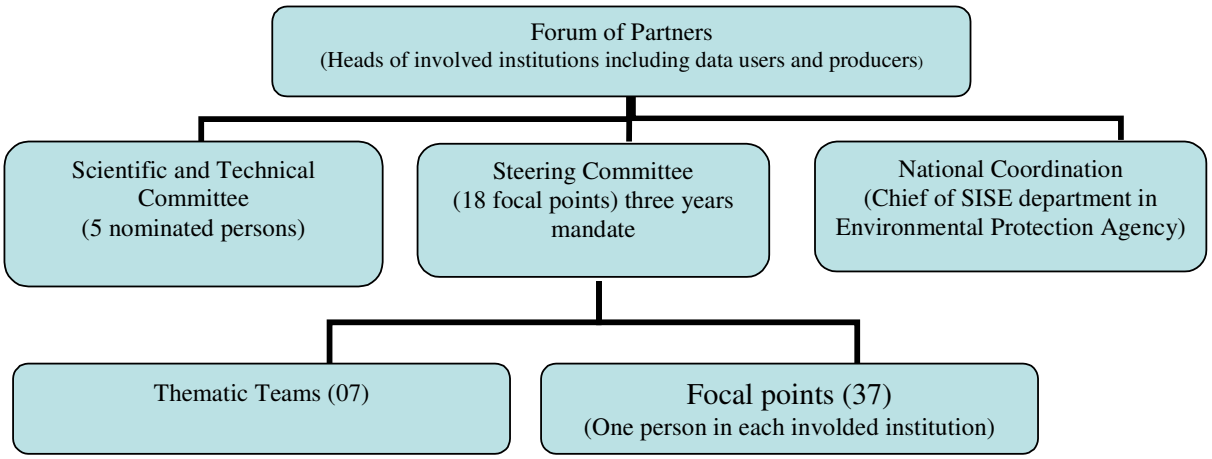
Three working Groups

- WG on natural resources
- WG on socio-economic and development policies
- WG on geo-information and information technologies

Benin

Système d'Information et de Suivi Environnemental (SISE)/ Environmental Information and Monitoring System (EIMS) – August 1996

Organizational Structure



1. Forum of Partners FP (Heads of involved institutions; 37 in 2002)
2. Steering committee SC (18 focal points) implement decisions deriving from the FP
3. Scientific and technical committee STC (5 high level scientist and technician) – analyses SISE products and report to FP and National Coordinator
4. National Coordination NC (SISE department of Benin Environmental Protection Agency) day by day activities; central budget execution
5. Thematic teams TT
6. Focal point FP: technician in charge of SISE in the member institution - data and/or metadata provider

SISE mission

To facilitate accessibility to environmental data and information for strategic planning and appropriate decision making for sustainable development actors

SISE objectives

- To produce (produce, collect, store, transform) basic environmental data
- To develop the legal framework for environmental information management
- To harmonize methodologies and standards of data collection and storage
- To promote the setting up of national data and information network
- To promote national expertise on environmental information production and management
- To develop tradable metadabases and information on regions for Environmental assessment needs, and for Programs and Projects development and management needs
- To develop user needs oriented tradable products
- To elaborate adequate indicators for environmental and social impacts assessment
- To publish specific reports and books on national environment
- To share national information through internet
- To sensitize decision makers and all other data user on the importance of liable data costs and usage

Membership

All public or private institution, or NGO or civil society who accepts the terms or SISE chart and ratifies it.

These include

- Environmental Protection Agency (mandated lead Agency)
- National Mapping Institute (IGN)
- Remote Sensing Center (CENATEL)
- National Institute for Statistics and Economic Analysis (INSAE)
- Meteorological Bureau (ASECNA)
- National Bureau for Mines and Geological Researches
- Laboratories of Climate, Biogeography, soil science (University)
- Benin Center for Scientific Research and Techniques (CBRST)
- National Oceanographic Committee (CNO)
- National Center for Natural Reserve Management (CENAGREF)
- National Institute for Agronomic Research
- Central Directorates of Ministries
- Three National NGOs
- One Subregional NGO (CREPA-Benin)
- Two privates(National Chamber for Trade and Industry, SERHAU-SA)

Working groups or task team

According to the chart, SISE comprises following thematic teams:

- "International Conventions" – lead by Directorate of Environment
- "Urban environment issues" – lead by SERHAU-SA (private enterprise)
- "Biodiversity and Tourism" lead by the Directorate of Forest and Natural Resources
- "Wetlands and Coastal zone" lead by Environmental Protection Agency
- "Library" lead by the laboratory of climate
- "GIS and Maps" lead by National Mapping Institute
- "Statistics and Indicators" lead by National Institute for Statistics and Economic Analysis

ANNEX III: EXAMPLES OF INSTITUTIONAL ARRANGEMENTS TAKEN FROM AFRICAN COUNTRIES

A few examples are necessary to show how institutional arrangements towards building a data community were (are being) initiated and conducted in Africa.

Senegal

In this country, the development of a National Geomatic Plan was the opportunity to start a dialog between the actors involved in geospatial data production and use. An inter-institutional task force was set up to prepare a Forum to discuss and adopt the National Geomatic Plan. This task Force composed of the following governmental agencies:

1. Ecological Monitoring Center,
2. Department of Geographic and Mapping Works,
3. Cadaster Department,
4. Land Development Department,
5. Planning Department,
6. Town Planning and Housing Department,
7. Water resources Management and Planning Service,
8. Canal du Cayor Survey and Development Mission,
9. Delegate Ministry in charge of Computer Science

The task force was in charge of:

1. preparing the terms of reference of the Forum,
2. identifying external experts
3. coordinating and validating a preliminary surveys with a view to writing a report on the status of geomatics in Senegal
4. select consultants and prepare their terms of reference
5. carry out the documentary research needed
6. implement a communication policy.

This example, though of a limited time-wise mandate, was taken because it was the first initiative to build synergy around the geoinformation activities in the country. Following this Forum which adopted the National Geomatics Plan in 1998, Senegal is now going through the process of implementing that plan. The latter makes provision, among other recommendations, for the establishment of an Institutional Framework for Guidelines. Once the guidelines are made available, the Framework is supposed to be coordinated by a "highly ranked body at decision making level, capable to boost dynamics and operation, in a

permanent search for synergy between the institutions and the sectors concerned". This institutional framework is supposed to contain all the necessary arrangements for leading the country towards the development of a type of national SDI. Since one of the Forum's recommendations was about "Private sector promotion, partnership and dissemination", there is hope that the Institutional Framework is not going to be exclusively governmental.

Tunisia

The country is considering starting national SDI development. As a first step, it is envisioned the elaboration of a National Geomatics Development Strategy, whereby a structured approach will be followed to plan the efficient contribution of geoinformation management to the national economy, including the clarification of geoinformation-related legal and institutional issues . In the meantime, priority actions contributing to the enabling environment need to be initiated, such as the enhancement of the national geodetic network by GPS measurements and capacity building operations.

A running program called the National Geomatization Program (GEONAT), started some five years ago, with a view to coordinating geoinformation management actions in Tunisia. The organizational structure of the GEONAT comprises a Coordination Committee involving 11 national level institutions. This institutional body is supported by a Steering Committee advising the Coordination Committee. Technical Committees are set up to provide technical advice to the Steering Committee on technical issues related to every specific action.

The private sector is likely to play a key role in the new vision, since the National Geomatic Development Strategy is envisioned through the principle of delegation whereby governmental and para-statal agencies call on private firms for the technical design and implementation activities on their behalf on the basis of a partnership agreement.

Kenya

The Survey of Kenya (SOK) took the initiative, with support from the Japanese Cooperation JICA, to start with the identification of key organizations in Kenya dealing with geoinformation (producers and users). A campaign of explanation of the SDI concept followed. Institutions from government, international organizations, academia, private sector were visited and short working sessions took place during which the concept of SDI was introduced and discussed, and the necessary explanations given. suggestions of potential institutions to include on the list were also recorded during these visits.

Following this, three SDI workshops were organized on November 2001, April 2002, and September 2002, with the contribution of organizations such as ECA, USGS, FGDC, GSDI, and ESRI. The first workshop attended by 55 participants from 30 institutions built consensus on the need to start a national SDI for Kenya. SOK was to assume the role of Kenya National SDI Secretariat. The second workshop allowed to agree on the structure of the national SDI Committees (Executive Committee, Steering Committee), and the working Groups (Standards, Legal, Education, Dissemination) and the definition of their respective ToR. In addition, participants enlisted on Working Groups of their choice, and an inventory of existing datasets started. The third workshop was a special one convened to reach a consensus and cooperation with related organizations that were to use the results of a proposed Large Scale Framework –Spatial Data Infrastructure (LSF-SDI) Project for the City of Nairobi under the Sponsorship of JICA.

The inventory of available data is going on with a view to build metadata for the clearinghouse. It is likely that the Working Group on legal issues will provide the basis for strengthening the institutional arrangements.

One concern though: the issue of the NSDI and its structure's sustainability when the JICA support stops.

Burkina Faso

This country has developed since April 2002 bylaws, a kind of code of conduct for the members of the national network of institutions involved in environmental information management, PNGIM. The bylaws have been in operation for a long time already and only need a formal endorsement by the authorities. This should take place shortly.

In summary, on collective liabilities, the bylaws state that:

Principle 1 Environmental information derived or generated using public funds (national or international) is de facto of public nature, and should be made accessible (except where national security may be at risk)

Principle 2 Environmental information shared over the Network is the collective property of the Network members. The latter commit themselves to respecting the code of conduct.

Principle 3 The members of the Network are collectively accountable for its active performance

Principle 4 The PNGIM may serve as an intermediary between two or more members of the Network for implementing a common program

Principle 5 Memoranda of understanding may be signed between the PNGIM and one or more members of the Network, or directly between members of the network for collecting, processing and disseminating environmental data and information

On individual liabilities, the bylaws state that:

Principle 1 The PNGIM being the result of governmental endeavour, all public institutions involved in environmental information management are de facto members of the Network. The Network is open to any other institution, provided that the code of conduct is formally observed

Principe 2 Every member of the Network is accountable for the reliability of the data and information made available on the Network

Principle 3 Every member institution is committed to regularly collecting, processing, storing and disseminating the data relevant to its expertise domain

On guaranty, rights, and duties the bylaws state that

Principle 1 privacy protection is guaranteed

Principle 2 Information carried over the network shall not create any prejudice to an individual or a corporate body

Principle 3 property rights, intellectual and artistic rights are guaranteed for every member of the Network

In addition, by the same bylaws every member of the PNGIM is committed to regularly informing the Network of its activities, and the data or information collected or generated. The members of the PNGIM meet twice a year. In every participating institution, two staff members are designated as focal point and substitute.

Namibia

SDI activities started in 1998 when the Infocom project was launched (although different terminologies were used, such as "Information services") with a view to making data available through the development of metadata, development of information portal (website) where the data are made freely available and the development of a resource centre. Following a duplication of efforts observed during the data collection phase, in relation to environmental indicators to use for thematic reporting on the state of the environment, a term review and a DEA stakeholder analysis in December 2000, the need to broaden the Infocom project's scope was revealed. Thus specific adjustments were made to the approach and workflow of the project, to include making information on environmental data available in the form of a metadatbase, and initiating and facilitating communication with and among data producing agencies as well as data users .

For the development of the metadatabase, a survey tool questionnaire on metadata issues was developed (following the FGDC metadata standard) , distributed by e-mail to all actors involved in environmental research or monitoring, followed by face-to-face interactions and a hands-on description of the datasets. This resulted in the effective availability of the metadatabase.

Regarding the initiation and facilitation of communication among and between data producers and users, a formal Environmental Monitoring and Indicator Network (EMIN) was established. Following an official contact and invitation letter sent by the Permanent Secretary of the MET to all the stakeholders (other ministries, NGOs, private sector), the first EMIN workshop was held in June 2001, with an attendance of 53 experts. Thus the EMIN was officially launched . The workshop also

- identified the EIS Unit as a key player in facilitating updates to the National Core Set of Environmental Indicators (NCEI) data through an interactive information system,
- decided that the EIS Unit and the EMIN would establish and manage a National Environmental Metadata
- mandated the MET to review and adapt its ongoing monitoring programs as well as monitor indicators that relate directly to the NCEI,
- decided that the monitoring work already being done by various public and private agencies on aspect of NCEI should be continued, and that reliable and sustainable mechanisms have to be put into place to allow for continued data flow and updating of the NCEI.
- recommended that the state of environment reporting process be linked up with other ongoing planning initiatives within the Namibian Government, such as the President's Vision 2030 and the National Development Plan (NDP).

A second EMIN workshop (EMIN II) was held in June 2002. It gathered 56 participants and resulted in a strong recommendation to set up a National Spatial Data Infrastructure (NSDI) Committee.

This recommendation was turned into reality and the NSDI Committee composed of 10 people met for the first time in February 2003. Its scope includes the establishment of:

- effective national data policies, strategies and organizational structures,
- procedures to foster and update ready access to information describing data available within ministries, NGO's and private sectors,
- a spatial data sharing programme to enrich national spatial data coverage, minimize redundant data collection at all levels, and create new opportunities for the use of spatial data throughout the country.

In addition, a specific role assigned to the NSDI committee is to provide guidelines/recommendations to the EIS unit and EMIN on:

1. Developing data standards and sharing policy/guidelines
2. Raising awareness about the value of metadata base
3. Developing/promoting human capacity for geographic information

Chapter 5

DATA POLICY

As a complement to the section "data policies and legislation" outlined in Chapter 3, this chapter explains what a data policy is, why it is important, explores the foundation of data policies and provides a few examples taken from Africa.

What is a data policy in the context of the SDI?

To explain a data policy, one has to go back to the fact that information is a meaningful conclusion derived from the processing of some data. Information policies are common: For example (1) TV channels are not allowed to show chocking images of injured people or dead bodies while reporting on natural disasters or terrorist attacks in the US; (2) In the context of a corporate body, an information policy will define the type of management information, the communication media to use, and the rules to be followed by the staff for that information to be shared within the various departments, sections and units of the institution, and with the outside world.

A data policy is more specific. In the SDI context, it constitutes the premises of a legal framework defining some basic principles specific to data, to be observed by individuals and institutions when generating, collecting, transforming, disseminating, and making use of data. Data in this case could be geospatial data, socio-economic data, policy data, etc.

While a distinction is to be made between information policy and data policy, it should be kept in mind that, during the SDI process, a piece of information may be used as an input to a further process, and therefore become an input data for that process. Consequently, it is sometimes difficult to draw a line between data and information, and therefore to clearly distinguish information policy from data policy in some cases.

Why data policies are important in the SDI context ?

In chapter 3 it was mentioned that some institutions refuse to share their data, either because of a restriction on these particular data, or because of the absence of a policy relating to provision of data altogether.

Even in the situation where a data policy exists, it may not have been ideally elaborated, i.e. in such a way that people apply it by consent and not by constraint. The data policy should be initiated with a clear understanding of why for example, some people and institutions are reluctant to share their data.

By nature, human beings tend to be suspicious about the quality of what comes from their neighbours, and, in the opposite, have confidence in the quality of their own produce. This feeling is not limited to individuals. Institutions too, develop the same feeling with regards to the outside world. It is understandable to be cautious about every relationship or partnership that could present

a risk for one own image, be it individual or institutional. This is particularly true when data exchange is involved.

From an institutional point of view, risks, virtual or real, are generally associated with the principle of sharing data :

1. as mentioned above, an a priori suspicion of the quality of third party data is common[1]. This generates a cautious attitude due to the false risk of deriving questionable information from the third party data;

2. another virtual risk arises from an a priori presumption that the institutions' own data (generally deemed of high quality by the latter) may be "wrongly" used if shared with a third party, or even that ownership thereof may be lost. This ends up in a paternalistic attitude characterised by attempts to find out in advance what the data will be used for by the third party;

3. some institutions may fear that other users discover the poor quality of their data by sharing them. Such a fear is likely to dictate a protectionist attitude with regards to sharing data, in an attempt to avoid the risk of deteriorating the image of the data owner institution.

The purpose of developing an SDI being merely to provide easy access to development information through data sharing, a sound data policy should look carefully at ways to remove the potential risks summarized above, so that the data producers be happy and confident in sharing their data.

All this shows how important the data policy is in achieving full participation of all stakeholders and their involvement and commitment to the SDI process.

Foundation of data policies

An insight in the historical evolution of information and data policies shows that they stem from the basic human right to freedom of opinion and expression thereof. Data policy is enshrined in the Universal Declaration of Human Rights which forms the basis of public access to information : Article 19 thereof stipulates that "*Everyone has the right to freedom of opinion and expression ; this right includes freedom to hold opinions without interference and to seek, receive, and impact information and ideas through any media and regardless of frontiers*". The World Resources Institute, in the framework of a study on environmental governance, compiled a document on existing data policy sources giving an overview of information policies in general, and environmental information in particular. (WRI presentation on Environmental Governance for Equitable Natural Resources Management at the USAID/WRI's Information Working Group Meeting in April 2001 in Washington DC)

This document shows that the human right to freedom of opinion and expression, was the basis and the reference for the drafting of constitutions and environmental information policies in various countries and institutions around the world.

Another important element that favoured the development of many data policies is Chapter 40 of Agenda 21 on "Information for Decision making" Two program areas are proposed in this Chapter for implementation, to ensure that decisions are based increasingly on sound information : (1) bridging the data gap, and (2) improving information availability.

[1] In the SDI context standards guide data collection and processing, while existing data (and new datasets) are documented, which removes the risk of poor quality data being accidentally used in decision making.

Examples of data policies in Africa

These main sources mentioned above, backbone of information/data policy initiatives worldwide, influenced a series of information policies. Following are a few examples of such policies:

- the Executive order of President Clinton on "Coordinating Geographic Data Acquisition And Access: The National Spatial Data Infrastructure" (1994)
- the Aarhus Convention on European public access to information, participation to decision making and access to justice in Environmental maters (June 1998)
- the Netherlands Government's Information Act (WOB) concerning public access to information
- the Global Terrestrial Observing System – GTOS Data and Information Plan
- the Biodiversity and Conservation Information System – BCIS Data Policy

Africa is not absent from the global « data-policy » picture. The following summarizes the best knowledge about data policy initiatives to-date in Africa :

South Africa : under the National Spatial Information Framework – NSIF initiative, a Spatial Information bill was developed (see Annex)

Nigeria : under the National Geo-spatial Data Infrastructure – NGDI project, a Nigerian National Policy on Geo-spatial Information was developed (see Annex)

Africover Under the FAO Africover Eastern Africa project, guidelines for custodianship were adopted. Data distribution and management is based on these Guidelines, whereas specific data access policies were developed in agreement with the National Focal Point Institutions (NFPI) for the different types of data sets. (see annex)

Benin In the framework of the SISEI (Internet –based Environmental monitoring and information system) project, an Information Charter was adopted to define the rights and obligations of the data providers and data users part taking in the SISEI network (see annex)

Burkina : The institutions members of the PNGIM (network of environmental data producers and users) drafted bylaws to regulate the process of data sharing within the network (see annex)

The table below shows how of few basic principles of data sharing, namely data ownership/custodianship, data discovery mechanism, and data maintenance are addressed in these examples of data policy in Africa.:

Data ownership/custodianship

South Africa	Data ownership is not explicit, but implied through clauses protecting "the copyright of the State and any other interested party". However, data custodianship is defined as follows : "a data custodian is an organ of state which is officially responsible for the capture, maintenance, management, integration, distribution or utilization of spatial information on behalf of the State and the public"
Nigeria	♦ "Ownership implies intellectual property right over a dataset by a body or individual." ♦ "A custodian is a body or person designated as having a certain right and responsibility for development and or management of spatial data. A custodian may have the right on behalf of the community to determine the condition for use, accessibility and distribution of data."

Africover	♦ Custodianship is seen by the AFRICOVER Steering Committee as being at the core of efficient and effective management and access to the **Multipurpose Africover Database on Environmental Resources (MADE)**. The principle of custodianship assigns to each National Focal Point Institution certain rights and responsibilities for the management of MADE on behalf of the relevant national country and its agencies. ♦ A custodian is a recognized contact point for the distribution, transfer and sharing of the information and has responsibilities regarding the maintenance and quality of the information. The custodian ensure accessibility to the information, and has the right to apply market conditions provided that this does not significantly disrupt accessibility
SISEI Bénin	♦ Data generated using public funds are by principle of public nature and should be made accessible, except where national security or institutional interest may be affected by such public access. ♦ Copyright, and intellectual property rights in general, are guaranteed for all institutional members. Implicitly data custodianship is recognized as well as data ownership.
Burkina Faso	Same as Benin above

Data discovery mechanism

South Africa	♦ "an electronic metadata catalogue which enables users to search for and gain access to spatial information". ♦ "An organ of state must capture and maintain metadata for any spatial information held by it. ♦ Metadata must conform to the standards and prescriptions referred to in section 17. ♦ An organ of state must ensure that metadata are available to users by – o including them in a manual on functions as described in section 14 of the Promotion of Access to Information Act, 2000; and either o establishing an electronic data base containing metadata for this purpose at the electronic metadata catalogue; or o making its metadata records available to the Department, in the prescribed manner, for inclusion in the electronic metadata catalogue"
Nigeria	♦ Every geospatial data producer shall provide metadata for each of its data holdings. ♦ Government, through the lead agency and in consultation with the NGDI Committee, shall establish electronic geospatial metadata catalogue and Clearinghouses in NGDI node agencies in partnership with those agencies

Africover	National Focal Point Institutions (NFPI) designated as custodians are responsible and accountable for …ensuring data documentation (conforming to ISO standards) is available so that datasets can be discovered through a metadata clearinghouse mechanism (and also website)
SISEI Bénin	♦ The Institutional Profile of the Environmental in Benin: a document detailing among others, environmental actors, their mandates, their products, the international agreements in which Benin is part taking, the national strategies, policy statements, etc. ♦ The SISEI website : particularly its search engine allowing the use of key words to retrieve information, the institutional data source giving, by field of operation, quick access to the WebPages of the contributing institutions, the thematic data source, giving access to classified environmental information, the Information and Products Data Source including metadata.
BurkinaFaso	A metadatabase fed and maintained according to the following clause : "All stakeholders involved or concerned with environmental information production are committed to inform the network of new activities undertaken in their respective fields, the data involved, and the findings resulting from their efforts,"

Data maintenance

South Africa	♦ "The Minister must, in consultation with the Committee, from money appropriated by Parliament for this purpose, establish and maintain an electronic metadata catalogue as a component of the SASII" ♦ "An organ of state must capture and maintain metadata for any spatial information held by it" ♦ "If an organ of state, other than a data custodian, captures or updates spatial information, it must only update the spatial information fields maintained by the data custodian and, within 30 days thereof, provide an electronic copy of those fields or records of the captured or updated information by the custodian, at no cost." ♦ "A data custodian of a base data set must, within 30 days of updating, furnish all updates of the base data set to the data custodian of a derivative dataset, in order to ensure synchronous maintenance of the two datasets." ♦ "A data custodian of a derivative dataset must update the dataset with reasonable promptness after receiving an update of the base data set, to avoid possible ambiguity in the spatial information presented." ♦ "A user or data vendor must, in terms of sub-sections (2) and (3), report any problem or shortcoming which in his or her opinion affects the quality of spatial information, within 30 days after discovering the problem or shortcoming, to the data custodian or data vendor who supplied the information." ♦ "The data custodian or data vendor must, subject to sub-section (5), respond, in the prescribed manner, to the user or data vendor within 30 days of receiving the report and such response must either convey the corrected spatial information or, if more appropriate, a reasonable explanation regarding the problem or shortcoming perceived by the user or data vendor."
Nigeria	♦ "Updating of these datasets [fundamental datasets] shall be done on a continuous basis but not later than five years after production." ♦ "All GI projects should contain in-built programme of data updating in line with policy item 5 above." ♦ "A custodian of a fundamental dataset must, not later than 30 days after updating, furnish all updates of the base dataset to the clearinghouse; the clearinghouse shall in turn inform the custodian(s) of the derivative dataset(s) within 7 days, in order to ensure synchronous maintenance of the fundamental and derivative datasets." ♦ "The owners of the datasets have responsibility to update their datasets when considered old in line with policy item 5." ♦ Efforts should be intensified on the operationalisation of Nigerian Satellites to provide stable primary data source for the production and updating of the relevant fundamental datasets. ♦ The producer of each dataset [Thematic dataset}shall ensure updating of the dataset on a regular basis as appropriate. ♦ A producer of thematic data who used a fundamental dataset as input shall only update the geospatial data fields produced and maintained by that particular producer. ♦ A custodian of a derivative dataset must update the dataset with reasonable promptness after receiving an

	update of the base dataset, to avoid possible ambiguity in the geospatial data presented. ♦ The custodian of a base dataset shall render all reasonable assistance to the data custodian of a derivative dataset to perform the updating contemplated in 6 above. ♦ The metadata of any dataset shall be updated whenever the dataset is updated. ♦ A user shall report any problem or shortcoming, which in his/her opinion affects the quality of a geospatial data, within 30 days after discovering the problem or shortcoming, to the clearinghouse. ♦ The clearinghouse shall convey the information to the relevant data custodian while denying access to the affected data until the producer has rectified the identified problem.
Africover	♦ "Custodian NFPIs must maintain plans for information collection, conversion and maintenance in conformity with the needs of users. Consequently they must liaise with Africover Steering Committee or an equivalent regional body that helps coordinate standards implementation at the regional level, clients and other affected parties when making any significant information management or dataset changes, so that the impact upon the user community and its clients can be assessed. The custodian NFPI is also responsible for negotiating the terms and conditions under which other agencies collect and maintain the MADE information on its behalf" ♦ "To achieve the purposes behind custodianship, NFPIs designated as custodians are responsible and accountable for: o maintaining the quality of the MADE information assigned to them e.g. accuracy, integrity, currency, and completeness o publicly declaring, through different facilities the status of MADE information concerning coverage, source and compliance with national and international standards." ♦ "User agencies receiving MADE information from a custodian should advise the custodian of any errors or omissions detected in the information received" ♦ "Where a user agency collects specific information on behalf of a custodian, it should do this according to the standard set by the custodian. User agencies are also obliged to pass the information back to the custodian for maintenance or storage free of charge." ♦ "User agencies producing information products from information which is the responsibility of another custodian agency should consider the passing back of the information product to the custodian as part of their agreement for the use of the information." ♦ "The user agency shall also pass on to the custodian information that has been improved or upgraded as part of this process. The custodian shall in turn ensure that that the improved or upgraded information is made available to any other users."
SISEI-Benin	"Every partner must ensure the regular updating of the information provided through its Web pages."
Burkina Faso	♦ "Every partner within the Network shall ensure the reliability of the data and information provided and is accountable thereof" [*maintenance implied*] ♦ "Every partner within the Network must undertake regular data collection, processing, storing and dissemination, in the limit of the field defined by its mandate". [*maintenance included*]

ANNEX 1: South Africa Spatial Information Bill

ANNEX 2: Nigeria National Policy on Geoinformation

ANNEX 3: FAO Africover Eastern Africa Guidelines for custodianship

ANNEX 4: SISEI Bénin : La charte Informationnelle

ANNEX 5: Burkina Faso : Règlement Intérieur du PNGIM

Chapter 6

GETTING STARTED

Introduction

Once the need for establishing SDI is acknowledged, it is necessary to set about developing SDI. There are many aspects of a coherent SDI, which may require attention, so how does one start? To return to the chess game metaphor of the introductory chapter: what are the tried-and-tested "opening moves"?

This chapter seeks to provide guidance to SDI implementers as to how to begin setting about developing the components of the infrastructure they require. Several of the elements to be developed have been described in previous chapters (policy development, partnerships and institutional arrangements), while the more technical components are covered in the SDI Cookbook. These details are not repeated here. This chapter then provides guidelines of how to begin given both the ideal situation/conditions, where there is wide support and adequate resources for developing SDI, as well as the less ideal - but perhaps more common – situation, where perhaps only certain elements can be developed due to limitations of resources or support.

Believing that a story may be worth a thousand theoretical frameworks, this chapter also includes illustrations of how SDI initiatives began in several African countries. These experiences are presented in the form of answers to the following basic questions:

- How did SDI activity begin in the country:
  - What were the drivers? I.e. what motivated the lead agency or partners to establish SDI?
  - Is there "an event" that marked the beginning?
- What activities were prioritised initially, and why?
- What has been the most visible or significant impact or outcome to date?
- Particular successes, as well as experiments which were less successful
- Lessons learnt from experience; what would you do differently now?

The perfect scenario

The ideal situation is one in which the SDI implementer has adequate dedicated resources at their disposal, and the support of all the relevant parties, who need to be involved to develop SDI, be they at political, managerial and technical levels.

A discernable pattern of broad steps, or stages, to developing SDI in general, is the following:

- A *consultative* phase, in which an understanding of and support for SDI is widened, and a deeper understanding is developed of one's requirements;

- A *defining* or *consolidating* phase, in which the goals of the SDI programme, as well as structures to guide its development are formulated and refined;
- The *phased implementation* of SDI, resulting in components of infrastructure becoming operational and finally, fully functional.

Note that the above steps are not fixed, may not necessarily follow in strict chronological order. There may be some overlap in time between these stages: for example, in refining ideas about the SDI programme, it may become necessary to repeat extensive consultation, or, once implementation begins, it may become evident that the goals of the overarching SDI programme or the structures supporting its implementation may need to be modified. There may even be a cycling through the steps: because there are bound to be ongoing changes in circumstances, both institutional and relating to technology, it may from time to time be necessary to review one requirements and how SDI is best implemented, requiring broad consultation with stakeholders once again.

These stages are described in more detail below. An alternate description of steps to developing SDI may be found in Box 1.

Box 1: Suggested steps by Prévost and Gilruth

(Adapted from *Environmental Information System in Sub-Saharan Africa; Post – UNCED series: Towards Environmentally Sustainable Development in Sub – Saharan Africa, Building Blocks for Africa*, Paper no. 12, Yves Prevost and Peter Gilruth, WorldBank, Washington, 1997.)

Note: These steps were originally formulated as those needed for creating "EIS National Policy"; however, the definition of EIS used, encompassing both institutional and technical factors, may be equated with SDI. The applicability of the suggested steps is neither limited to, nor specific to, "environmental" information.

Step 1: Promote the development of a national "community of usage", that is, the grouping of individuals and organizations interested in applying geo-information. The community should be as broad as possible, and not limited to the public sector. It will have the responsibility for promoting the awareness of:

- The potential of information in decision-making,
- The long-term cost of poorly organized information to national development, and
- The need to achieve wide consensus with regard to national policy.

Step 2: Create awareness of information availability and quality, by establishing an inventory of current data holdings, and disseminating the results to the information community, preferably using the Internet. This would lead to the establishment of a clearinghouse or co-ordination unit, responsible for maintaining and developing metadata catalogues and listings of environmental projects. The training of national staff may be required to be able to do this.

Step 3: Create awareness of database architecture issues (e.g. standards), through the construction of a data exchange and integration prototype. The prototype will identify the minimum set of standards to which databases must comply in order to be interoperable. This will also serve as a demonstrator. Training in database design and management may be needed. Expertise within the local private sector or universities may be available for this.

Step 4: Using the prototype results as a starting point, define a national environmental information policy, addressing issues such as

- Core data sets (defining their content, scale and required accuracy standards) which are a public good,
- Data custodianship for core data,
- Data access conditions,
- Setting priorities for the use of investment to build or upgrade core databases,
- Mechanisms for establishing and adopting data standards (e.g. standardizing place names) and
- Training priorities, with an emphasis on database design and management.

Step 5: Build the data infrastructure, requiring substantial investments in building the capacity of data custodian institutions to maintain databases.

Step 6: Develop applications in support of specific decision-making processes.

The consultative phase:

What happens during this phase?

As the name implies, the main component to this phase is consultation with parties who need to use geo-information, in order to develop a common vision for how geo-information collection and management can be co-ordinated, in order to bring the maximum benefits to the widest range of users possible. Apart from finding out what peoples needs are, this phase serves to . establish an understanding of SDI and wider support for participating in SDI. At this stage, the resources available may be extremely limited, so some effort should be directed to identifying how to fund the endeavour and raise support for it. Note that this phase may take a long time: for example, in Tunisia, there was a period of almost a decade between original ideas, perhaps broadly a consultative phase, and the development of a concrete implementation plan. Developing a common vision and understanding of SDI across many agencies, with different briefs, may simply take time.

Who is involved in this phase?

The consultation process may be initiated by a single "champion" institution, or, at very early stages, by an individual (or individuals) within an institution. Someone must have some idea what SDI is about, and feel passionate about it, in order to initiate action towards SDI. This initiating champion may play the leading role only during this phase – another institution may emerge as being more appropriate to act as lead agency, during the consultation process. All the key stakeholders, i.e. producers and user of geo-information, need to be – and feel – included in this phase. The stakeholder list may grow during this phase, as more players are identified in the course of interactions with stakeholders (see also the Annex "Participation Analysis" associated with Chapter 4 of this guide).

How is this undertaken?

Consultation and the promotion of the need for a co-ordinated approach to geo-information management may take place through a series of small meetings with individual stakeholders, or through workshops, or both. Depending on circumstances, it may be more appropriate to meet with a range of stakeholders on a one-to-one basis first, in order to stimulate their thinking, before convening a consensus-building workshop. On the other hand, information sharing may be more effectively achieved with a start-up workshop, after which there are follow ups with stakeholder institutions and individuals in smaller groups. Examples of both approaches may be noted in the "country stories" which follow in this chapter.

Because both consultation and a situational analysis generally require face-to-face meetings with many players, it may be efficient to undertake these simultaneously, i.e. meetings with stakeholders may be designed to do all the following:

- Promote the notion and understanding of SDI,
- Discover the geo-information needs of the organisation, as well as
- Gather information on the organisation's existing capacity, practices and geo-information resources.

Kenya provides an example of where meetings with stakeholders were used both to promote the concept of SDI, as well as learn what data the stakeholders already had and/or required.

6.2.2 Defining an SDI programme:

What does this entail?

An overarching framework for developing SDI needs to be set out, based on the findings of and opinion garnered in the consultative phase. The programme should have a clear identity and a name that ensures it is widely supported. This framework is needed to provide direction and coherence to perhaps many projects, which would be undertaken in parallel, and over several years. Elements to be included within this framework are:

- A vision of what the programme will achieve, and the benefits SDI will bring;
- The principles on which it will be developed (e.g. partnership relationships);
- The identity of the lead agency (see chapter 4 of this guide);
- The institutional structures needed to ensure that there is ongoing consensus in order to have buy-in, at both technical and strategic levels (Chapter 4 provides details on institutional arrangements). For example, one may constitute a
  - A steering body (this might be termed a "Steering Committee", "Board", "National Committee for Geoinformation Infrastructure" etc.), most likely chaired by the lead agency committee, to provide ongoing guidance at a strategic level;
  - Technical working groups (focussing on policy, data standards, clearinghouse development etc.);
  - A stakeholder forum.
- How the programme is to be funded, or even how future fundraising will be tackled (see Chapter 7 for further details);
- Milestones to be achieved in SDI development, along with the associated timeframes.

How does one draw this up?

Often it may be most efficient for an institution (most likely the institution which has played the lead role during the consultation phase) to be tasked to produce a draft document (or documents), which can serve as the basis for discussion at a workshop. Several iterations may be needed. There is need to gain support for the programme at both technical and strategic levels across various agencies. It is likely that different fora will be needed to gain support for the programme at these levels.

6.2.3 A phased implementation of Spatial Data Infrastructure:

As not everything can be done at once, there is obviously a need to draw up a plan for the implementation of SDI in phases. Targets and timeframes relating to specific activities and outcomes need to be established. A benefit of a phased implementation with well-defined milestones which can be reached at regular short intervals, is that the achieving of recognised objectives is likely to engender more support for the process, as well as keep those involved in implementation enthusiastic about the process.

In drawing up a timetable for implementation, some factors to be considered are the following:

- What outcomes will have the widest impact: what are the needs of users, and what are the (national) priorities?
- What projects are currently in progress?
- What resources, both human and technical, are currently available?

- What can be achieved relatively easily and quickly?
- How should certain developments be ordered? E.g. the development of some datasets may depend on the availability of other datasets, and developing a web map service clearly requires digital datasets to be available.

The less-than-perfect situation

Insufficient resources for implementation

Often, in defining an SDI development programme, it may become apparent that the resources available for SDI development are simply not sufficient to undertake development in the "ideal" way. Worse still, resources may not be available even to define an SDI progamme at the level of detail desired. While efforts should continue to raise additional resources (more ideas on this are presented in chapter 7), it is not necessary to stall all SDI development until additional funding, or human resources, is obtained. There may thus be a need to begin with developing only some elements of SDI, for which the moment is opportune. Development may simply take place over a longer period than was anticipated.

In this case, it is important to examine even more carefully how one intends to phase development of SDI. In addition to the considerations listed in the preceding paragraph, further questions which could be asked, in order to establish priority projects, are the following:

- What can be achieved without much funding?
- What are the relatively low cost, but high impact activities that can be undertaken? e.g. the creation of an e-mail list server for sharing information (instead of convening face-to-face meetings), or a web-page for communicating developments and encouraging ongoing discussion
- What emerged as the *priority* needs of users of geo-information during consultation with stakeholders?
- Are there any activities, which may result in outcomes, which would be likely to assist in motivating for additional funding?
- Are there sub-regional, regional or global programmes of activities, which could be harnessed to contributing to building national SDI?

Lack of support for SDI by all stakeholders

Even more difficult to deal with than having inadequate resources, is encountering less than ideal support for SDI from all the relevant stakeholders. During consultation with stakeholders, it may become apparent that one will not immediately be successful in gaining the support or understanding of certain agencies, or senior decision-makers. In this case, it is likely that there will also not be adequate resources available for SDI implementation, and it may not be possible to develop a widely-supported framework for SDI development.

Nevertheless, it may still be possible to make gains in SDI. Sometimes, going ahead with activities produces results that makes other parties want to come on board. An example of this is the decision by Namibia's EIN unit to make datasets available through the Internet: by going ahead and doing this, other organisations followed suit in due course.

The questions listed above become even more pertinent, and in addition, one should perhaps concentrate on the following:

- Who are the supporters of SDI? Is there a particular sector, where there is support for a co-operative approach to developing SDI? If so, it makes sense to (temporarily) narrow one's focus to this sector, in order to make tangible gains.
- If the "perfect plan" can't be realised, what is achievable? Focus on what can be done. For example, obviously documenting all existing geo-information resources is the ideal, but if it is not possible to document all legacy datasets, begin by ensuring that all new datasets developed, or all datasets that are updated, are documented at the time of production or updating.

Using a project as a catalyst for an SDI programme

In many ongoing SDI related initiatives in the continent, the activity itself started after the implementation of specific project which brought out the need for partnership, data sharing etc., and thus the need to set up NSDI. An example of this is the undertaking of the "Country-at-a-glance" activity by Ghana. Another example is presented in the case of Namibia, where the Infocom project highlighted the need for greater co-ordination with respect to data collection and dissemination.

It may even be possible to incorporate the building of a component of SDI into an existing project. An interesting case in point is presented by Nigeria's experience, where it proved possible to reconfigure a government-approved project, to contribute to building national SDI.

The caution in using a project to catalyse SDI activity is that this still leaves the need to think of the long-term sustainability of SDI development (the focus of chapter 7), i.e. what will happen when the project funding terminates.

Possible "opening moves"

Ideas regarding specific facets of SDI development

Some ideas are given below, as to how to begin to develop various aspects of SDI. These activities may be integrated into a phased implementation, or may be tackled while one is still waiting to be able to embark on a formal SDI programme. This list of possibilities is certainly not exhaustive, and should rather be viewed as an aid to stimulating ideas, appropriate within one's country context, on how to begin to enable wider and more effective use of geographic information.

- *Getting institutional arrangements and partnerships working:*
  - Start with the willing partners: this may even involve bilateral arrangements only, around data sharing or co-operation with respect to data updating, for example.
  - Establish informal (if need be) working groups – call this a "GIS user group" or "GI user group" - at a technical level, for sharing information about projects being undertaken within ones agencies, or experience in managing geographic information, on a regular basis.
- *Policy development:*
  - Start developing a data policy for one's own institution, or component within the institution.
  - Establish MOUs relating to data sharing or data management and production partnerships with individual institutions as and when the need arises, if relevant overarching policy and legislation is not yet in place. Make use of existing MOUs (e.g. those developed in Zambia), in order to fast track the drafting of an MOU.
  - Instead of developing policy from scratch, use other examples of policy documents, to raise awareness and stimulate discussion on the elements needed in a policy framework for one's country. For instance, an informative workshop could be convened to discuss existing policy

documents generated by other African countries (e.g. Nigeria's Geoinformation Policy, South Africa's Spatial Information Infrastructure Bill, Uganda's SDI decree).

- *Metadata:*
  - Start by capturing one's own metadata, using free metadata capturing tools.
  - Demonstrating how metadata within a clearinghouse can be used to locate data sets one requires, can be very powerful demonstration of the benefit of capturing metadata. If you are unable to establish your own clearinghouse, you can still publish your metadata by registering a node with an existing clearinghouse, or, in the short term, until capacity allows you to undertake this yourself, even by providing the metadata to some other agency, which can publish it (e.g. ECA) on your behalf.
- *Geospatial data development:*
  - Explore opportunities provided by global or regional initiatives, if national resourcing is limited.
    - For example, there are 23 African countries participating in Global Map (as at March 2003), which produces 8 standardized digital thematic layers (these are: boundaries, drainage, transportation, population centers, elevation, land cover, land use and vegetation), at an effective scale of roughly 1: 1 000 000 (see http://www.iscgm.org). Kenya is one of twelve countries worldwide, to have completed their national datasets.
    - Another example is the Africover project (see http://www.africover.org), which has seen the completion of datasets pertaining to several African countries already.
  - Prioritise the development or updating of one or two datasets likely to be most widely used. Once developed, these will have the most visibility and are likely provide the greatest benefit. For example, the Corporate GIS Division of the City of Johannesburg, on the basis of the information required by the most departments within the municipality, decided on a few key datasets to provide through the intranet. This focus ensured that a system, which was of use to many people, was available in a much shorter time than it would have taken to compile and publish everything on the wish-list.
  - It may be possible to obtain some base datasets on one's country from outside the country, and use these as a starting point from which to develop one's core geospatial data.
- *Standard development and implementation:*
  - Choose software products which comply with international standards e.g. those which web map server interface
  - Adopt or adapt existing standards where possible, rather than trying to develop one's own from scratch.
  - Explore opportunities provided by global or regional initiatives (e.g. the AFREF project – see http://w3sli.wcape.gov.za/SURVEYS/MAPPING/afref.htm)

Considerations in choosing "opening moves"

Here are some considerations in selecting activities, with which one can begin implementing SDI. Once again, while not ideal, it may be possible to embark on some activities before one has a formal, funded SDI programme.

- Tangible products have a clear motivational power, that is, it is ideal to find something that can be achieved (preferably in a relatively short time), with a well-defined and clearly visible outcome. For example, one might consider tackling metadata publishing, web-site

development or a half-day workshop to raise awareness of SDI concepts and share information about developments taking place within various agencies.

- Establishing communication and networking channels can offer high impact for relatively little effort, e.g. the creation of an e-mail list server for sharing information, or the creation of a web-page; the web-page(s) may even be created as part of an existing web-site.
- It is helpful to be on the lookout continuously for opportunities provided by current national issues, e.g. drought etc.
- It is also helpful to be aware of opportunities presented by externally driven and funded projects.
- It may be possible that a particular sector is more ready to begin addressing its information infrastructure needs in a systematic way. In this case, it does no harm to begin with this sector: many characteristics of the information infrastructure developed will have a broader application to other sectors.
- Consider going ahead and developing (small scale) demonstration projects or prototypes, in order to attract further support. Often a demonstration may prove more effective in drawing out support, than a beautifully written description of what one intends to do, along with a clinical description of the associated benefits.

African experiences of the early stages of SDI development

It may be helpful to study what has happened in various countries in Africa with respect to SDI development. Narratives, as recorded by people who have been or are directly involved in these efforts, are provided in full in the appendices and/or at their respective websites. Some early SDI experiences are summarised below.

These records of early SDI implementation experiences illustrate the point that there have been many different perspectives or points of departure with respect to initiating SDI development. In particular, a range of different drivers for embarking on SDI development, that is,. factors used to motivate the need for SDI, are evident in the examples set out below. Even so, there are remarkable similarities in the kinds of approaches that have been aken towards developing SDI. While there are many parallels between the needs of countries with respect to SDI, it is important to note that each country is unique – in terms of both its history and geography – and that an understanding of one's country is the key to determining the best way to proceed - what will succeed, and how it should be tackled.

Burkina Faso

How did SDI activity begin:

What were the drivers?

SDI activities in Burkina Faso started in the early 90's, driven by the high demand for sound, reliable and up-to-date information on natural resources, human activities etc., in order to work out and implement the National Environmental Action Plan.

Is there "an event" that marked the beginning?

At a national level workshop held in Bobo Dioulasso (2nd major town in Burkina) in May 1991, it was decided to create the National Environmental Information Programme (in French, Programme

National de Gestion de l'Information sur le Milieu, PNGIM) to act as a network to coalesce and co-ordinate all the initiatives in data collection, processing, dissemination and updating.

What activities were prioritised, and why?

At the workshop, it was decided to:

1. promote the use of common geo-information and thematic data in digital format as reference data (the national topographic database at scales of 1:200,000 and 1:1,000,000, national database on towns and settlements, land use and land cover etc.);
2. update certain old databases (water bodies and drills database) and create several new databases (estate owned forest resources, forest species);
3. increase the visibility and accessibility of all the available data by creating a metadata database called ENVIDATA;
4. train more and more people in GIS, remote sensing, traditional and modern techniques of data collection, processing, dissemination and updating.

Most public/noticeable impact to date?

1. Better visibility and accessibility of data and information to the former members of the PNGIM network;
2. Better use of available, standardised and useful information and better decision making;
3. Increased aspiration for having one's own information system, due to the increase in human resources.

Particular successes, as well as experiments which were not successes?

Other successes:

1. Greater enthusiasm for providing information and working in multi-disciplinary groups;
2. Better contribution to the PNGIM goals.

Difficulties:

1. Reluctance of data providers to share information directly, free of charge, with anyone, without a formal request and the procedures of the PNGIM co-ordinating body ;
2. Difficulties in updating and creating more accurate and useful reference data and information due to poor financial, logistic and human resources;
3. A lack of a formal approach to making decision makers more aware of geoinformation, due to poor financial, logistic and human resources.

Lessons learnt / what would you do differently now?

1. Data and information must be produced, disseminated and updated by the core agencies with expertise in the relevant discipline;
2. A ministerial decree or even a law is necessary to regulate and promote data and information flow, and define the benefits associated with and limitations of data ownership;
3. Promoting and supporting a national level network can advance the setting and using of standards, harmonising and co-ordinating initiatives, and raising key issues at a high decision-making level.

Kenya:

How did SDI activity begin?

The Survey of Kenya identified key institutions dealing with geo-information, both producers and users of spatial data, encompassing national government institutions, regional and international organisations, educational facilities and private sector institutions. Each institution was contacted through letters, telephone, faxes or e-mails. Appointments were made with these stakeholders to explain "NSDI", as well as learn about the organizations, and what type of data they had. Subsequently three national SDI workshops have been held (November 2001, April 2002, September 2002), to advance structures for developing SDI. SDI development is at an early stage in Kenya.

What were the drivers?

NSDI in Kenya is one of the most important and urgent tasks for the country to meet the ever-expanding demands for accurate and up-to-date geo-information, achieve effective good governance, realize sustainable development of the country and tackle poverty eradication. The Government of Kenya, through its current National Development Plan 2002-2008, is implementing an initiative for the establishment of NSDI, for the efficient management of geo-spatial data in the country.

Lessons learnt from previous experiences?

Previously it was found that it was difficult to try to inject geo-spatial considerations into general ICT policy.

Namibia:

Namibia began exploring the idea of sustainable development soon after independence in 1990. It marks a commitment by the Namibian people to meet their own needs without compromising the ability of future generations. In January 1998, the Directorate of Environmental Affairs (DEA) of the Ministry of Environment and Tourism (MET), jointly with the Government of Finland, launched a four year (1998-2001) national programme entitled Information and Communication for Sustainable Development (Infocom). The overall aim of Infocom is to promote sustainable development in Namibia through:

- Developing an effective Environmental Information Systems (EIS) Unit within MET;
- Developing communication mechanisms to disseminate environmental information.

How did SDI activity begin?

SDI activities in Namibia began in 1998 when the Infocom Project was launched. However, different terminologies such as "information services" were used. The whole ideas of making data available through the development of metadata, the development of an information portal where the data are made freely available and the development of a resource centre in essence represent the implementation of SDI.

Infocom started with defining environmental indicators. These indicators were defined on the basis of the thematic reporting of the state of the environment. For each indicator defined, a set of data were collected (or efforts were made to do so). As the indicators were defined thematically and there was little communication amongst data producing agencies as well as data users; the process of data collection allowed duplication of efforts. Thematic groups ended up collecting similar data sets, as many of the indicators were cut across the thematic domains.

It wasn't until Infocom's term review (December 2000) and a DEA stakeholder analysis (December 2000), that Infocom realised it had to broaden its scope. Both the Project's term-review and the DEA stakeholder analysis indicated that lack of easily available, up-to-date and reliable data was a big problem in environmental decision-making in Namibia. The team therefore, altered their main Project components and work plan, which was adopted by its Steering Committee (SC) in 2001. The new approach emphasised the following:

- The team will strive to make available and manage environmental data through a meta-database.
- The team will strive to initiate and facilitate communication with and among data producing agencies, as well as data users.

What were the drivers?

The Directorate of Environmental Affairs (DEA) of the Ministry of Environment and Tourism (MET) was concerned to make information available and accessible to decision-makers and the Namibian community at large.

Is there 'an event' that marked the beginning?

The letter from the Permanent Secretary of the MET to other permanent secretaries advanced the interest of stakeholders who attended the first Environmental Monitoring and Indicator Network (EMIN) workshop. This workshop, held in June 2001, was officially opened and closed by the MET Deputy Minister and the MET Permanent Secretary respectively.

Most significant achievement to date?

All data produced within EIS are being made freely available online. (see http://www.dea.met.gov.na/programmes/infocom/EMIN%202.htm). This includes the actual data and their metadata. Other data collecting departments/agencies have adopted the same approach, to make their data available and accessible through internet. See DRFN for example (http://www.namibia-desertification.org)

Lessons learnt through Infocom?

- Need to develop the trust and support of the community
- Need to build local capacity
- The right information products need to be developed, in order to resonate with policy – and decision-makers
- There is a need for an overarching framework, to align parallel projects working towards the goal of improved access to better data, which outlasts short-term projects.

See the document "Namibia SDI Narrative" for more information, and the Web-site of the MET, http://*www.dea.met.gov.na* .

Nigeria:

How did SDI begin?

Nigeria has recently been able to obtain resources to begin SDI development, through reorienting a funded project, the Integrated Resource Management System (IRMS)/National Geographic Information System (NAGIS), when it was transferred to the National Spatial Research and Development Agency (NARSDA) for implementation. NARSDA initiated consultation with experts and stakeholders, leading to the decision to refocus the project and begin implementation of a National Geospatial Data Infrastructure.

What are the drivers?

Duplication of effort is a concern, while the lack of accessibility and lack of standardization of data inhibit its use. It is interesting to note that concerns about possible duplication of mapping efforts lead to the promulgation of the Survey Co-ordination Act as long ago as 1962, which has served to promote the co-ordination of the activities undertaking by Surveyors General at state and federal levels.

First activities?

In November 2002, the Honourable Minister of Science and Technology inaugurated a 10-member committee to draw up a draft National Geoinformation Policy, within three months.

Events?

Stakeholders, at a workshop held in Abuja, in February 2003, considered this draft policy. In November 2002, a workshop was held on Geospatial Data Infrastructure for all the federal and state Surveyors-General and senior staff of NARSDA.

Lessons learnt?

The report developed through an initiative in 1990 to develop a Land Information System was never implemented, with lack of funding the apparent reason. A move was made to resuscitate this initiative in 1996, but after the initial establishment of a National Geospatial Information Infrastructure forum and a start on the compiling of an inventory of the country's geospatial data resources, this effort also died away, due in part to lack of funding, as well as a change in administration. These experiences illustrate the importance of committed funding, as well as the need for commitment of individuals who play key roles in the stakeholder organisations.

See also the document "FinalNigeriaGIPolicy.pdf"

South Africa:

The National Spatial Information Framework (NSIF) (it will be known as the South African Spatial information Infrastructure (SASII) in the future) represents South Africa's SDI initiative. The Department of Land Affairs dedicated staff and funding to developing the NSIF in 1997.

How did the SDI activity begin:

What were the drivers?

The main concern of the Department of Land Affairs in initiating the NSIF was that of the duplication of digital data capture by government departments.

Is there an even that marked "the beginning"?

Most of South Africa's geographic information community would have seen a one-day workshop held in February 1998 as the birth of the National Spatial Information Framework (NSIF). This workshop was designed both to raise awareness of the need to develop SDI, as well as to instil confidence in stakeholders, that the Department of Land Affairs as lead agency, would undertake SDI development in a consultative way. Considerable care was taken to advertise the workshop as widely as possible beforehand, and afterwards to ensure that all the commitments made at the workshop were fulfilled.

What activities were prioritised initially, and why?

Early on it was recognised that the development of geographic information standards and a policy framework would take some time due to the necessity of a comprehensive consultative process. It

was thus decided, that while standard and policy work was initiated, that there would be a strong focus on getting metadata captured and published through a clearinghouse. It was also decided, in the interests of having highly visible results as soon as possible, that the free software developed and made available by the FGDC for metadata capture and a distributed catalogue should be used.

Most significant achievements to date?

- Spatial data pricing policy has been revised, with data now available at the cost of media only.
- Also at the level of policy, the Spatial Information Infrastructure Bill is well on its way to being passed as an Act of Parliament.
- Several standards nearly have the stamp of "national standards".

Other successes, difficulties, lessons learnt?

- The convening of quarterly seminars in different centres across the country proved very valuable in garnering support for the NSIF. Allowing participants to share information on the management of spatial information in their institutions proved more motivating, than using the meetings to present explicitly the aims of the NSIF.
- A significant number of metadata records are available through the clearinghouse, which was established in 1998. However, it has proved difficult to get people both to capture and to update metadata records.
- The importance of sufficient personnel to be able to advance SDI is illustrated through the fact that a similar programme, the National Land Information System, which was a precursor to the NSIF, was not able to make significant impact, due in large part to a lack of human resources.
- Sometimes it is necessary to go ahead and do things, rather than waiting for things to happen…

For a more detailed account, see other documents in the country information folder.

Uganda

The first extensive creation of digital geographic databases took place under the National Biomass Project. There was a growth in the number of users of the products generated by the Department of Forestry and Surveys and Mapping through this project. The National Environment Management Authority established an Environmental Information Network (EIN), with both "horizontal" (between national agencies) and "vertical" (within sectors from national to district level) components. EIN set up a data standards and training committee, but not much progress was made with respect to co-ordinating data capture and updating activities. The government, through the Ministry of Finance, Planning and Economic Development (MOFPED), realised that GIS is an effective tool for monitoring and improving service delivery in the government's efforts to eradicate poverty. MOFPED established a National GIS Task Force to oversee the development of a National Spatial Data Infrastructure.

How did SDI activity begin:

Is there an event that marks the beginning?

The World Bank provided funds for a study to design and develop National Spatial Data Infrastructure. An SDI Master Plan was developed in April 2001 and awaits implementation.

The development of the Karamoja Information System through the Karamoja Data Centre, may be seen as a local SDI prototype for National SDI.

What were the drivers?

The need for information to manage the environment, as well as plan effective utilisation of the country's natural resources, together with the need to improve service delivery through effective monitoring of government projects and programmes, rallied the following groups:

- Local experts with GIS training
- Donors
- External Consultants And Consulting firms.

Most public /noticeable impact to date?

Improvement in the production of the District Development Plans for Moroto District, leading to an improvement in service delivery.

Zambia:

In 1997 the government of the Republic of Zambia embarked on the Environmental Support Program (ESP), consisting of various investment components to stimulate widespread interest and investment in environmental and natural resources management, within a framework of economic growth. The programme is being executed through a number of ministries, agencies and local communities and is supported by the government of Zambia, as well as a number of bilateral and multilateral donors. One of the four investment components of the ESP is the Environmental Information Network and Monitoring System (EINMS). EINMS's main objective is to increase the availability and accessibility of environmental information to various stakeholders, in order to assist in the implementation of ESP.

How did SDI activity begin?

The SDI activity began by carrying out a needs assessment of EINMS by all key institutions with a bearing on environment and natural resources in Zambia. This assessment indicated the role each institution would play in EINMS. A national stakeholders meeting was convened by the Vice-President of Zambia to introduce ESP and its components. The meeting also discussed the role of each institution in the implementation of EINMS activities. An EIS/GIS capacity assessment of the key data centres in Zambia was then undertaken to identify the critical issues in EIS/GIS. These included capacity building, hardware/software issues, data exchange issues and data availability and usage in these institutions.

Is there 'an event' that marked the beginning?

The initial stakeholders meeting that was chaired by the Vice-President of Zambia helped to kick start the process. However, several players have kept the initiative alive.

What were the drivers?

The business driver was the environmental agenda that sought to increase the availability and accessibility of environmental data in decision-making. What is common throughout the various sectors where environmental degradation is a problem, is that relevant data and information are very scarce, and where it exists, it is not in a format that facilitates its integration with other data. It is therefore important to establish a mechanism to generate needed data , harmonize it and make it available, in order to decrease the rate of environmental degradation, particularly for rural communities.

Most visible/noticeable impact to date?

- Mapping standards are being used widely by most institutions.

- Digital base maps have been used by various institutions to produce thematic maps.
- Capacity building in GIS /RS has taken place.
- There is collection, collation and processing of data from various institutions to assist rural communities to develop fundable micro-projects.
- There is a voluntary co-operation of parties, on the basis of MoUs.

Chapter 7

FUNDING MECHANISMS FOR SDI IMPLEMENTATION IN DEVELOPING COUNTRIES

Introduction

Previous chapters have focused on providing practical guidance to SDI implementation based mainly on the actual African experiences of individuals and institutions. The nature of this chapter is different in that it presents a more conceptually biased view on the funding of SDI implementation in developing countries. This is in part due to the fact that there are no 'tried and true' mechanisms for funding SDIs in developing countries. Implementation of SDIs in these countries varies from infancy stage to early development phase.

If an SDI is to be implemented in a timely and efficient manner, funding mechanisms must be in place to assist in the structuring of the short and long term financing of each component. In this chapter the term "funding mechanisms" is used to refer to both funding and financing instruments. It should be noted that funding mechanisms are not universal; the implementation environment of individual SDI may differ, requiring adjustment to the mechanisms. However, conceptual funding mechanisms can become very important to SDI development as they can assist program coordinators in developing, analyzing, and simulating strategies for funding the implementation of their SDIs.

The usage of funding mechanisms to facilitate SDI implementation in the general information society is significant but the usage of these mechanisms is even more important in developing nations [Giff and Coleman, 2002]. Developing nations are usually influenced by the negative effects of having very limited financial resources, poor capital markets, and inadequate political structures [IIPF, 2001]. These and other factors will make infrastructure financing which on its own is a formidable task an even more complex problem in developing countries. Funding mechanisms is one of the tools available to SDI program coordinators in addressing this problem.

The aim of this chapter is to provide SDI program coordinators of developing nations with a guide on how to access, structure and develop funding and financing mechanisms for SDI implementation. After an overview of funding mechanisms and their importance in SDI implementation, this chapter reviews the funding mechanisms used for SDI implementation in the developed world. The authors then analyse the implementation environment of developing nations and determine whether or not current funding mechanisms are applicable. The chapter closes with proposed funding mechanisms for the environment of developing nations and a summary of the key points associated with the development of funding mechanisms for SDI implementation in developing nations.

Background on SDI Funding Mechanisms

An SDI creates an environment that facilitates access, sharing and the dissemination of spatial information. The importance of having readily available spatial information in the required format is well recognized by the stakeholders of the spatial information community. The challenge

therefore, is to sell the importance of spatial information — stimuli of economic growth, facilitator of good governance, enabler of more efficient natural resources and disaster preparedness management, key component of environmental management, and a useful tool in formulating and implementing national defense strategies — to the financial arms of the public and private sectors, and international funding agencies.

Selling the concept of an SDI to Financiers

Successful implementation of an SDI to some extent depends on ability of the SDI community on selling the benefits/gains of an SDI to the financiers. The main prospective financiers of SDI implementation in developing nations are governments, and international funding agencies. Therefore, methods must be developed to effectively sell the benefits of an SDI to the different groups. In selling the concept of an SDI to financiers, SDI program coordinators should emphasize the benefits of interest to the targeted financier(s).

A suitable technique for convincing the relevant public sectors in developing countries to invest in the implementation of an SDI is to classify spatial information within the realm of a public good. For a product or service to be classified as a pure public good, it must exhibit the essential characteristics of non-excludability and non-rivalry [IDS, 2001]. The term "non-excludability" means it is either impossible or not cost efficient to exclude those users who do not pay for the good from consuming it. The term "non-rivalry" is used to refer to the characteristic that any one person's consumption of the public good has no effect on its availability to others for consumption [IDS, 2001].

Although spatial information posses some of the characteristics of a public good, questions do arise as to whether or not it is a pure public good. Authors (e.g. Masser, 1998; Onsrud, 1998; and OXERA, 1999) have done extensive research reviewing the classification of spatial information within the categories of a "resource", "commodity", "asset", "public common" or "public good" without producing a clear-cut classification. Adding to the complexity of classifying spatial information as a pure public good is the ability (through the use of technology) of the custodians to vary the properties of "non-excludability". This ability to vary the non-excludability characteristic of spatial information excludes it from being classified as a pure public good. For this reason spatial information may be classified as what Love (1995) defines as a "quasi-public good". A quasi-public good falls in the intermediate category of public and private goods (Figure 1).

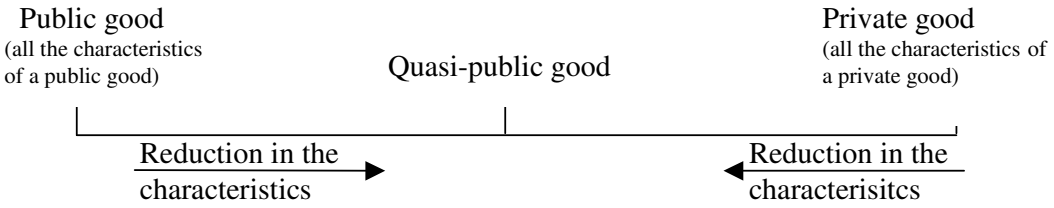


Figure 1: An illustration of the relationship amongst private good, public good, and quasi-public good

There can be varying degrees of quasi-public goods, depending on the quality of the characteristics of either end of the scale the good possesses (Figure 2). The closeness of the quasi-public goods to either the "public" or "private" end of the spectrum will be a function of the implementation environment.

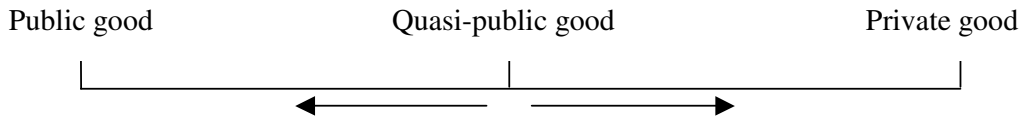


Figure 2: An illustration of the varying degree of quasi-public good

Classifying spatial information as a quasi-public good strengthens the concept of including the private sector, the public sector, and the civil society in general to assist in the financing and promoting of SDI implementation [Groot and Georgiadou, 2002]. This is plausible since, as a quasi-public good, spatial information will require government intervention for the provision of the public good aspect of spatial information and the private sector will enter the market to capitalized on the ability to make a profit based on the private good characteristic of spatial information. Therefore, the quasi-public good concept facilitates both private and public sector investment in the creation and dissemination of spatial information.

The Need for Funding Mechanisms

Funding mechanisms are essential tools for SDI implementation since, without proper financing, it would be impossible to efficiently implement and maintain an SDI. These mechanisms facilitate SDI coordinating agencies in analyzing and managing the financial needs associated with the implementation of an SDI. If an SDI is to be implemented efficiently, funding mechanisms must be in place to address the entire life cycle — development phase, implementation phase, and maintenance phase — of an SDI. These funding mechanisms will serve as a guideline to SDI coordinating agencies on how to integrate, formalize, structure, present and source financing for the development, implementation and maintenance. This is achieved through the analysis, testing and modelling of the funding mechanisms under different circumstances. The results of this type of analysis should provide the answers and or guidelines to such questions as:

- Where and how to seek out funds?
- What are the relationships amongst the different funding components?
- How best to present the funding arrangement to Governments and Financial Institutions (both international and local)?
- How funds should be structured to facilitate efficient implementation (i.e. the different phases and component(s)?
- Over what period will the funds be disbursed? and
- What are the effects of funding on pricing policies?

If funding mechanisms are in place that are capable of providing answers or guidelines to the above questions then it will be easier for program coordinators to plan for the long term implementation and maintenance of an SDI.

Funding Mechanisms for SDI Implementation

The majority of the developed world (e.g. Australia, Canada, Germany, The Netherlands, United Kingdom and The United States) are now in the process of implementing the next generation of their SDIs. An important aspect of the general implementation strategies adopted by the developed world is the funding mechanisms component. Researchers have investigated this component of SDI implementation and the results (funding mechanisms) can be seen in the publications of for

example, Beerens and de Vries, 2001; Fries et al., 2001; Giff and Coleman, 2002 and 2003; Rhind, 2000; and Urban Logic, 2000.

The funding mechanisms proposed by the above authors were mainly designed for SDI implementation in developed countries. These implementation environments normally consist of vibrant economic climates of which the geomatics information sector provides on average 0.5% of GNP [Tveitdal, 1999]. This and other favourable factors of the implementation environment of the developed world allow the funding mechanisms to be developed with a good mix of public and private sector components. Also the majority of the next generation of SDIs will be beyond the status of marginal cost providers and thus, will be more suitable to commercialization (e.g. the creation of value-added products and services) [Giff and Coleman, 2001].

Funding Mechanisms for The Next Generation of SDIs

This section attempts to categorize current and proposed funding mechanisms according to the emphasis placed on whether or not spatial information as a quasi-public good is closer on the scale to a public good or a private good (Figure1). The categories proposed by the authors are funding mechanisms for quasi-**public** good (emphasis on public good) and funding mechanisms for quasi-**private** goods (emphasis on the private aspect of spatial information [i.e. a commodity that can be traded for profit]).

Funding Mechanisms for SDIs Classified as Quasi-**Public** Goods Producers

In this category spatial information is considered by the developers of an SDI as more of a public good than a private good and therefore, government policies will significantly influence the funding mechanisms due to characteristics of public goods (e.g. externalities, the creation of monopoly, and its necessity to facilitate the normal activities of the average citizen and government). Funding mechanisms more suitable for this category includes:

- Government Funding — defined by Rhind, (2000) as funds derived mainly from general taxation (i.e. funds set-aside from government's budget)
- Special Taxes — taxes imposed on either goods or services for the specific purpose of financing SDI implementation [Giff and Coleman, 2003]
- Public Sector Funding —through fees charged to customers by public sector bodies [Rhind, 2000]
- Special banks or financial institutions established to underwrite low interest loans to the public sector for the investment in SDIs [Urban Logic, 2000]
- The issuing of medium and long term tax-free bonds specially targeted at (for example) large public and private spatial data user and spatial data software developers
- SDI funded through partnerships — example federal government and state government
- Responses to declared emergencies, special projects funding and/or alignment with central/state government financed special initiatives – This model offers SDI coordinating agencies the possibility of:
    1. Ensuring that data is collected in a manner suitable for sharing
    2. Advising stakeholders on the implementation of local GISs generated from the project (ensuring they supports interoperability)
    3. Accessing funds to implement SDI components that support the project(s) goals
- Limited-recourse Structures — In this technique, the private sector will undertake the construction, financing, operating and maintenance of the infrastructure for a limited concession

period (build operate and transfer [BOT]) [Buljevich and Park, 1999]. At the end of the concession period the infrastructure is then transferred to government

- A combination of the models listed above. Combining the models would depend on government structure, financial markets, the political climate, and the component(s) to be implemented to name a few.

Funding Mechanisms for SDIs Classified as Quasi-**Private** Goods Producers

In this category spatial information as a quasi-private good is considered to be closer to or heading towards a private good (Figure 2). That is, spatial information is viewed as a commodity that can be traded for a profit or at least at a self-sustainable level. The nature of this category will tend to attract more private sector investment. Funding mechanisms falling in this category includes:

- The creation of a consortium to manage and generate funds for SDI implementation. The incorporation of this type of organization will facilitate the following:
  1. The issuing of shares in the organization on the stock exchange or through private subscriptions (Urban Logic, 2000).
  2. Large users of spatial data can be asked to pay a membership fee to the organization (Urban Logic, 2000).
  3. The solicitation of contributions from the individual partners, which should be considered as capital investment into the consortium.
  4. Access to capital market for financial assistance such as revolving loans and other similar debt structures.
- Project Finance — where limited recourse loans (repayment depends uniquely upon the cash flow generated by the project) is used to finance implementation [Pollio, 1999]
- Limited-recourse Structures — this category will favour the build own operate (BOO); build own, operate, and transfer (BOOT); and the build, least, and transfer (BLT) options
- SDI funded through partnerships – A number of different combinations of partnerships are available for financing SDIs in this category. Examples of available partnerships are:
  1. Government and private sector partnerships
  2. Government partnerships with community organizations (e.g. with environmental bodies, forestry, tourism and other community organizations). Community groups can contribute to SDI development through the sharing of data/information they have collected, and/or through the provision of services and technical infrastructure
  3. Private sector partnerships with community organizations
  4. Government, private sector and community organization(s) partnerships
- Private Sector non-cash contribution – Under this model the private sector may invest in the implementation of an SDI through the provision of goods and services that may be used in the implementation/maintenance of component(s) of an SDI [Giff and Coleman, 2003]
- The Indirect Method – here funds for implementation are derived from advertising, sponsorships and other indirect techniques [Rhind, 2000]
- The sale of spatial information and spatial information related services by the public sector
- The usage of all or more than one of the models above to finance different components of an SDI is also possible.

Financing of an SDI that falls within this category is not restricted to the mechanisms listed above, but may also include different combinations of those listed in the sub-section on Quasi-Public Goods Producers. Classifying an SDI in this category does not exclude government from participating in its financing. Government still play an important role in the financing, implementation, maintenance, and regulation of an SDI not withstanding its classification (see Giff and Coleman, 2003 for more details).

The funding mechanisms proposed in these subsections on Quasi-Public and Quasi-Private Goods Producers are a summary of more in-depth funding mechanisms proposed for the implementation of the next generation of SDIs. These mechanisms have been formulated using the implementation environment of the developed world as the framework. However, the implementation environment of developing nations differs greatly from that of developed nations. Therefore, if the proposed funding mechanisms are to be employed in developing nations then, the implementation environment of these nations must be analyzed to determine the suitability of these mechanisms.

The African Implementation Environment and its Effect on Financing

The funding mechanisms in the last section were designed mainly for the implementation environments of the developed world. Key features of these environments that influenced the mechanisms include:

- The nature of the economies;
- The general market environment;
- The maturity of the SDIs;
- Government policies;
- Availability of supporting infrastructure; and
- The influence of culture and availability of skilled work force.

If the above characteristics are in anyway different in the developing world then, the application of the funding mechanisms in these nations will be affected. The aim of this section is to compare and contrast the general SDI implementation environment of the developing world to that of the developed world. The result of the comparison will be used to a) evaluate the funding mechanisms discussed earlier, b) adjust them where necessary, and c) assist in the development of new mechanisms more suitable for application in developing countries.

The Economies and Market Environment of African Nations

In contrast to that of developed nations, the implementation environments of developing nations and nations in transition varies from having sustainable to very poor economic climates. In general, these economies are burdened with large external and internal debts, high inflation, unstable exchange rate, and political uncertainty, which affect the ability of these nations to generate investment in infrastructure development [Jenkins and Thomas, 2002]. The nature of the economies of developing countries does not lend support to 'pure' government investment in SDI. The limited resources available to the governments of these nations are normally apportioned in priority to other areas of the economy (e.g. health, education and security). Also the usual small portion of the budget set aside for infrastructure financing will normally end up financing the more traditional infrastructure (e.g. roads, utility and telephone) and projects that exhibits more tangible returns. This normally occurs because information infrastructures including SDIs are not usually ranked as

high priority by the governments of developing countries—due to the lack of awareness of the value of spatial information to economic and social development.

In the developing world the market environment (private sector activities) is not as vibrant as that of the developed world. Government policies, legislation, and the instability in the economic climate to name a few, put up huge barriers to private sector investment. In these economies, the local private sector do not have the capital to make significant investment in the economy and the international private sector tend to limit their investment in the economies of developing countries due to the economic instability of these nations. In addition the concept of a spatial information market is a new one in developing countries and thus, is not yet capable of attracting significant private sector investment. Also the technology to support and encourage the usage of value-added products and services (e.g. location based services) are not readily available in developing countries.

The level of private sector investment in the spatial information sector in developing countries can be seen in a report by Tveitdal, (1999) which, states that the contribution of the geomatics information sector to the economy of developing nations is on average a mere 0.1% of GNP. This contribution is very low when compared to the developed world (0.5% of GNP), bearing in mind that the GNP of developing nations are much lower than that of the developed world. This is a clear indication that the private sector is not very active in the spatial information market in developing countries.

In the mechanisms presented in the last section (especially those for Quasi-Private Goods Producers) the private sector especially the small and medium enterprises (SMEs) were factored in as significant contributors to the funding of an SDI. This was possible since in the developed world SMEs are well organised, and supported by formal information system, legal and institutional framework, and skilled labour. In contrast to the developed world the SMEs of developing nations are usually informal and are lacking in financing, information, and the skills necessary for them to increase production and reduce their cost, and thus, make an impact in the market [Duncombe and Heeks, 2001].

Other factors limiting the impact SMEs have on improving the markets in developing countries are:

- The private sector especially the information sector tends to be supply oriented — Greater emphasis needs to be placed on demand rather than supply. The private sector should move towards needs-driven organisations and be less entrepreneur-driven organisations [Duncombe and Heeks, 2001];
- High interest rates and the lack of capital to invest;
- The lack of efficient social and technical infrastructure, technology, internet providers and trained professionals to support investment in an SDI [Ezigbalike et al., 2000]; and
- The lack of political support—Governments of developing countries can do a lot to assist the efforts of the private sector in building a market for spatial information. Incentives for private sector investment in the information sector can be offered in terms of: the removal of legislation and policies that act as a barrier to the collection and dissemination of information, the reduction of taxes on the information sector, and through the encouragement of the public sector to utilise more spatial information in their decision making.

Government Policies and the Maturity of the SDIs

Government policies and the level of maturity of an SDI will affect the mechanisms used to fund its implementation and maintenance. The different levels of government policies will affect funding of an SDI due to the fact that:

1. Governments are the largest users of spatial information;
2. Governments are the largest investor in spatial information; and
3. Government from time-to-time acts as the regulator of the spatial information industry and the economy in general. Therefore, legislation and policy decisions made by government can have either positive or negative effects on the spatial information industry.

In the developed world the e-government concept is well adopted. An important aspect of the e-government concept is the Geoinformation Government Program, which is defined as

> *... the usage of geospatial capabilities (technology, data, and services) to enable more informed decision-making, greater efficiency, increase accountability, and better management in all levels of government, providing citizens with the best possible services at the lowest cost.*
>
> *(Moeller and Karmazin, 2003)*

This program encourages the usage of spatial information in decision making across all levels of government. It also facilitates the participation of citizens in the decision making process thus, exposing citizens to the usage of spatial information in decision making. In contrast developing nations are slow to implement e-government policies in particular that of geoinformation government. This is mainly due to the lack of available technology and infrastructure to support this concept. The digital-divide that exists between the developed world and the developing world, and also within individual nations of the developing world greatly affects the usage of spatial information. This is further propagated by the lack of institutional coordination amongst the spatial community, the need for policies and legislations, and the awareness of the usage of spatial information [Giff, 2002].

The maturity of the SDI will also affect the funding mechanism. An SDI in the early stage of implementation will not be capable of producing spatial information at a profit or at a sustainable cost and therefore must be subsidised. However, governments of developing countries are usually not capable of providing the required subsidy. Alternative subsidy can come from international funding agencies, and or local/ international private sector. The international funding agencies can be attracted to subsidise the production of spatial information on the premise of a public goods, while the private sector will invest at a loss based on long term expected gain on investment.

In summary, the SDIs of developing countries are not mature enough to attract private sector investment and government cannot afford to invest heavily in them. In addition, the demand for spatial information in the developing world by both government and citizens is not as high as that of the developed world. This low demand level will reduce the benefits (e.g. reduction in cost due to volume) to be gained from high usage. Therefore alternative funding mechanisms must be developed for SDI implementation.

The Availability of Supporting Infrastructure

Successful implementation of an SDI requires the support of both technical and social infrastructure. If the supporting infrastructure are not in place then the funding mechanisms proposed earlier would have to be modified before they can be applied in this type of environment.

In most developing countries the infrastructure required to support the implementation of an SDI are not in place. For example the utility and telephone networks are usually in poor state and are normally only available in the urban areas. Other technical infrastructure not in place in developing countries includes broadband cables, computer networks, Internet providers, data collection devices and spatial information supporting software.

In the case of the social infrastructure, this is also under developed. For example, policies, legislation, and trained professionals necessary to support SDI implementation are not in place. The funding mechanisms for SDI implementation in this environment would therefore, have to consider the financing of both the technical and social infrastructure if they are to be successful.

Summary

The previous sections reviewed key factors, which make the implementation environment of developing countries different (as it affect SDI funding mechanisms) from that of the developed world. The business environment of both worlds was first reviewed and the conclusion from the review was, the business environment of developing countries differs (again as it affect the financing of an SDI) from that of the developed world in three main categories. They are:

- Economic Stability and Security
- The Activities of the Private Sector
- Monetary Market Activities – Stock exchange, bonds, the availability of capital and interest rates

The second key factor reviewed was government policies and their effects on the funding of SDIs. The review indicated that government policies had significant impact on SDI funding. The impact of government policies was very significant because the function of government is closely integrated into the concept of an SDI. Government was identified as the major user, producer, and financier of spatial information. Therefore, changes in government policies will have significant effect on SDI funding mechanisms.

The conclusion from this section of the review is that policies of governments in developing countries are somewhat different from that of their counterparts in the developed world partly due to the differences in political and institutional frame works, and economic constraint. Government of developing countries cannot afford to invest in SDIs and do not posses the tools necessary to generate investment in SDI (e.g. the infrastructure to facilitate large-scale usage of spatial information). Also governments of these nations are slow in implementing the policies and social infrastructure necessary to facilitate investment in SDI.

The third and final component reviewed was that of the supporting infrastructure. In the review the supporting infrastructure for SDI implementation was classified as technical and social infrastructure. In developing countries both the technical and social infrastructure needed to support SDI implementation are underdeveloped and thus, funding mechanisms must take this into consideration. The development of these infrastructures is all tied in with government policies. They all rely heavily on government to finance and regulate their activities. This is further evidence of the impact of government policies on funding mechanisms for SDIs.

The above factors are key input variable (figure 3) that should be assessed and analysed when developing and applying funding mechanisms for SDI implementation and maintenance. Failure to properly analyse these variable will result in shortfall in funding and thus the failure of the SDI.

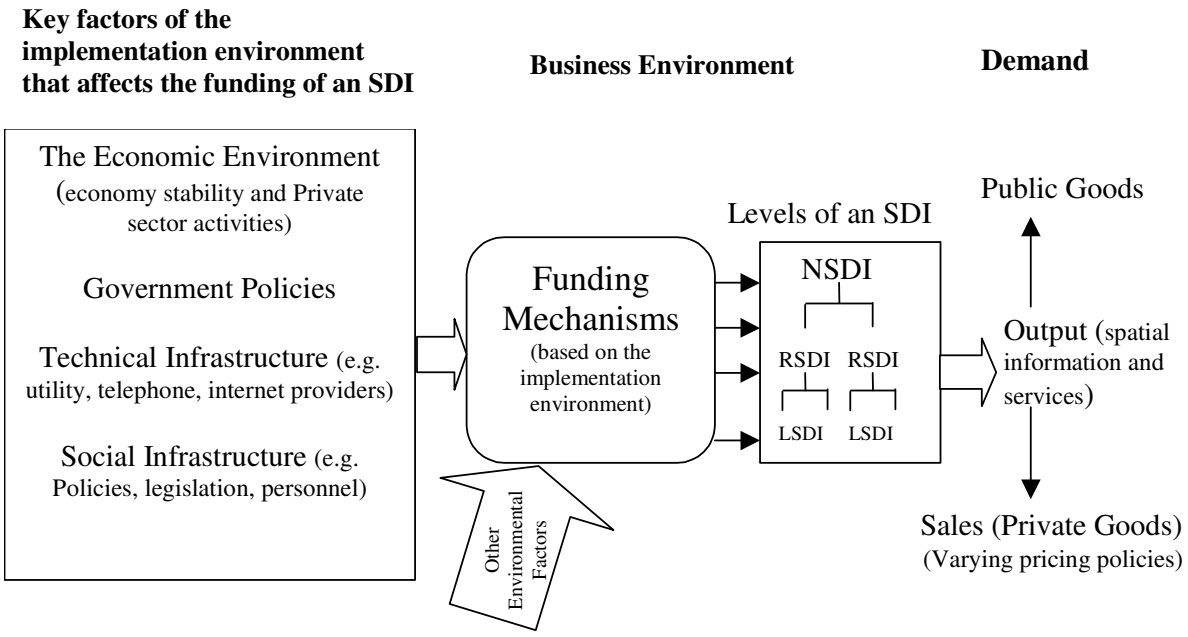


Figure 3: The Influence of the Implementation Environment on SDI financing

Funding Mechanisms for the SDIs of Developing Nations

The unique characteristics — when compared to the developed world — of the implementation environment of developing countries, warrants special or different funding mechanisms for SDI implementation. These mechanisms must be sensitive to the economic climate, the nature of government, and the quality of the supporting infrastructure in developing countries. The following section will propose a number of funding mechanisms more sensitive to the implementation environment of developing countries and thus should be applicable in most part to SDI implementation in developing countries. Further modification of these mechanisms may be required based on specific local implementation environment.

Functions of SDI Coordinating Bodies in Securing Funding

In any implementation environment the SDI coordinating bodies should play a key role. This is even more so in developing countries where SDI implementation is more constrained due to lack of resources. The authors are of the opinion that individual SDI coordinating bodies in emerging nations should consider establishing a limited-term sub-committee or task force responsible for the creation of a business plan to assess and, if favourable, promote the concept and viability of an SDI (see CIE, 2000 for more details on an SDI business plan). The task force should consist of both public and private sector members experienced in both infrastructure financing and the operations of international funding agencies. An important component of this business plan should be funding mechanisms based on the local implementation environment. Other funding related activities this sub-committee should be responsible for includes:

- The fostering of good working relationships with the relevant funding agencies (international);
- Acting as advisors or liaison between the respective technical group and the funding agency(s);

- The creation of a Donor Funding Pool – This will alleviate the lack of coordination amongst projects funded by external agencies [de Montalvo, 2001, The SDI Cookbook, chapter 8] and also minimise the occurrence of lapse funds since it is expected that the pool will facilitate carry-over funding. This type of funding arrangement is necessary since, spatial information activities are normally developed on a project basis with no funds allotted for continuation or maintenance. If a funding pool exist it will be easier to plan for the continuation and maintenance of the SDI. This donor pool should be organized in such a manner that it will ensure there is sufficient funds to sustain the SDI until it becomes self-sufficient or other methods of funding are secured [ECA, 2001] (see appendix?? for examples and case studies of this type of arrangement);
- The fostering of good working relationships with the relevant Government Ministries (e.g. Ministry of Finance, Environment etc) and other public sector agencies;
- Be aware and familiar with all spatial information related international agendas – If the coordinating bodies are aware to the agendas they can promote them and hold the international communities and government to the agendas. An example of an agenda that a coordinating body can hold government and the international community to, for financial support of an SDI, is the UN Agenda 21 [UN, 1997];
- Foster relationships with special projects and national/sub-regional/regional Programs;
- Develop special marketing tools that will encourage private sector involvement in SDI implementation;
- Acquire and or develop the skills, technology and tools that will facilitate them in the speedy preparation of business plans for specific projects; and
- Keep up to date on all the special spatial information related projects operating not only within the country but also within the region; so that they can align the SDI with these activities and benefit from them financially or through the sharing of information collected according to the specification of the SDI. A key special project that is common to most nations that an SDI could align itself to is the national population census (See Nigerian case study in appendix??). Also, of interest in Africa there is the Environmental Information Systems (ESI-Africa).

  This model offers SDI coordinating agencies the possibility of:

  1. Ensuring that spatial information is collected in a manner suitable for sharing
  2. Advising on the implementation of local GISs generated from the project (ensuring they supports interoperability) and
  3. Accessing funds to implement SDI components that support the project(s) goals

In developing countries a key financier of infrastructure is the international funding agencies. Therefore, it is extremely important that this sub-committee is familiar with the operations of these organisations, aware of the different projects individual organisations are willing to fund, familiar with the tender and application process, and up to date on the all current and pending policies of these organisations. This type of information can be used to advice the spatial information community on how to access these funds (see appendix?? for a list of international funding agencies and examples of the type of projects they have sponsored).

Funding Mechanisms Influenced by Government

Prior to the 1990's infrastructure financing in developing countries was primarily the function of government and the international funding agencies. However, the 1990's saw a worldwide reduction in public spending by governments [Rhind, 1994], [Johnson, 1997], [Moody's Investors Service, 2001], and [Frank and Martinez, 2001]. This constraint on the budgets of governments of

the 1990's resulted in the governments of developing countries cutting back on infrastructure spending and also significant reduction in the funds available to international funding agencies for infrastructure financing. This short fall in infrastructure financing must be filled if the societies of developing countries are to provide a reasonable standard of living for their citizens. One method of filling this short fall is to encourage the private sector to get more involved in infrastructure development and maintenance.

Although governments are reducing their expenditure on infrastructure, they still play a key role in funding the implementation of an SDI. Some government supported funding mechanisms available for SDI implementation in developing countries include:

- Funding from the budgets of ministries closely related to the production or usage of spatial information. For example in South Africa the National Spatial Information Framework (NSIF) is funded from the budget of the Department of Land Affairs. Also individual government departments and NGO's should include in their budgets the cost of their input into the SDI. It is important that these budgets are carefully planned and utilized. The return of funds at the end of the financial period will only lead to the reduction in the amount available for the next period;
- Government and donor agencies partnerships — Here government can share the cost of implementation with one or more international funding agencies. An example can be seen in the case of Zambia, where the central government supports an initiative in conjunction with donor funds (i.e., the Environmental Information Network and Monitoring System [EINMS] which is a component of the Environment Support Programme [ESP], funded by the World Bank and the Nordic Development Fund). In cases where financial resources are low government may negotiate to provide the social infrastructure;
- Government partnerships with large users/producers of spatial information (e.g. utility and telephone companies). An example of this type of partnership can be seen in Costa Rica where the national mapping agency partnered with the national electricity company (ICE) to produce base maps;
- The pooling of government resources — governments of the region contributes to a pool that is used to finance components of SDIs throughout the region. The resources can be either financial, non-financial or both. The sharing of experiences and professionals can result in cost savings. An example of this type of arrangement is the Nordic Trust Fund for Governance in Africa established by the four Nordic countries [Denmark, Finland, Norway, Sweden];
- Special Taxation — taxation here can either be positive (tax incentives – the reduction or removal of taxes to encourage spatial information activities), negative (tax increment – taxes applied to for example, information related goods and services), or a combination of both. The revenue generated from these taxes should go directly to the development of the SDI and not into the general treasury. An example of this type of taxation can be seen in North America where a tax is imposed on telephone service to support the E-911 program;
- Government can propose the usage of "Tied Aid Financing" to the governments and the private sector of the developed world — In Tied Aid Financing funds are tied to purchases from donor country(s) and/or organisation(s) providing the funds. The funds allotted from this type of financing can be used to purchase hardware and software to support implementation;
- The usage of Retention Schemes — Under this scheme SDI related organisations are allowed to retain a significant portion of the revenue they generate to reinvest in the development of components of the SDI. An African example of this type of initiative can be seen in the Selous Game Reserve of Tanzania. The reserve is allowed to retain 50% of the revenue it generates for tourism. The retained revenue is used to improve and maintain the quality of the facilities of the reserve. In the developed world a number of spatial information organisations (e.g. the

Ordnance Survey and Service New Brunswick) are allowed to keep the revenue they generate for reinvestment into the development and maintenance of the organisation;

- SDIs are often established across different levels of government. Matching ratio can be used to facilitate the participation of all levels of government. In this type of arrangement the central/federal government would match (at a specified ratio) the amount invested in SDI by the lower levels of government;
- Government can support the establishment of special banks or financial institutions to underwrite low interest loans for the investment in SDIs. This can be done in conjunction with international lending agencies. Examples of this type of initiative can be seen in the Local Authorities Loan Fund of Malawi, the Municipal Development Fund of the Philippines, and the Regional Development Accounts of Indonesia [Johnson, 1997]; and
- Government can also provide non-monetary contributions to SDI implementation. Non-monetary contributions can come in the form of rent or lease free premises to house the coordination bodies and other components of the SDI, the secondment of personnel, and the provision of equipment.

The above are some of the funding mechanisms government can employ in SDI implementation. However, there are other steps government can take to ensure that an SDI is implemented efficiently. A key step is to remove the barriers preventing the mass usage and the commercialisation of spatial information. Some of the steps a government can take to remove these barriers are (see Giff and Coleman, [2003] for more details):

- Give tax breaks to large SDI stakeholders
- Monitor and correct the economic problems associated with this type of infrastructure;
- Foster the sharing of data within the Public Sector – Where possible government should make it obligatory for any institution whose spatial information was financed by government to make it shareable (i.e. collected within the framework of the SDI and available for dissemination);
- The modernisation and restructuring of organisations providing the framework data
- Improving the laws associated with copyrights and database protection issues;
- Address the issues affecting government and private sector data pricing and data licensing [Urban Logic, 2000];
- Address the legal issues affecting data transmission (e.g. bandwidth and licensing);
- The removal/ reduction of restrictions on the provision of spatial information by the local private sector. For example, in India the creation of digital maps at a scale of 1: 20, 000 or better by the private sector requires clearance from the Ministry of Defence. While international private organizations can produce these type of maps from satellite imagery without any restriction [Rajgopalan, 2003]; and
- Encourage more free market activities (i.e. decentralized the economy).

" Without good political governance, everything else falls apart." Tito Mboweni, Governor of the South African Reserve Bank. From this statement it can be concluded that good government policies are absolutely necessary for the effective implementation of an SDI. The implementation of an SDI is very dependent on government financing, supportive government policies and the political will of the government. Government must be committed to the SDI and recognise the value of spatial information to the development of the society. Government should appoint a minister or minister of state with responsibility for SDI implementation. An example on government commitment to an information project and the steps taken by government to ensure it success can be seen in the Benin ICT case study in appendix ????

Private Sector Oriented Funding Mechanisms

Although the local market for African spatial information is not very vibrant there is a very active international market for African spatial information. This is evident from the number of Internet sites selling African spatial information. Therefore, there is a possible market the African private sector can target in the short term while focusing on the local market for long-term benefits. The long-term sustainability of an SDI will be a function of its ability to produce and market spatial information, value-added products, and services [ECA, 2001]. The marketing and production of value-added products and services is a function more suitable for the private sector and thus, the need for private sector involvement in the creation of an SDI.

Although the majority of the private sectors of developing countries are faced with a number of financial constraints there are other techniques they can use in conjunction with their limited financial resources to contribute to the implementation of an SDI. Possible funding mechanisms for SDI implementation with private sector influence include:

- The re-investment of revenue earned form spatial information activities (e.g. the sale of spatial information, the provision of spatial information related services, and the sales of value-added products)
- Financing SDI implementation through partnerships – The creation of partnerships amongst local and international private sector with interest in spatial information. Examples of possible partnerships are [Giff and Coleman, 2003]:
    1. Government and private sector partnerships;
    2. Donor Agencies and private sector partnerships;
    3. Donor Agencies, government and private sector partnerships. Example of this type of partnership can be seen in road construction and maintenance in Burkina Faso (see appendix?? For details); and
    4. Partnerships with international private sector (e.g. local-international private sector partnerships, international private sector-government partnerships, and local private sector-international private sector-government partnerships.

    The contribution of the private sector to the above partnerships does not necessarily have to be monetary. The private sector contribution can be in the form of management services, consultation, the provision of expertises, the sharing of information collected, the customisation of software, and the provision of other technical services.
- The private sector can also access capital provided by private investment cooperation specially geared for infrastructure financing or the financing of the provision of public good. An example of this type of fund is the U.S. Overseas Private Investment Corporation (OPIC) which is currently providing funds for infrastructure financing in Sub-Saharan Africa (see appendix for details)
- The usage of Limited-recourse Structures – This method has been used over the past thirty years to increase private sector contribution to public infrastructure financing. Example of this type of arrangement is the Aguas Argentinas water distribution system in Argentina [Buljevich and Park, 1999];
- Project Finance – That is the use of limited recourse loans, where repayment depends uniquely upon the cash flow of the business (in this case the SDI or the component(s) of the SDI being financed) [Pollio, 1999]. An example of infrastructure projects financed through this model is the production of the second runway of the Eldorado Airport in Colombia [Pollio, 1999]. The application of this model to SDI implementation would require the private sector to prove that SDI or component(s) of the SDI will generate adequate returns on investment. An efficient tool

to illustrate the benefits of an SDI and its potential returns on investment is a good business plan.

- The utilisation of several of the mechanisms above require a vibrant private sector capable of convincing holders of capital that an SDI can generate return on investment. At present the market for spatial information in developing countries is not very active but factors do indicate that there are scenarios supporting the creation of a spatial information market, which will become more viable as the SDIs mature.

Alternative Funding Mechanisms

The nature of the implementation environment of developing countries require the development of alternative funding mechanisms to cover the short fall of traditional (government and private sector) funding mechanisms. SDI financing in developing countries cannot rely solely on government funding or a combination of government and private sector funding due to the constraints the implementation environment places on these organisations thus alternative methods must be employed. These alternative funding mechanisms must be ingenious and utilise the properties of local financing techniques. Possible alternative funding mechanisms to government and private sector includes:

- The usage of fund raising activities – SDI coordinating bodies can organise funding raising events similar to those of charity organisations. Revenue generate from these activities can be used to finance components of the SDI or educate the stakeholders and the public on the benefits of an SDI. Example of funding raising activities applicable here are: dinner parties, bingo parties, and raffles;
- Government can establish a national lottery – Revenue from the lottery can be used to finance the SDI. Lotteries of this nature can be seen in Jamaica (where the national lottery was used to finance the national football team [the reggae boys] and other social organisations, in the United Kingdom (revenue from the lottery used to finance the arts and national heritage) and in South Africa (national lottery used to finance a number of charities and sport programs);Annual telethon and media campaigns directed at financing a specific component(s) of the SDI — The coordinating body should select a spatial information related issue close to the heart (e.g. environment protection or something health related) of the public as the basis of the telethon;
- Tax creditable donations from organisations and the general public;
- Invite all spatial information stakeholder to contribute a membership fee to the coordinating body; andTwin SDI with an SDI in the developed world (i.e. is similar to how cities of different nations are twined) — This type of arrangement will facilitate the sharing of experiences (e.g. cost reduction techniques and methods of generating funding). International vendors interested in selling their products to developing nations can also subsidise the cost of this type of venture.SDI funding in developing countries must be creative and modelled off tried and proven funding mechanisms used in these environments.

A Combination of the Mechanisms

In the majority of implementation environments the mechanisms proposed under the different categories above will fall short of raising the capital investment required for the implementation of an SDI. However, individual funding mechanisms will be capable of funding the implementation of one or more component of the SDI. This will result in different combination of the mechanisms listed above being used to fund the implementation of the SDI (figure 4). Combining the funding mechanisms would depend on the local implementation environment (i.e. government structure and policies, financial markets, the political climate, and the component(s) to be implemented or maintained to name a few).

The alternative funding mechanisms proposed for SDI implementation in developing nations are not expected to replace "traditional" SDI funding mechanisms used in these nations but are considered as an effective means of augmenting them. These mechanisms can be used to effectively fund specific components of an SDI and provide program coordinators with alternative methods of raising money to accelerate implementation.

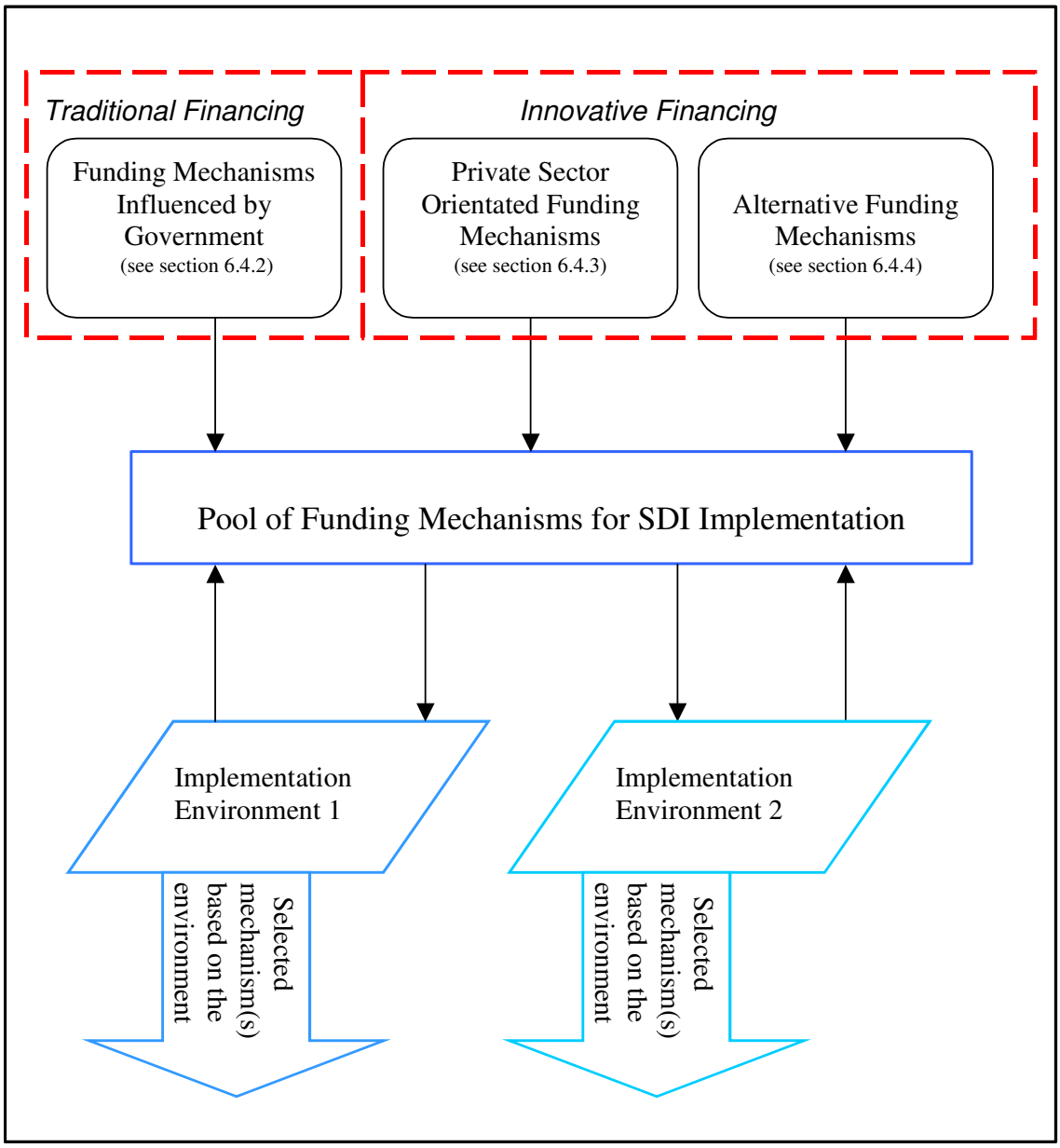


Figure 4: Funding Pool for SDI Implementation in Developing Countries

Re-engineering the Policies of Donor Agencies

Along with government international donor agencies are the largest financiers of infrastructure implementation (including SDIS and component(s) of SDIs) in developing countries. Therefore the success of the implementation of an SDI will also be a function of the policies of the donor agencies. If SDI implementation is to be successful in developing countries donor agencies must be

more flexible with their loans and grant policies. Some policy changes that donor agencies can adopt to facilitate successful implementation of an SDI include:

- Enter into more loan/grant agreements with NGO's and private sector organisations (local and international);
- Promote inter-agency coordination — Better coordination amongst the funding agencies will result in more structured financing of SDI related projects;
- Ensure that spatial information collected remain in the local environment so that it can be incorporated in the SDI. Often information collected for a particular project is taken to the host country of the funding agency and thus, is not available for use locally;
- Correct policies that hinder the repatriation of spatial information collected in the past; and
- Collect information in a format useful to local environment (e.g. use the native language and the local standard or recognised international standards).

Conclusion

The chapter presented a number of funding mechanisms used/proposed for SDI implementation in the developed world. The general implementation environments of developing nations were then analysed to determine whether or not these mechanisms could be used in their current form for SDI implementation in developing nations. The review indicated that the funding mechanisms are not applicable in their entirety in developing nations.

The applications of the funding mechanisms were in part limited because key variables used in the design of the mechanisms (e.g. economic circumstances, private sector activities, the nature of the spatial information market, government policies, and organizational culture) were in fact different in developing nations. In that, they were not as vibrant in the implementation environment of emerging nations as they were in the developed world.

The differences in the quality of the variables were then used to determine the effects they would have on using the mechanisms for SDI implementation in developing nations. The analysis of the effects of the changes in these variables on the funding mechanisms indicates that in general the models are not applicable in their current format.

The chapter then proposed funding models for SDI implementation in emerging nations based on the unique features of the variables of the environment of developing nations. The mechanisms for developing nations were in part similar to those of the developed world but had unique characteristics that made them more applicable in developing nations.

Having funding mechanisms geared specially for the environment of developing countries is not the total solution to the problem of securing financing for SDI Implementation. SDI program managers must be capable of selling the concept that an SDI is just as important to the development of a nation as any other infrastructure. That is, they need to demonstrate that if the components of an SDI are integrated into existing infrastructure (e.g. health, commerce, environmental, national defence and agriculture) then it will be capable of producing valuable public goods and not viewed, as a luxury developing country cannot afford.

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