

The challenges of diffusing Geoinformation Technology for decision making

Geoinformation Technology can be said to become pervasive with the new visibility brought about by GoogleEarth and the issues surrounding climate change. However, decision makers have been slow in taking up Geoinformation Technology as a tool in economic decision making. While economic models continue to dominate in terms of how economic and planning decisions are made it is important for scientists in the Geoinformation arena to bring Geoinformation solutions to the political table. This paper focuses on the challenges associated with the establishment of Spatial Data Infrastructure in Botswana as a building block to the vision of making Botswana a well-informed nation. It highlights the challenges the NSDI development process has undergone and what steps have been taken to move the process forward. The NSDI as a concept is seen by many in decision making as a preserve for the technocrats and sometimes is viewed as money gobbling toy with no relevance to the needs of society.

The paper will highlight some of the decisions taken with respect to NSDI implementation in Botswana at a National Conference held in November 2007. The paper identifies the main challenges to be more skills based and organizational rather than financial and technical. It also suggests the need for more visible beneficitation of GI with more service centric projects. Projects that tackle poverty alleviation, or go towards addressing MDGs will be more amenable for political reception than those that merely address new technology per se.

The paper concludes that there is need for concerted efforts from scientists in the Geoinformation technology arena to identify and address societal issues through technology in order to bring real visible benefits to the communities.

Keywords: GIS technology, decision making, MDGs, SDIs

Introduction

Sustainable development is sometimes seen as an over-arching theme in the whole concept of development. Wikipedia defines **Sustainable development** as that which meets today's needs of development without compromising future generations' ability to develop. It can also be viewed to consist of three areas i.e. social, environment and economic. As seen in Figure 1 there are interlinkages between these areas of development

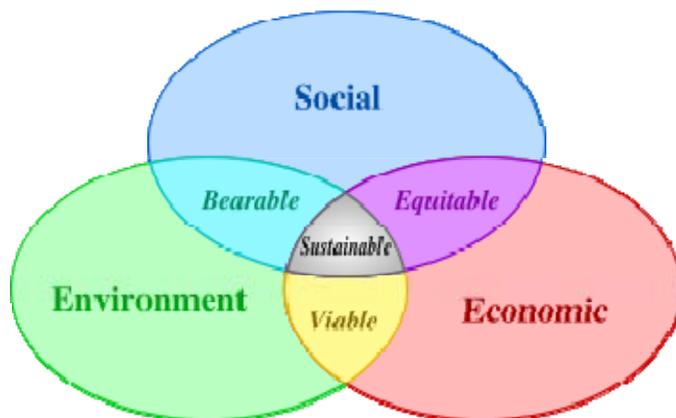


Figure 1: The sustainable development nexus

Environmentally sustainable development has been addressed adequately in a lot of fora e.g. the Earth Summit of 1992 which proclaimed that *“without improving environmental management, development will be undermined and, without accelerated development in poor countries, the*

environment will continue to degrade.” Indeed it might appear paradoxical that while we yearn for accelerated development we have to ensure that the environment is not harmed in the process. The basis of sustainable development, it can be shown, is information. Most of the development models use economic information as a basis to propose development. Examples of the most commonly used economic models are shown Table 1

Table 1: Some Economic Models

Economic model	
Comparative Advantage	Economic theory predicts all countries gain if they specialise and trade the goods in which they have a comparative advantage. This is true even if one nation has an absolute advantage over another country.
Rostow	This is a linear theory of development. Economies can be divided into primary secondary and tertiary sectors. The history of developed countries suggests a common pattern of structural change
Harrod-Domar	The Harrod-Domar model developed in the 1930s suggests savings provide the funds which are borrowed for investment purposes.
Lewis	The Lewis model is a structural change model that explains how labour transfers in a dual economy. For Lewis growth of the industrial sector drives economic growth
Dependency Theory	Dependency refers to over reliance on another nation. Dependency theory uses political and economic theory to explain how the process of international trade and domestic development makes some LDC's ever more economically dependent on developed countries
Balanced growth theory	Balanced growth (or the big push) theory argues that as a large number of industries develop simultaneously, each generates a market for one another.
Unbalanced growth theory	Unbalanced growth theorists argue that sufficient resources cannot be mobilised by government to promote widespread, coordinated investments in all industries

While these models are helpful in the development process they do not tell the whole picture regarding development as we have seen in Figure 1. The role of spatial information in the development nexus presented in the figure persuades one to think that more consideration needs to be brought to the political table when discussing development. It is recognized that institutions such as the World Bank have shown concern about environmentally sustainable development (ESD) and has financed a number of ESD projects in Sub-Saharan (World Bank, 1996). Concerns regarding climate change have brought to the fore a need for more information to perhaps curb the insatiable appetite for man to “develop” the earth at the expense of the social and environmental conditions. The desire to incorporate other types of information in the development agenda can help the world achieve sustainable development.

NSDI and sustainable development

One component of ensuring sustainable development is the establishment of National Spatial Data Infrastructures (SDI). According to the SDI cookbook (2000) SDIs are meant to be a collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The cookbook further states that the SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general. So if we start from the premise that sustainable development can only take place in an environment which has information we can see that an NSDI is an important component for development. Those in the geospatial professions are sure about the importance of establishing SDI and perhaps do not need any convincing because that would be preaching to the converted. However even as we extol the virtues of an NSDI most of the African governments do not seem to give it the same kind of admiration as they do other more mundane infrastructures such as road networks, phone networks etc. Ezigbalike (2001) observed that the reasons for the lack of support of SDI initiatives from the highest offices might be

- The lack of awareness of the value of SDI
- Confusions surrounding the definition of SDI
- Lack of policy and coordinating arrangements
- The complexity of national issues such as the political, cultural, and economic positions of most countries

The BOTSWANA NATIONAL SPATIAL DATA INFRASTRUCTURE

In Botswana there has been considerable government support however on the implementation of an NSDI and an official launch was done in 2002. Tembo & Manisa (2003) report that after twists and turns the NSDI was successfully launched with the establishment of permanent working groups and a National GIS coordinating Committee (NGCC). Structurally the working groups are shown in Figure 3. According to Tembo & Manisa (2003) the functions of the working groups were as shown in Table 2:

Table 2: Functions of working groups

Working Group	Functions
Fundamental data	<ul style="list-style-type: none">• Analyse the need for fundamental datasets• Make specifications for the datasets• Put requirements for production, maintenance and updating routines of the fundamental datasets;• Disseminate information on fundamental datasets
Standards	<ul style="list-style-type: none">• Analyse in what areas standards are needed for the NSDI• Find suitable standards and seek agreement about and promote the use of established standards;• Review established standards and propose any necessary changes or additions
Metadata	<ul style="list-style-type: none">• Establish the metadata services• Monitor and support the development of metadata services• Promote and advertise the use of metadata services

Institutional Framework	<ul style="list-style-type: none"> Analyse how GI stakeholders should cooperate with government; Analyse what responsibilities between stakeholders should be contained and assigned Seek financing for the NGCC and its activities Review the general performance of the NGCC and the NSDI initiative
Architecture and Infrastructure	<ul style="list-style-type: none"> Establish requirements on GI and GIS activities on institutional level Develop guidelines for establishing GI and GIS infrastructure at institutional level; Develop guidelines for GI and GIS maintenance.
Education and Human Resources	<ul style="list-style-type: none"> Analyse the present GIS knowledge on different levels and in different GIS related positions, mainly in government organizations; Review the existing GIS education and training courses provided by training institutions in Botswana Analyse requirements on future staff needs of the NSDI.

The launch also saw the establishment of website whose screen cut is shown in Figure 2



Figure 2: NSDI website

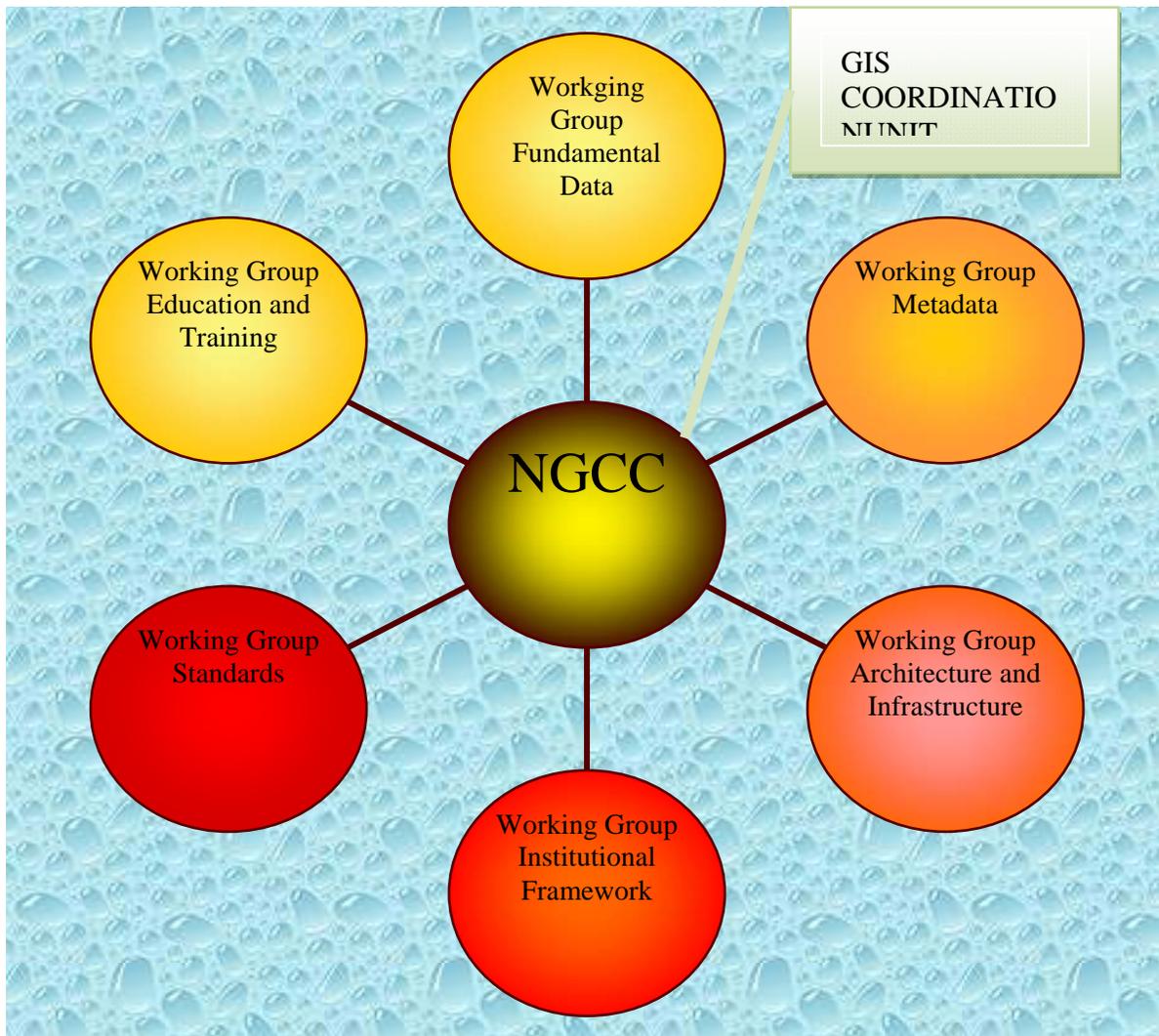


Figure 3: Organisational structure of BNSDI

Current status

The Working groups continued to meet and feed information to the National GIS coordinating Committee (NGCC) but, in truth, little was achieved in these working groups. Meetings were held to address the terms of references for each working group and to review progress on the mandates given to them but it appears that nothing was being achieved. While there was a lot of zeal by most members initially it became apparent that there was need to address the issues surrounding skills in the working groups if the Infrastructure was indeed going to be achieved. Some of the participants in the NGCC, particularly the national mapping agency have developed national databases which form part of the identified fundamental datasets. Utility companies have, through private mapping companies, been collecting country wide village data at scales of 1:5000 with view of mapping these villages for purposes of providing utility services to the villages. Tembo (2005) reports on the diffusion of GIS in the utility companies and highlights insufficiency of geospatial skills in the utility organizations. Manisa and Nkwae(2007) have shown the various GIS activities that have taken place in various government departments over the years in Botswana Some of these are the Tribal Land Integrated Management Systems, State

Land Integrated Management Systems, National GeoScience Information Systems, and the Environment Support Programme. Others like the Department of Town and Regional Planning have set up a planning portal which would be used by the Planning Boards over the government intranet. A lot of money has been spent on all these projects. All these activities are supposed to feed into a National Spatial Data Infrastructure. The question to be asked is: is this happening? The answer is a resounding NO at the moment. While it can be said that most of the tools that are cited here go beyond data collection there still have to demonstrate beneficiation to the common man. Discussing the state of Environmental Information Systems in certain select African countries EIS-Africa in 2001 noted that most information systems in the countries studied were planned on the basis of applying digital techniques such as remote sensing and/or GIS technologies for data acquisition, update, management and visualization. Botswana has perhaps moved slightly above data collection with the introduction of the new systems. However, when these are analysed against the ideals of an SDI we seem not have moved as envisaged. Vexing questions need to be asked as to what should really happen if we indeed are going to achieve a truly functioning SDI.

Geoinformation conference recommendations

At the Geoinformation conference held in November 2007 participants recommended among other things:

- that there was need to strengthen the professional association representing the geospatial information professions.
- That there was need to propose a geoinformation policy and coordination unit. This was to be done by establishing a drafting team which would work with a consultant
- That government acquisition of GIS software tools be done through enterprise agreements to realize economies of scales
- That enhancement of skills at school, institutional, and national levels was required to enable GIS penetration to all of society

Challenges of implementing NSDI

NSDI ideals revolve on issues of coordination, technology, data and people.

Data

Data acquisition seems to be managed well at institutional level. However, other institutions are not normally availed information as to the accuracy, currency and standards used to collect these data sets that are “littered” all over the various institutions. Also as stated by Cavric & Ikgopoleng (2007) little effort has been spent on transforming data into information for decision making. The challenge is to ensure that data is discoverable so that individual institutions in the SDI do not have to collect this same information at tremendous cost. Data needs to move from the realm of data to information.

Coordination

The recommendation of the Geoinformation conference highlight the fact that there has been poor coordination of the NSDI effort as evidenced by the number of stand alone projects government is undertaking in the GIS area. Cavric, Ikgopoleng and Budic-Nedovic (2003) also observed that the majority of GIS users in Botswana were working in an uncoordinated manner, expressing no interests to co-operate and function on multiparticipant basis. They further state that the prevalent disharmonic approach and dispersion of technical and human resources is Botswana’s reality that restricts more beneficial outcomes from existing GIS capacities. The recommendation to establish a drafting team to consider holistically the issues of coordination can be seen in this light. Also, there is no current professional oversight with respect to people

who pretend to offer services in the area of GIS. There exists the Botswana Surveying and Mapping Association whose focus seems to be on the surveying and mapping fraternity alone. In respect of coordination it is expected that institution arrangements need to be strengthened and that the current ad-hoc arrangements of working groups who do it on volunteer basis cannot be sustainable.

Technology

No doubt technology forms the backbone of all the activities in the SDI. The acquisition and maintenance of such technology is normally the mandate of the Department of Information and Technology within the government. Proposals for hardware and software acquisition to enable effective e-government have been received well within government. It has been suggested that enterprise licencing arrangements be entered into between government and service providers so as to allow for economies of scale.

People

The greatest challenge in the successful implementation of any technology seems to be people. While new solutions are being proposed there sometimes is lesser investment in the people who should run those systems. One observes that most of the systems that have been or are in the process of being implemented are based on a champion in the organization. In the event that the champion leaves that organization there is little doubt that the system would face major challenges and sometimes could become redundant.

In the organization of coordination one observes that little has been done to set up a proper coordinating unit with capable personnel to run the unit. This leaves the whole organization of SDI at the mercy of personal interest rather the common good. The human resource factor at this level therefore needs to be addressed adequately because without a proper driver the whole NSDI implementation seems to be going round in circles.

The cook book offers solutions regarding the organizational issues surrounding the SDI by proposing that the following should be done while building an SDI

- **Build a consensus process: build on common interests and create a common vision**
- **Clarify the scope and status of the SDI**
- **Exchange best practices locally, regionally and globally**
- **Consider the role of management in capacity development**
- **Consider funding and donor involvement**
- **Establish broad and pervasive partnerships across private and public sectors**
- **Develop clearinghouses and use open international standards for data and technology**

Management needs to seriously address the issue of capacity building especially that of human resources to enable full participation of individuals in the working groups so that the mandate of the working groups can indeed be effected.

SDI and funding models

Implementation of an SDI will necessitate funding. While this paper argues that money seems not to be the biggest problem in the establishment and continual implementation of an NSDI it nonetheless plays a major part in the way SDI can and will continue to exist past the “project” phase. Rhind(2000) established that there were four different models existing on SDI funding:

1. Government Funding (Funds derived from taxation);
2. Private Sector Funding (Derived from fees charged to customers);
3. Public Sector Funding (Derived from fees charged to customers); and

4. The Indirect Method (Funds derived from advertising, sponsorship and other indirect methods).

These funding models need not work in isolation. In the case of Botswana the current funding model revolves around direct government funding through taxation and public sector funding through cost recovery by charging users.

Giff & Coleman (2002) highlight the key factors associated to the funding models state that the design and usage of funding models are affected by a number of issues associated with the SDI implementation environment. Some of the most significant factors are:

- Government Structure - The level of government responsible for SDI implementation;
- Government Policies – SDI classification (Classic Infrastructure [public good] or
- Network Infrastructure [capacity based]), is there a need for earn returns on investment?
- Capital market – The availability of local capital for investment ;
- Social and Political Culture – The society’s views on infrastructure financing;
- Private Sector Activities- The level of private sector involvement in SDI implementation;
- and
- Legislation – The different laws that affects infrastructure financing in general and SDI pricing policies.

They conclude that for developing countries the best funding model should have the following components

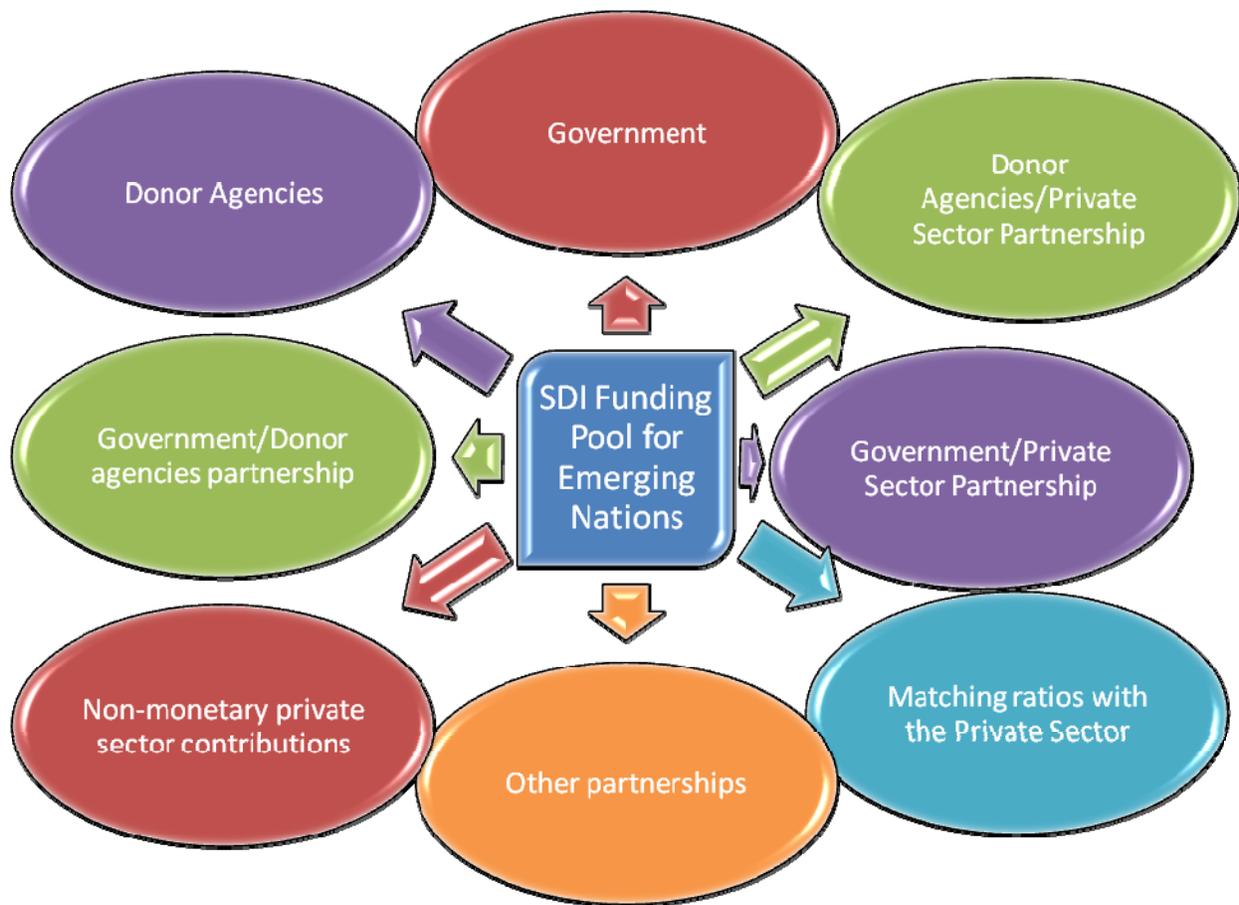


Figure 4: Funding models (After Giff & Coleman)

We can learn from this that much needs to be done in respect of creating the enabling environment in which the private sector can participate in the SDI. The need to create partnership between private sector and government has not fully been explored, for instance. Partly, this is because the size of the geospatial private sector is almost insignificant in Botswana. However overtures have been made by some private sector companies who see their role in both application and data development. Private sector companies in Botswana have been involved in developing applications for government as well as collecting data. Private sector companies cited areas in which they could participate in the SDI as:

- ▶ Standards based data development
- ▶ Service provision and support for data management
- ▶ Contributing to the development of the SDI elements ie. Discovery and access mechanisms (Portals)
- ▶ Skills development

Way forward

While all these issues talk to the arrangements of a proper SDI the challenge still remains on beneficiation of the SDI to sustainable development. The much talked about think globally, act locally comes to mind here. How can we think “big” and bring local solutions to bear in our SDI? One of the millennium goals states that “*In cooperation with the private sector, make available the benefits of new technologies, especially information and communications*”. One sees the role of SDI as that of providing information services to the betterment of society. SDI must now move from the current teething problems of institutional arrangement to the actual solution provision in issues of poverty alleviation. It is proposed that SDIs be aligned to the United Nations declaration of the MDGs. In this respect it is proposed for example to set up programmes that address the MDGs in a systemic manner. See Side bar. It is the responsibility of geospatial technologist to bring beneficiation to the communities by proposing solutions on how MDGs will be addressed within the SDI environment.

MDG Goal 1 and SDI

Halving the population of the people who earn less than a dollar and suffer from hunger by the 2015-The contribution of SDIs.

It is proposed that SDI's will collect information and set up systems that inform the political process in terms of the number of people who are still earning a dollar a day in any particular jurisdiction. Further all those who are deemed to suffer from hunger should have their information collected in databases created for this purpose.

This requires working with Statistical Offices and Mapping Agencies and private sector geospatial organizations. The information so collected could then be used to plan mitigation measures and halve the number of the poor by the targeted date.

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