



Cambridge  
Conference

[www.cambridgeconference2003.com](http://www.cambridgeconference2003.com)

Ordnance Survey  
Romsey Road  
SOUTHAMPTON  
SO16 4GU  
United Kingdom

## **Funding Models for SDIs: Are they Applicable in Emerging Nations?**

G Giff  
University of New Brunswick  
Canada

D Coleman  
University of New Brunswick  
Canada

**Paper 4A.5**

# Funding Models for SDIs: Are they Applicable in Emerging Nations?

G Giff and D Coleman  
University of New Brunswick  
Canada

*Authors' Note: This paper was originally prepared as a chapter in the forthcoming book Africa SDI: An Implementation Guide, the publication of which is sponsored through the Development Information Service Division (DISD) of The United Nations Economic Commission for Africa. The book is due for release in the fall of 2003.*

## Abstract

National spatial data infrastructure (SDI) initiatives now in place are all aimed at improving the quality and availability of spatial information throughout their respective constituencies. (See surveys conducted by [Onsrud] and [GINIE]). The majority of this first generation of SDIs evolved from National Mapping Agencies and thus, a significant proportion of their funding was derived from the budgets of these organisations. Support for their implementation was also derived from funds set-aside by government and international funding agencies for special projects. These supports were typically "one-off" in nature and were not designed to finance the maintenance of these SDIs nor the development of the second generation of SDIs.

Current SDIs are now maturing and proving to be an integral part of the information society supplying spatial information of potential significant economic value [Andari Consultants, 2001]. Along with the maturity of these SDIs comes the need for structured financing mechanism for their restructuring, implementation and maintenance. Authors (e.g. [Giff and Coleman, 2003]; [Rhind, 2000]; and [Urban Logic, 2000]) have proposed financing models for future generations of SDIs. However, these models were designed and developed for the implementation environment of developed nations and may not be applicable in emerging nations.

The implementation environment of emerging nations differs from that of developed nations in terms of: the economy, government policies, markets (financial and spatial information), the level of private sector activity, and the availability of general infrastructure and skilled work force. These factors were key elements in the development of the proposed financing models for the next generation of SDIs. Therefore, if these elements differ in emerging nations then it is expected that the effectiveness of the models will also be affected.

The aim of this paper is to investigate this hypothesis. The paper will first analyse the general implementation environments of emerging nations and determine its effect on the proposed models. The authors will then customize these models for application in the relatively different economic and political environments of emerging nations and where possible develop new models suitable for this environment.

## Introduction

Infrastructure is one of the key components of modern society that facilitates sustainable economic, environmental and societal growth [Johnson, 1997] and [Eberts, 1990]. In particular, a Spatial Data Infrastructure (SDI) producing current and reliable spatial information in the required format provides the framework for different levels of the public sector to better manage their natural, cultural and economic resources [Sorensen, 1999]. It also facilitates preparation and response to natural disaster (e.g. hurricane, fire, earthquake, famine, etc.) and the protection of a nation against woeful attacks. An SDI does not only serve the public sector but also provides the private sector with a dynamic tool to optimize their strategic planning, marketing, distribution, and production of new and innovative products.

The importance of an SDI to the information society is now well recognised and is evident from the more than 50 SDI initiatives in place over the information society (see <http://www.spatial.maine.edu/~onsrud/GSDI.htm> for more details). The efficient implementation and maintenance of these SDIs will require long and short term financing models. Over the past five years researchers – for example, Rhind, 2000; Urban Logic, 2000; Beerens and de Vries, 2001; Giff and Coleman, 2001; Fries et al., 2001; Giff and Coleman, 2002 and 2003 – have carried out research to address the financing issues of SDI implementation. This resulted in the formulation of different types of funding models for SDI implementation and maintenance. These funding models have sought to address long and short term financing of components of an SDI, financing of the different levels of an SDI, the usage of a mix of different financing techniques for SDI implementation and the function of the different stakeholders in SDI financing.

SDI funding models currently in use and those proposed by researchers do however have significant limitation in their application throughout the information society. This is because they were designed mainly for the implementation environment of the developed world. That is, all the key design features of the models were the result of analysis done on the environment of developed nations. The implementation environments of developed nations are very different from that of emerging nations; in that key design features of the models such as the economic climate, government policies, private sector activities and the capital market environment are very different in emerging nations when compared to developed nations.

This paper will analyse the implementation environment of emerging nations to identify the differences in the key design factors and determine their effects on the application of the proposed models in the implementation environment of emerging nations. After an overview of funding mechanisms and their importance in SDI implementation, the paper reviews the funding mechanisms used for SDI implementation in the developed world. The authors then analyse the implementation environment of emerging nations and determine whether or not current funding mechanisms are applicable. The paper closes with proposed funding mechanisms for the environment of emerging nations and a summary of the findings.

## Background on SDI Funding Models

The importance of having readily available spatial information in the required format is well recognized by the stakeholders of the spatial information community. The current challenge, therefore, is to sell the importance of spatial information – as a stimulus of economic growth, facilitator of good governance, an enabler of more efficient natural resources and disaster preparedness management, a 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 the international funding community.

## Selling the concept of an SDI to Financiers

Successful implementation of an SDI to some extent depends on ability of the SDI community to sell the benefits/gains of an SDI to the financiers. Infrastructure financiers generally tend to look for two main types of benefits/gains when investing; they are competitive financial return on investment and the creation of a product that will generate growth (e.g. economic, political, and environmental) within the implementation environment or across the wider society. Therefore, methods must be developed to effectively sell the benefits of an SDI to the different type of financiers.

In selling the concept of an SDI to potential financiers, an SDI program coordinator should consider the use of a business plan (see CIE, 2000 for more information on a business plan for SDI implementation). A key component of this business plan should be funding models. The term “funding models” in this paper is used to refer to both funding and financing instruments applicable to SDI implementation. Another key component of the business plan should be techniques – methods of selling the benefits of an SDI – capable of convincing the potential financiers to invest in an SDI.

A suitable technique for convincing financiers who are more interested in returns in the form of the generation of societal growth 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 possesses 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.

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]. Spatial information as a quasi-public good will encourage the private sector to enter the market to capitalized on the ability to make a profit based on the private good characteristic of spatial information. Therefore, when targeting financiers who expect monetary return on their investment it is best to place more emphasis on the private good aspect of spatial information.

In summary, classifying spatial information as a quasi-public good provides strong arguments for both types of financiers to invest in the implementation of an SDI. Financiers interested in societal growth – usually government and non-for profit organisations – will invest in an SDI for the provision of the public good aspect of spatial information. While those interested in monetary returns will invest based on the expected gains from the private good aspect of spatial information.

## The Need for Funding Models

Funding mechanisms are essential tools for SDI implementation since, without proper financing, it would be impossible to efficiently implement and maintain 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 program coordinators on how to integrate, formalize, structure, manage, present and source financing for SDI development, implementation and maintenance. This is achieved through the analysis, testing and model simulation of the funding mechanisms under different circumstances. The results of this type of analysis should provide the answers and or guidelines to key financing questions such 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. financing of 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. That is, funding models will enhance the capabilities of anticipating and identifying external and internal economic changes to an SDI that will affect financing and adopt alternative models to meet these challenges.

## Funding Models 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 of these SDIs is the funding. The funding models proposed by researchers for these SDIs and those currently in use are made up of mainly a good mix of public and private sector funding (Figure 1). In general, these models purport three main categories of financing an SDI. They are (1) financing an SDI from government funding, (2) financing through private sector funding and (3) financing through partnerships amongst the different SDI stakeholders (see Rhind, 2000; Urban Logic, 2000; Giff and Coleman, 2002 and 2003 for more detailed description of the funding models for the next generation of SDIs). The models also support the mixing of all the categories to finance the implementation of different component(s) of an SDI.

The funding models proposed for the next generation of SDIs were mainly designed for the implementation environment of 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 models to be formulated 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].

## The Implementation Environment of Emerging Nations and its Effect on Financing

Proposed and current funding models 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;
- The influence of organisational and institutional culture; and
- The availability of skilled work force.

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

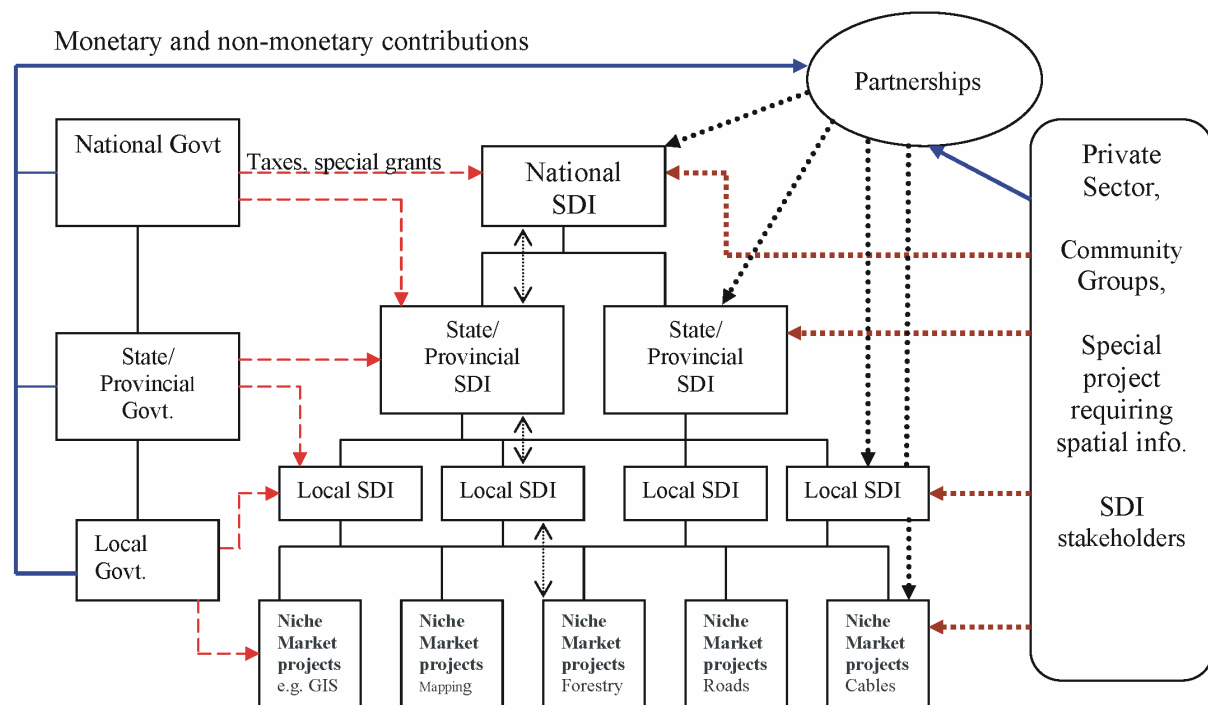


Figure 1: A Summary of Funding Models for SDI Implementation in Developed Countries

### Key

- > SDI Finance through Government – from the national budget (renewable fix term), special taxes, special project grants (one-off), user fees, etc
- .....> Private (non-government) financing – Loans, bonds, capital investment by the private sector, provision of data, special financial mechanisms, sales, royalties, subscription membership fees, expertises, etc
- .....> Financing through partnerships
- ↔ Contribution from the different levels of the SDI – monetary, data, expertises, office space, etc

## The Economies and Market Environment of Emerging Nations

In contrast to that of developed nations, the implementation environments of emerging 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, high interest rates, 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 emerging nations 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 telecommunication) 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 emerging nations. Therefore, the SDI funding models for developed nations that rely heavily on government investment will not be applicable on their own in emerging nations.

In the developing world the market environment (private sector activities) is not as vibrant as that of the developed world. For example, government policies, legislation, and the instability in the economic climate may 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 emerging nations, due to low international ranking and the economic instability of these nations [Ballard, 2002]. Also, where capital is available it is very expensive due to high interest rates associated with the risk factor involved in these economies. In addition, the concept of a spatial information market is a new one in emerging nations 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 emerging nations. This will greatly limit the ability of the private sector to develop a market for spatial information. Private sector activities in emerging nations are also affected by the lack of "free market economies". These control/centralized economies place restriction on the ability of the private sector to develop infrastructure in general and spatial information markets [Neal, 1998].

The level of private sector investment in the spatial information sector in emerging nations can be seen in a report by Tveitdal, (1999) which, states that the contribution of the geomatics information sector to the economy of emerging 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 emerging nations are much lower than that of the developed world. These figures clearly indicate that the private sector is not very active in the spatial information market in emerging nations.

In the proposed models the private sector [especially the small and medium enterprises or "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 and skilled labour. In contrast to the developed world, the SMEs of emerging nations are usually informal and are lacking in financing, information, and the skilled workforces 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 emerging nations 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 [Ezizbalike et al., 2000]; and
- The lack of political support – Governments of emerging nations 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 (see Giff and Coleman, 2003 for more details on how government can encourage private sector investment in SDIs).

### **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, emerging 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. SDIs in most emerging nations are in the early stages of implementation and therefore, are not capable of generating profit or sustaining themselves. Therefore, these SDIs will not easily attract private sector investment since they are neither profitable nor sustainable.

Subsidy for an SDI in the early implementation phase can be obtained from government, international funding agencies, and or local/international private sector. Government and the international funding agencies should subsidise the production of spatial information on the premise of a public good, while the private sector should consider investing at a loss based on long term expected gain on investment.

In summary, the SDIs of emerging nations 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 emerging nations by government, the private sector and the 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.

### **The Availability of Supporting Infrastructure**

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

In most emerging nations, 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 emerging nations 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 emerging nations 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 emerging nations 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 competitive 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 emerging nations are somewhat different from that of their counterparts in the developed world partly due to economic constraint. Government of emerging nations cannot afford to invest in SDIs and do not possess 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 legislation and policies necessary to facilitate investment in an 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 emerging nations 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 models for SDIs.

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

## **Funding Models for the SDIs of Emerging Nations**

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

### **Functions of the SDI Coordinating Bodies in Securing Funding**

In any implementation environment the SDI coordinating bodies should play a key role in securing financing. This is even more so in emerging nations 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. The task force should consist of both public and private sector members experienced in both infrastructure financing and the operations of international funding agencies. As mentioned before an important component of the business plan should be funding models based on the local implementation environment. Other funding related activities this sub-committee should be responsible for include:

- 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);
- Creation of a Donor Funding Pool to facilitate implementation – 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];
- 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, when seeking financial support for an SDI, is the UN Agenda 21 [UN, 1997];
- Foster relationships with special projects and national/sub-regional/regional spatial information Programs;
- Promote the integration of spatial information/SDI into main stream government (e.g. ministry of health, ministry of natural resources, and the ministry of environment) and main stream management information systems;
- 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 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. 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 emerging nations 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 all current and pending policies of these organisations. This type of information can be used to advise the spatial information community on how to access these funds.

### **Funding Models Influenced by Government**

Prior to the 1990's, infrastructure financing in emerging nations was primarily the function of government and the international funding agencies. However, the 1990's saw a worldwide reduction in public spending by governments. This constraint on the budgets of governments of the 1990's resulted in the governments of emerging nations 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 emerging nations 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 of the funding mechanisms for SDI implementation supported by government contributions include:

- Funding from the budgets of ministries closely related to the production or usage of spatial information. In South Africa, for example, 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;
- Develop 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;
- Financing of an SDI through 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;
- 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];
- Implementation of Special Taxation to finance an SDI – 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;
- 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;
- Financing of an SDI through 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 reserves;
- 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 the 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);
- Modernization 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);
- 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 its success can be seen in the Benin ICT development (see [http://www.oridev.org/activites/info-sensi/achives\\_orita/archive.htm](http://www.oridev.org/activites/info-sensi/achives_orita/archive.htm)).

### **Private Sector Oriented Funding Models**

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 emerging nations 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 models for SDI implementation with private sector influence include:

- The re-investment of revenue earned for 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; 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 customization 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;
- The use of Limited-recourse Structures – This method has been used over the past thirty years to increase private sector contribution to public infrastructure financing. An Example of this type of arrangement is the Aguas Argentinas water distribution system in Argentina [Buljevich and Park, 1999];
- The funding of SDI implementation through 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 emerging nations 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 of emerging nations mature.

### **Alternative Funding Models**

The nature of the implementation environment of emerging nations require the development of alternative funding mechanisms to cover the short fall of traditional (government and private sector) funding models. SDI financing in emerging nations 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 models must be ingenious and utilise the properties of local financing techniques. Possible alternative funding models to government and private sector include:

- The usage of fund raising activities – SDI coordinating bodies can organise funding raising events similar to those of charity organisations. Revenue generated 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 for SDI financing – 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 radio-thon 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;
- Implementation of policies that facilitate Tax creditable donations from organisations and the general public;
- Invite all spatial information stakeholders to contribute a membership fee to the coordinating body; and
- Twin SDI with an SDI in the developed world (i.e. is similar to how cities of different nations are twinned) – This type of arrangement will facilitate the sharing of experiences (e.g. cost reduction techniques and methods of generating funding).

SDI funding in developing countries must be creative and modelled off tried and proven funding mechanisms used in these environments.

### **Combination of the Mechanisms**

In the majority of implementation environments the models proposed under the different categories above will fall short of raising the capital investment required for the implementation of an SDI. However, individual funding models will be capable of funding the implementation of one or more component(s) of the SDI. This will result in different combination of the models listed above being used to fund the implementation of an SDI (Figure 2). Combining the funding models 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 models proposed for SDI implementation in emerging nations are not expected to replace “traditional” SDI funding mechanisms used in these countries but are considered as an effective means of augmenting them. These models can be used to effectively fund specific components of an SDI and provide program coordinators with alternative methods of raising money to accelerate implementation.

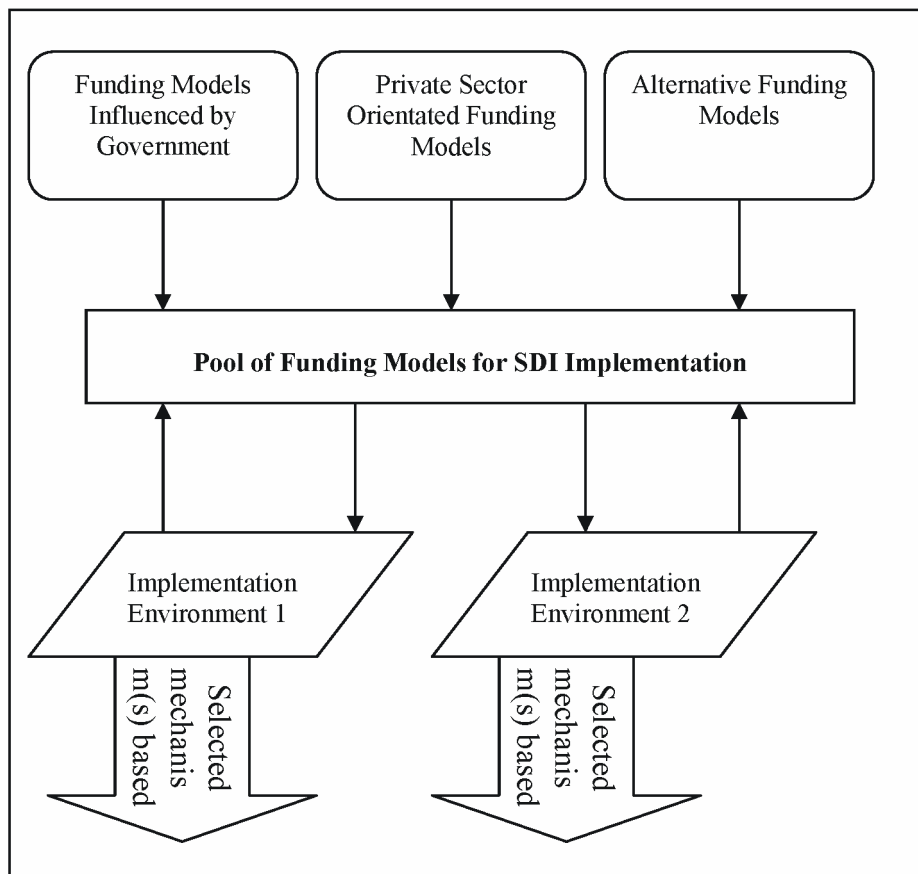


Figure 2: Funding Pool for SDI Implementation in Emerging Nations

## Re-engineering the Policies of Donor Agencies

Along with government, international donor agencies are the largest financiers of infrastructure implementation in emerging nations. 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 emerging nations 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);
- Implement policies that better facilitate 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 title of this paper is “Funding Models for SDIs: Are they Applicable in Emerging Nations?” In an attempt to answer this question the paper reviewed the SDI implementation environment of emerging nations to determine whether or not current and proposed funding models are applicable. The review indicated that the funding models are not applicable in their entirety in emerging nations.

The applications of the models were in part limited because key variables used in the design of the models (e.g. economic circumstances, private sector activities, the nature of the spatial information market, government policies, and organizational culture) were in fact different in emerging 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 application of the models in emerging nations. Analysis of the effects of the changes in these variables on the models indicates that in general the models are not applicable in their current format.

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

## References

- Ballard, H. H. (2002). “Key Performance Indicators of a Financially Viable Municipality.” Proceedings of the Institute of Municipal Financing Officers Conference, Bellville, Cape Town, South Africa, 8-10 October, 2002.
- Beerens, Sjaak and de Vries, Walter (2001). “Economic, Financial and Capacity Aspects of National Geospatial Data infrastructure” In GISdevelopment.net, <http://www.itc.nl/library/Papers/0006.pdf>
- Buljevich, Esteban, and Park, Yoon (1999). Project Financing and The International Financial Markets. Kluwer Academic Publishers, Boston, ISBN: 0-7923-8524-1
- Centre for International Economics (CIE), (2000). Scoping the business of SDI development. <http://www.gsdi.org/docs/capetown/businesscase/scoping.pdf>
- Duncombe, R., and R. Heeks (2001) “Information and Communication Technologies and Small Enterprise in Africa: Lessons from Botswana.” A report prepared for Institute for Development Policy and Management. <http://idpm.man.ac.uk/ictsmees.html>
- Eberts, Randall (1990) “Public infrastructure and regional economic development.” Federal Reserve Bank of Cleveland Economic Review, Spring 1990 pp.15-27.
- (ECA) Economic Commission of Africa (2001) “Memo on the need to Build an African Regional Geographic Database.” An ECA position paper [http://www.uneca.org/eca\\_resources/Conference\\_Reports\\_and\\_Other\\_Documents/disd/codi/docs/doc8EN.pdf](http://www.uneca.org/eca_resources/Conference_Reports_and_Other_Documents/disd/codi/docs/doc8EN.pdf)
- Ezizbalike, E., Selebalo Q., Faiz S., and Zhou S. (2000) “Spatial Data Infrastructures: Is Africa Ready?” Paper presented at the Fourth Global Spatial Data Infrastructure Conference, Cape Town, South Africa, March 13-15, 2000. <http://www.gsdi.org/docs/capetown/ezig.rtf>

Fries, T. James, Annie Metcalf, and Lisa Warnecke (2001) "Final Best Practices Report For The Ohio Spatial Data Cost-Benefit Analysis." Report prepared for the Ohio Geographically Referenced Information Program (OGRIP). [http://www.nsgic.org/hot\\_topics/cost\\_benefit/pgi-gma\\_%20finance\\_document.pdf](http://www.nsgic.org/hot_topics/cost_benefit/pgi-gma_%20finance_document.pdf)

Giff, Garfield (2002). "A Critical Review of the GSDI Cookbook from the Viewpoint of SDI Implementation in Emerging Nations." *Geomatica*, Vol. 56, No. 3, pp. 246 -250.

Giff, Garfield and Coleman, David (2001). "Financing Spatial Data Infrastructure Development: Towards Alternative Funding Models." Proceedings of International Symposium on SDI, Melbourne Australia Nov. 2001

Giff, Garfield and Coleman, David (2002). "Funding Models for SDI Implementation: from Local to Global." Proceedings of GSDI6 conference on SDI, Budapest, Hungary Sept. 2002

Giff, G and Coleman D. (2003). "Financing Spatial Data Infrastructure Development: Examining Alternative Funding Models." In *Developing Spatial Data Infrastructures: from concept to reality*. Taylor & Francis, London. NB this book is due out shortly.

Georgiadou, Yola and Richard Groot (2002) "Policy development and capacity building for geo-information provision." *GIS Development*, July 2002  
<http://www.gisdevelopment.net/magazine/gisdev/2002/jul/pdcbgp.shtml>

(IIPF), The Institute of International Project Finance (2001) "Project Financing in Developing Countries." <http://www.economics.uni-linz.ac.at/IIPF2001/>

(IDS) Institute of Development Studies Sussex (2001) "Financing and Providing Global Public Goods: Expectations and Prospects."  
<http://wbln0018.worldbank.org/EURVP/web.nsf/>

Jenkins, Carolyn and Lynne, Thomas October (2002) *Foreign Direct Investment In Southern Africa: Determinants, Characteristics And Implications For Economic Growth And Poverty Alleviation. A Globalisation and Poverty research programme case study*. Available at <http://www.gapresearch.org/finance/G&P%20FDI%20report%202002-10.pdf>

Johnson, Ronald (1997). "Emerging Markets Experience in Infrastructure Financing: Lessons for South African Local Government." Proceedings of the Institute of Municipal Finance Officers annual conference, Durban, South Africa, September 1997

Love, James (1995). " Pricing Government Information." *Journal of Government Information*, Vol. 22. No. 5, pp. 363-387, 1995.

Masser, Ian (1998). "The first Generation of National Geographic Information Strategies" Proceedings of GSDI3 conference on SDI, Canberra, Australia, Nov.1998 Also available <http://www.gsdi.org/docs/canberra/masser.html>

Moeller J., and G. Karmazin (2003) "Time to Fund NSDI." *Geospatial Solutions*, Vol. 13. No. 4, pp. 58, 2003

de Montalvo, Uta Wehn (2001). "Outreach and Capacity Building." In *Developing Spatial Data Infrastructures: The SDI Cookbook*, Ed. D. Nebert  
<http://www.gsdi.org/pubs/cookbook/cookbook0515.pdf>

Neal, Ronald V. (1998) "Bridging the Telecommunications Gap" *Africa Recovery*, Vol.12. No.1, August 1998

Onsrud, H.J. (1998) "Balancing Intellectual Property Rights and Public Goods Interests in Geolibraries", International Federation of Surveyors (FIG), Vol. 3, pp. 222-226, July 25, 1998. Also available at <http://www.spatial.maine.edu/~onsrud/pubs/balanceIP&PG.pdf>

(OXERA), Oxford Economic Research Association Ltd (1999) "The Economic Contribution of Ordnance Survey Great Britain." A report prepared for the Ordnance Survey of Great Britain. <http://www.ordnancesurvey.co.uk/literatu/external/oxera99/>

Pollio, Gerald (1999). International Project Analysis and Financing. University of Michigan Press, Michigan. ISBN: 0-472-11095-0

Rajgopalan, S. (2003) "Digital Mapping Policy: The Issues in India" GIS Development, Vol. 7. No. 4, pp 34, April 2003

Rhind, David (2000) "Funding an NGDI." In Geospatial Data Infrastructure Concepts, Cases and Good Practice, Ed R. Groot and J. McLaughlin. Oxford University Press, New York, NY. Pp39-55

Sorensen, Mark (1999) "Institutional Linkages for National and Regional GIS Management Issues, Opportunities and Challenges." Proceedings of the Ordnance Survey Conference, July 1999, Cambridge, UK.

Tveitdal, Svein (1999) Economics of EIS. Environment Information Systems in Sub-Saharan Africa (EIS-SSA) Publication, May 1999, Pretoria, Republic of South Africa. <http://www.grida.no/eis-ssa/products/econom/index.htm>

Urban Logic, (2000) "Financing the NSDI: National Spatial Data Infrastructure." Report prepared for Federal Geographic Data Committee, Washington, D.C. <http://www.fgdc.gov/whatsnew/whatsnew.html#financing>

(UN) United Nation, (1997) "Agenda 21" A United Nation policy document. Available at <http://www.un.org/documents/ga/res/spec/aress19-2.htm>