

# **The Role of Private Sector Participation in the Development of National Geospatial Data Infrastructure**

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## **ABSTRACT**

Over the last few years, the pace of changes in the Surveying and Mapping industry has accelerated with the introduction of National Geospatial Data Infrastructure. These changes are being driven by a number of forces. The most important of these is the promotion of spatial data infrastructure as a basic component for good governance. This is leading to a demand for geographical information and geographically enabled applications from very rapidly growing markets and sectors.

Under the auspices of the National Spatial Data Infrastructure (NSDI), a basic geographic data set or “framework” is being produced. The framework will be a consistent set of digital geospatial data and supporting services that will satisfy the needs of users to maintain and manage the variety of common information being collected by the public and private sector. Therefore, this paper will discuss the need and the role for private sector participation with special focus on the industry best practise.

## **1. INTRODUCTION**

Geographic information or Geoinformation or better still Geospatial information (GI) is beginning to provide 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, is beginning to play a major role in shaping policies, programmes and projects of Government establishments. Geospatial information 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.

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## **1.1 World Summit on Sustainable Development (WSSD)**

The World Summit on Sustainable Development was characterized by a high level of participation by major groups, in accordance with General Assembly resolution 55/199, which encouraged effective contributions from, and the active participation of, all major groups, as identified in Agenda 21. Among the resolutions of the WSSD is to ensure that our rich diversity, which is our collective strength, will be used for constructive partnership for change and for the achievement of the common goal of sustainable development of spatial infrastructure.

## **1.2 Millennium Development Goals**

The government has launched a clear and credible poverty reduction strategy - the National Economic Empowerment and Development Strategy (NEEDS), restored macroeconomic stability, and effectively managed oil revenues. The administration is taking courageous and decisive action against corruption. Nigeria is leading the world on implementation of the Extractive Industries Transparency Initiative (EITI) and has established a dynamic Economic and Financial Crimes Commission to fight corruption. At State level, the challenges are greater, but here too there has been progress. Most States have implemented State Economic Empowerment and Development Strategies (SEEDS). Their performance in economic governance and transparency is being measured through a SEEDS 'benchmarking' process. Donors and the Federal government are seeking to support States to reform.

## **1.3 NEPAD**

Nigeria hosted the NEPAD Fish for All Summit in Abuja from 22 – 25 August 2005 under the Chairmanship President Olusegun Obasanjo. NEPAD Nigeria was actively involved in the Summit. The NEPAD Fish for All Summit is the first high-profile Africa-wide event to draw global attention to the vital role of fisheries and aquaculture to meeting Africa's development agenda. The NEPAD Secretariat, the World Fish Centre and FAO took up an invitation from President Obasanjo, Chairman of NEPAD Heads of State and Government Implementation Committee (HSGIC) and Chairman of the Fish for All Initiative, to hold this event in Abuja, Nigeria. The Summit comprised a 2-day Technical Symposium, a Nigeria Fisheries Day, an Africa Fisheries Exhibition, and a Heads of State Summit to endorse common African objectives for the future of fisheries and aquaculture in pursuit of the Millennium Development Goals. The

Summit produced among other things the Abuja Declaration on Sustainable Fisheries and Aquaculture in Africa and the NEPAD Action Plan on Fishery and Aquaculture.

#### **1.4 Needs**

National Planning Commission (NPC) has primary ownership of the core goals and objectives of the National Economic Empowerment and Development Strategy (NEEDS) at federal level. On the State level, State Economic Empowerment and Development Strategies (SEEDS) are being developed to compliment NEEDS.

#### **1.5 Integration and Cooperation of Good Governance**

In order to successful compliment the collective aims and objectives of the world summit on sustainable development, millennium development goals, new partnership for African development, national economic empowerment and development strategy, it is essential that the following are made available:

- (i) the need for adequate collection, management, dissemination, and use of geo-spatial data.
- (ii) the need to treat information 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.

Therefore, SDIs are increasingly being recognized as an indispensable part of the national infrastructure that any country has to establish and maintain as part of the country national infrastructure.

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 couple of years in order to understand:

- ❑ what the infrastructures are,
- ❑ how are they built,
- ❑ how they work, and
- ❑ why they are important.

## **2. GEO-SPATIAL DATA INFRASTRUCTURE IN NIGERIA**

The concept of a spatial data infrastructure is not new again in Nigeria and a lot is going on in the establishment of spatial data infrastructures at the national, state and local levels. At the moment, geo-spatial data in Nigeria is under-used with no systematic collection and maintenance of fundamental geo-spatial datasets taking place. There is a paucity of standards in the way of national policies for the collection, management and utilisation of geospatial information.

This lack of effective spatial data infrastructures (SDIs) is negatively impacting upon effective decision-making and development planning. Various development projects collect geospatial datasets, but only to satisfy the minimum requirement of the project and often not in accordance with accepted standards. This data collection is done in a sporadic and uncoordinated manner with no intention of maintaining such data. As a result the data becomes obsolete very soon, and also is not accessible for purposes other than for that project.

There are a number of factors that undermine the ability of Nigeria 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<sup>1</sup>. Nigeria therefore needs to revise her strategies for spatial 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 of government activities and policies in line with international best practices are beginning to offer unprecedented opportunities for Surveyors in the integration of Digital Mapping, Geoinformation and Geospatial data holdings into day-to-day activities of the government programmes particularly at the Federal and State levels. The collection of these Geospatial data holdings is now being regarded as national assets.

## **3. ROLE OF PRIVATE SECTOR PARTNERSHIP IN DEVELOPMENT OF GEOSPATIAL DATA INFRASTRUCTURE IN NIGERIA**

In order to address the under utilization of the geospatial data infrastructure, the private sector partnership will be needed in the following areas

### **3.1 Need for Private Sector Partnerships In Development Of Geospatial Data Infrastructure Framework In Nigeria**

The Development of Geospatial Data Infrastructure is a means to assemble geographic data nationwide to serve a variety of users. The framework is one of the key building blocks that forms the backbone of the National Geospatial Data Infrastructure. The framework can be categorized in three major parts

Generally, there are gaps in determining what constitutes the fundamental geo-spatial datasets and their attributes. The reasons for these gaps include and not limited to the following:

- Uncertainty in spatial information: How it is conceptualised, Described, Modelled, and Propagated.
- User interfaces: Usability testing, Interface design, and Visual languages
- Scale issues of geographical information: Problems with scale, Exploiting scale, Multiscale analysis and description.
- Databases: Extending Geographical database structures, Data Models, Data fusion, Data base description and ontology, Interoperability.
- Dissemination of Geographical Data: Spatial Data Infrastructures, Web Access, Watermarking
- Visualisation: New and traditional approaches to visualisation and mapping, Generalisation, Symbolisation,
- Terrain and surface modelling: Interpolation, Modelling, Analysing, and Extracting Features
- Spatial Modelling: The use of spatial data in urban, regional, transport and environmental modelling
- Remote Sensing: The conversion of RS data to information, Novel algorithms, and Integration and Fusion of data
- Spatial Cognition: Human understanding of space, Models of space, Wayfinding,
- Social issues of GIScience theory and GISystem use
- Critical approaches to and evaluations of the use of GISystems in applications
- Social, Economic, Legal and Policy issues of Geodata and GISystems use

It is therefore important for the private sector to partner with public sector so as to undertake a gap analysis for each the fundamental geo-spatial datasets and their attributes.

### 3.1.2 Catalogue of Available Fundamental Geo-Spatial Datasets

This is the catalogue (inventory) of the available fundamental geo-spatial data, at national, state and local levels. A catalogue is required of what fundamental geo-spatial data are currently available. The datasets to be included in the catalogue will:

- a) cover national datasets;
- b) cover regional/subregional datasets;

- c) metadata for each dataset must be collected;
- d) geo-spatial data may be available in different formats, including maps (hard copy)
- e) metadata to be collected for each dataset must conform to the ISO 19115 –Geographic Information – Metadata standard.

The following metadata elements must be included:

- Dataset title;
- Dataset reference date;
- Dataset responsible party;
- Geographic location of the dataset;
- Dataset language;
- Dataset topic category;
- Spatial resolution of the dataset;
- Abstract describing the dataset;
- Distribution format;
- Spatial representation type;
- Reference system;
- Lineage;
- Metadata file identifier;
- Metadata language;
- Metadata character set;
- Metadata point of contact;
- Metadata date stamp.

### 3.1.3 Data Content Standards

A data content standard that specifies what information should be contained within a geospatial data set, and provides a formal description of a model that defines the concepts of a view of the real or hypothetical world that includes everything of interest, for data required by one or more applications. The definition of data content standards shall include and not limited to the following:

- o Documentation specifying the information in a data set. This includes:
  - Data dictionaries, feature catalogues and classification. These define the types of geographical features (ie: the classes or feature types) one would find in a data set, together with their attributes (types and domains) and other peculiarities, enabling users to have a shared understanding of the contents of the data set.
  - Feature instances. The instance of a feature in a data set represents a discrete phenomenon in the real (or imaginary) world – that is, something specific out there that is

modelled in the data set. The instance normally has coordinates and may be portrayed on a map by a particular graphic symbol. Standards for feature instances specify the unique, definitive versions of features.

- ❑ Metadata. “Data about data”, metadata includes the various types of information that describe the structure and content of a data set, and how to access and use the data. Metadata encompasses issues such as data quality (positional accuracy, attribute accuracy, completeness, logical consistency, currency and lineage), data schemas, spatial referencing systems, constraints on the use of data, and contact details for those responsible for the data set. Metadata enables data discovery, determining fitness for use, data access and data transfer.
- ❑ Spatial representation. This addresses how locations are represented, either through coordinates (given within the context of a spatial referencing system) or geographical identifiers (eg: the name of a town).
- ❑ Data organization. This encompasses the logical description of the data set, using formal languages such as the eXtensible Markup Language (XML) or its implementation for geographical information.
- ❑ Reference models. These provide conceptual descriptions of data sets, using standards such as ISO/IEC 10746, the Reference Model of Open Distributed Processing (RM-ODP) with its five Viewpoints (Enterprise, Information, Computation, Engineering and Technological).
- ❑ Formal description of a model, for example using the Unified Modelling Language (UML). Such formal descriptions are (hopefully) embedded in the data content standards and hence for the purposes of this project, we need only record their presence or absence and use them to understand the content of the standards, rather than analyse the models per se.

There are already many initiatives addressing these issues for geospatial data in Africa by both public and private sectors, but the participation and involvement of Nigerian private practitioners are limited.

#### 3.1.4 Mapping Africa for Africa

The representatives from all African countries were invited to a meeting held in August 2003 in Durban, South Africa. At this meeting the Mapping Africa for Africa initiative was launched with the drafting of the Durban Statement on Mapping Africa for Africa. The Durban Statement

was adopted by the General Assembly of the International Cartographic Association in August 2003

and by CODI in April 2005. There is a CODI-Geo Working Group on Fundamental Geospatial Datasets that is currently working on addressing the situation of a poorly mapped Africa. This Working Group is currently defining what should be the fundamental geospatial datasets at the national, sub-regional and regional levels.

The best practice for the collection and maintenance of the fundamental geospatial datasets, including data models, processes and appropriate technologies is being prepared to assist countries. Each country will then be able to prepare a plan of action to address the gaps in the geospatial datasets. All of this work will require the full participation of all the countries through public private partnership for data collection and maintenance.

Simultaneously there is another CODI-Geo working Group addressing the establishment of a uniform geodetic reference frame, called the African Reference Frame (AFREF). Such a geospatial reference frame is one of the underpinning fundamental geospatial datasets. Good progress is being made with AFREF and all African countries are now invited to submit their intent to participate in AFREF.

### 3.1.5 Global Navigation Satellite System Technologies

Global navigation satellite system technology is currently being used in a wide range of sectors including but not limited to: aviation, maritime and land transportation, mapping and surveying, monitoring of the environment, agriculture and natural resources management, and disaster warning and emergency response. Particularly for developing countries, global navigation satellite systems (GNSS) are an enabling technology that can make a major contribution to economic growth and social betterment. The Plan of Action, contained in document A/59/174 entitled “Review of the implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space” and endorsed by the General Assembly in its resolution 59/2, presented findings and proposed specific actions in the areas that are important for strengthening and further developing the well-being and the future of all nations.

These actions include, among others, maximizing the benefits of the use and applications of global navigation satellite systems to support sustainable development, improving medical and public health services through the use of space technologies, developing a comprehensive, worldwide environmental monitoring strategy as well as improving the management of the Earth’s natural resources. Since 2001, the Office for Outer Space Affairs of the United Nations has organized a series of regional workshops and international meetings to promote the use of GNSS. These workshops and meetings presented the status of existing and near-term GNSS

systems and their augmentations and also presented examples of GNSS applications that support sustainable development and protect the environment.

It is important to note that the meeting of Global Navigation Satellite Systems is opened to both private and public sectors in order

- (a) to increase the awareness among managers, policymakers and decision makers about the potential benefits of applying GNSS technology to the areas of remote sensing, precision agriculture, aviation, transport and communications and e-learning
- (b) to strengthen regional information and data exchange networks on the use of GNSS technology; and
- (c) to develop regional/national pilot projects that use GNSS technology in the above areas for improving the social and economic growth.

Therefore, private sector participation is paramount.

### 3.1.6 SDI Web-based Information Portals

The development of web based portal for SDI projects is the ultimate aim and goal of Global Spatial Data Infrastructure. An SDI web-enabled software system has been developed, it allows one to build, view and edit feature catalogues and classification schemes, and all the elements in them, and to export and import feature catalogues and classification schemes using a simple structure consisting of ten files containing comma-separated values. The system provides a consistent interface for adding, viewing, editing or deleting data fields. A form of security is provided to prevent accidental change of the data. The system caters for feature catalogues and classification schemes that are empty (ie: not yet populated). The system was developed to allow only one user at a time to build or edit a specific catalogue or classification scheme, but other users can view the catalogue or classification scheme.

## **4. CONSTRAINTS OF PRIVATE SECTOR IN THE ESTABLISHMENT OF GEOSPATIAL DATA INFRASTRUCTURE IN NIGERIA**

The major constraints to establishing an effective spatial data infrastructure are:

### **4.1 Lack of Political Support and Funding**

A spatial data infrastructure and its geospatial information are a means to an end, and not an end in itself. An SDI does not deliver a service to the citizen of the country and fundamentally supports the delivery of services. The citizens therefore do not see the benefit of an SDI and therefore the politician will not win any votes in the next election specifically because they have

facilitated the establishment of an SDI. The result is lack of political support and government funding for an SDI. Without funding SDI programmes cannot be executed

#### **4.2 Communication**

Communication between organisations and even within the same organisation, at times, is poor. Anyone who has sent out a questionnaire or an e-mail request for information will know what poor response is from Federal, State and Local Government establishments. There are also difficulties in identifying the contact persons, due partly to political interference in the public service, which makes ongoing communication difficult. Lack of communication is hampering national and regional efforts to establish SDIs.

#### **4.3 Data**

Without the geospatial datasets there can be no SDI. These datasets must be relevant to the needs of the users. To be relevant will require the datasets to be collected in accordance with accepted standards and be maintained. The collection and maintenance of geospatial data is an enormous task, requiring a lot of resources, and therefore the SDI should prioritise the fundamental and core geospatial datasets.

#### **4.4 SDI Technologies**

New SDI technologies, particularly in the imaging and GIS fields, are making it easier and speedier to implement an SDI and collect geospatial data. The technologies are very expensive.

#### **4.5 Standards**

System interoperability and data standards are essential for an SDI. These standards will enable data to be shared among organisations, thereby avoiding duplicating the collection of data. More importantly, adherence to standards will enable the synergistic building of new information and knowledge through the merging of datasets. There is a lot of work that has been done with respect to standards by the International Organisation on Standardisation (ISO) and the Open GIS Consortium. Implementing these standards may be difficult with limited skilled resources.

#### **4.6 Delivery Mechanisms**

Data is of no use and value unless it is used. An SDI must made every effort to ensure that the available geospatial data is accessible to users. Various mechanisms, such as clearinghouses, are being used to allow user to easily determine what data is available and what are the metadata. Technology, particularly the web, must be used to remove the tedium of searching for and then

accessing the data – where the data is physically located should be transparent to the user. For now, access to these data is very difficult.

#### **4.6 Financial Resources**

A lot of work is still necessary to convince politicians and senior public officials to fund the establishment of an SDI and for the collection of data. This is a not going to be easy. One possible way to do it is to prepare value chains, which highlight the role of geospatial data in the delivery of services to the citizens.

#### **4.7 Human Resources**

The best systems will not work unless there are the right skilled people to operate them. Capacity building programmes need to receive a lot of support from governments. Partnerships must be created between the public and private sector to retain such skills within the industry and within the country. Nigeria cannot afford to be an importer of skilled people.

### **5. RECOMMENDATIONS**

#### **5.1 SDI Capacity Development Initiatives**

Considering the technical, financial and operational implications of SDI, and particularly the benefits to be derived it is important for surveyors to take advantage of the SDI initiatives though capacity building.

#### **5.2 Participation at International Conference**

The organisations which include and not limited to International Federation of Surveyors (FIG), Global Spatial Data Infrastructure, AARESE, EIS, AfricaGIS etc have been placing emphasis on SDI initiatives particularly for Africa through the organisation of conference, workshops, seminars, and exhibitions Surveyors should see the participation at the international conferences as INVESTMENT and not EXPENCES.

#### **5.3 Responding to Government Reform Programmes**

In order to find lasting solutions to the problems of the Aviation Industry, the Federal Government organized a National Aviation Workshop on Safety, Quality Assurance and Reforms organized by the Federal Ministry of Aviation which was held from January 19 to 20, 2006. The workshop, which had the theme “Building Consensus for Effective Aviation Sector Reforms”, was attended by Nigerian Aviation Stakeholders as well as International Experts from ICAO, IATA, AFRAA, IFC, Boeing and Airport Company of South Africa (ACSA). I responded

to the call with a presentation of paper titled “Satellite Imagery and GIS as Innovative Technology for Aviation Industry. My recommendations were accepted and these led to invitation to tender for surveying and mapping of all Airports in the country.

## 6. CONCLUSION

Nigerians are beginning to move beyond talk and address the obstacles and constraints retarding the establishment of effective spatial data infrastructures. To name but a few include the missionary work of National Space Development Agency, Regional Centre for Training Aerial Space (RECTAS), Academia, and private organisation like AAC Consulting. In recent times there is a growing movement in Nigeria to go beyond talk and start to implement development programmes that will make a difference to all the people of Nigeria.

In considering ways to address the constraints that are hampering the establishment of effective SDIs we can discuss the way forward under the main components of an SDI, namely policies, organisational remits, data, technologies, standards, delivery mechanisms, and financial and human resources. Mapping Africa for Africa is a bold initiative to move beyond talk and to achieve results. This will only happen with the full support of each country, the African Union and NEPAD, development agencies and the international community. Let us work to achieve the ‘4 C’s Challenge’ of communication, cooperation, coordination and collaboration.

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## **BIBLIOGRAPHICAL NOTES**

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Tony inspires innovative action, foster change and influence decision-making processes in the development of GIS in Nigeria. His many acclaimed – and best selling books include Geographic/Land Information Systems – Principles and Applications and Geographic Information Systems – Operations and Management.

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