

# **GEOINFORMATICS AND THE INTERNET AS STRATEGIES FOR A SUSTAINABLE MARKETING OF THE NIGERIAN MINERAL RESOURCES**

**Dr. Peter C. NWILO and Dennis A. OSANWUTA, Nigeria**

**Key words:**

## **ABSTRACT**

Nigeria is endowed with reserves of mineral resources distributed throughout the country. They include mineral fuels, metallic and industrial minerals. However, most of these minerals remain untapped due to inadequate information in terms of location, quantities and qualities that fosters development and marketability. Using Geographic Information System (GIS) technology, a database of Nigerian Solid Mineral inventory and miners have been created. Interactive digital maps of Nigeria showing towns, road networks and approximate locations of the mineral site have also been created. This work has put together body of knowledge on mineral resources in Nigeria that can be marketed via the Internet. There is the need for the Ministry of Solid Mineral to create a website that will help potential investors get information on Nigerian mineral resources.

## **1. INTRODUCTION**

Mineral resources encompass a wide variety of endowments going from mineral fuels to metallic and non-metallic minerals. Some of them are found on the surface while others can only be obtained from the earth through mining. Nigeria is endowed with scores of mineral resources that are widely distributed in almost all the states in the federation. Most of these minerals have remained untapped due to inadequate maps showing their accurate geographical locations, quantities, proximity to towns and infrastructures such as roads, electricity, water, railways, waterway, etc. For several years now, the dedicated tool for marketing these mineral resources have been pictures, paper maps where available, paper drawings, paper work orders, paper forms, and photocopiers. Field service personnel on assignment have relied on printed copies of map schematics to execute service orders. But, with the digital revolution which has improve efficiency and productivity, maps and drawings are being created from established mineral resources database on-screen using computer-aided solutions. Users can now easily access data using geographic information system (GIS) and the Internet.

The Nigerian mineral resources can be described as naturally occurring substances and are more than three scores distributed across the nation. These mineral resources are of high quality that meets international standards. They can be classified into mineral fuels, metallic and non-metallic minerals. Mineral fuel include coal, lignite, tars and bitumen; metallic minerals comprise of uranium, iron, tin, lead and zinc, etc; while the non-metallic

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minerals includes gemstone, talc, asbestos, marble and limestone, to mention a few (see fig. 1). The management of these information can be greatly enhanced by the use of the geographic information system (GIS). In this project crude oil and gas have not been incorporated as information on them are readily available.

## **2. THE GEOGRAPHIC INFORMATION SYSTEM (GIS)**

### **2.1 Definition**

ESRI (1999) defines geographic information system (GIS) as a computer based tool for mapping and analysing things that exists or happens on earth. Siting mining company, finding a mineral location or figuring out the best route to a mineral location, have a geographical component. GIS enables the integration of these components and other information to create maps, visualise scenarios, solve complicated problems, present powerful ideas, and develop effective solutions.

On the other hand, a database is a design on how people record and maintain information using a computer. Through periods of social changes, varying concepts grew from pieces of paper to file folders and file cabinets as the principal storage tool for important information. Today, the computers have replaced these old tools. It is now possible to add new data, display maps, manage and retrieve data. The purpose of all these concepts is to create a data system that can facilitate rational utilisation, planning and management of resources.

Also, a database can strictly be any collection of data items but Taylor (1998) defines a database as a self-describing collection of integrated records. However, a record is a representation or model of some physical or conceptual reality and each having multiple attributes. A database consists of both data and metadata as explained by Taylor (1998). Metadata is a data that describes the structure of the data within a database. This makes database contents a description of its own structure (self-describing). For instance, a mineral type has a name, location, quality of deposit and other relative and descriptive quantities to form a data for that particular mineral. A group of this type of data stored together forms a database.

GIS database embraces all types of data through a location referencing procedure by which a direct relationship between information and their geographical location is established (i.e. geocoding). Therefore GIS is an ideal instrument to link a database suitable for generating digital maps. To support the idea, Ayeni (1979) gave the following reasons:

- It has the ability to update information easily and ensure currency of data.
- It has the flexibility in aggregating current data.
- It eliminates unnecessary duplication of information.

Finally, GIS database can be queried independently or from within the GIS.

### 3. DEVELOPMENT OF A NIGERIAN MINERAL RESOURCES DATABASE

This will be grouped into the following subheadings: selection of database software, planning the database, digitisation of existing map, integrating CAD drawings with base map.

#### 3.1 Selection of database software

The selection of database software for this work is based on the following:

- **Ability:** to carry out specific or multiple tasks as may be required
- **Flexibility:** which such software affords in aggregating data over a range of boundaries (i.e. to consolidate and summarise information to obtain statistics and make the data easier to interpret and manage).
- **Work Environment:** refers to avoidance of loss of data due to transfer, storage and conversion of data from common database.

This work is based on a relational database model. ArcView GIS which is a relational database software for desktop GIS and mapping was used due to the fact that it can handle lots of tables and create relationship among them. Also, it allows integration of Computer Aided Design (CAD) drawings in a number of different file formats directly to existing digital maps without first having to convert these files. Joining of tabular data to features in the CAD drawings is equally allowed. Other qualities include the ability to visualise, explore, query and analyse data geographically.

#### 3.2 Planning the database

The database for this work consists of records and each has multiple attributes. To obtain a simple and effective relationship among these attributes, Wempen (1997) gave the following guide:

- **Determination of the needed tables:** Technically one table is needed but since too much information will be stored it was best to create tables and create also relationship among them.
  - (a) Each table is given a theme: For instance, mineral type, towns or roads as the case may be.
  - (b) Splitting of Repetitive data into their own table.
  - (c) Using ID numbers for all records to avoid typing errors that comes from entering long text strings (such as names) and to help link tables.
- **Determination of the forms needed:** This is subject to data entry action. For instance keeping track of inventory or collecting the names and contact information for mining companies.
- **What report to produce:** to satisfy the need for information about the data. For instance the status of a particular mineral.

### **3.3 Digitisation of existing map**

Digitisation as described by ESRI (1999) is the process of converting the features on a paper map into digital format. Using AutoCAD software program in conjunction with a digitising tablet connected to be computer, the features of map of Nigeria, which includes political boundaries, rivers, lakes, towns and connecting roads were digitised.

The x and y coordinates of these features were automatically recorded in AutoCAD drawing files (drawing formats) and stored as spatial data onto an base map of Nigeria showing the state and local government boundaries. Each of these features was represented as a theme, and each theme was on its own layer. This is to allow for creation of additional new set of themes or an update of an existing theme. For instance, the base map of Nigeria is on its own layer, each state on its layer, towns, roads, river and mineral types are on their own layers.

### **3.4 Integrating CAD drawings with base map**

Integration of Computer Aided Design (CAD) drawings was direct without converting the files. The processes are given by ESRI (1999) in the manuals of ArcView GIS.

## **4. INTERNET**

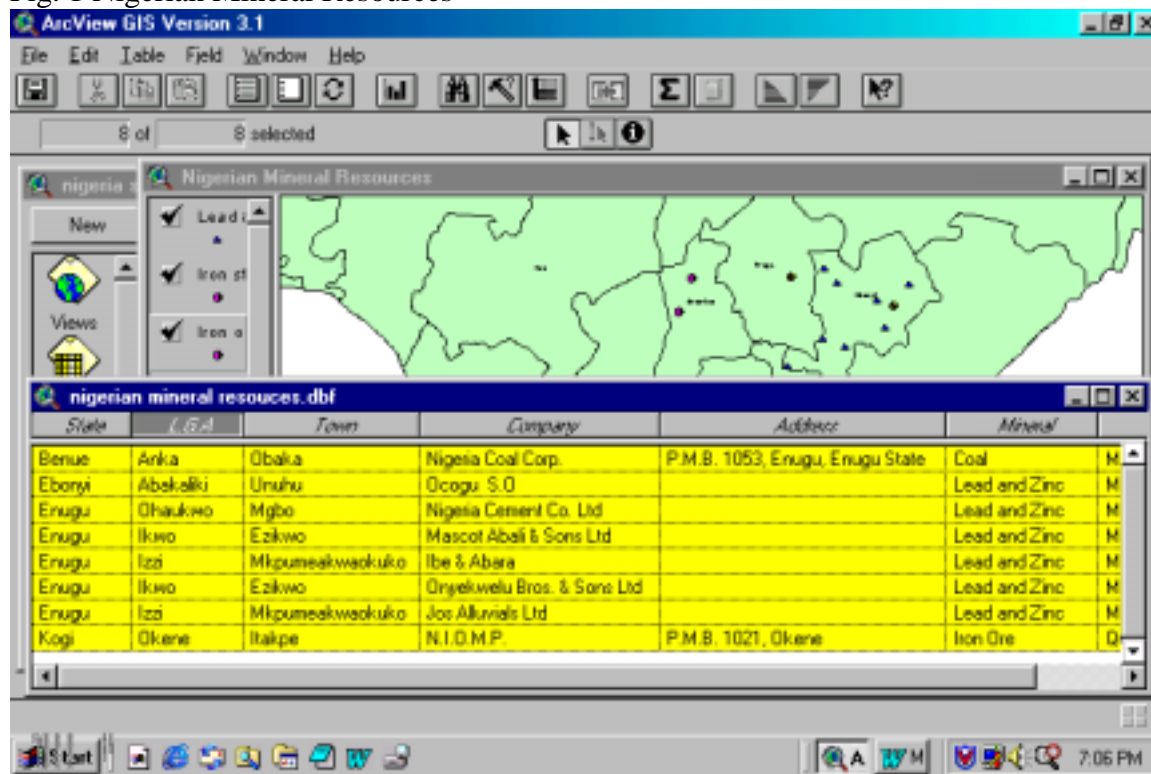
The Internet is rapidly setting the environment in which modern businesses and government service have to operate. E-commerce is currently the buzzword for marketing resources including mineral resources. According to Hootsmans (2000), the new market consist of three major players:

1. Those managing the technical infrastructure – mainly directed by telecommunication companies that have global influence.
2. The service providers – who actually link users and producers of information together.
3. The content providers – those possessing information that is potentially valuable for Internet access.

### **4.1 Nigerian solid mineral website**

Without doubt, the potential role of the Ministry of Solid Minerals is that of content provider. This can take many forms from passive to active involvement. The Ministry of Solid Minerals website should be seen as a pioneer medium for anybody needing reliable information about a certain mineral with respect to type, grade, accurate location, and proximity to infrastructures and towns.

Fig. 1 Nigerian Mineral Resources



These geographic information should attract some fee that can be related to the costs involved in producing the data as well as benefits accruing to potential customers. In this way, Ministry of Solid Minerals Development in conjunction with other government agencies will again be playing a pioneering role in innovative e-commerce services. Thus, providing a platform for new business ideas for commercial marketing mineral resources. Finally, geoinformatics and Internet will solve the costly and time consuming search through the hardcopy database since it provides easy tool for using database via the Internet.

#### 4.2 The marketing strategy

Internet is the world fastest growing market. It provides a wider market coverage that is significantly different from any other. The adoption of GIS society-wide and worldwide is inevitable as it provides information on location and attributes online. This technology will advance in concert with the increases in capability and lower cost of production. It will also meet the globalisation trend that is currently in vogue.

From the above expectations, the factors that will have the most impact on geoinformatics and Internet are easy to purchase and acquire. Advantage of the technology is optimised to reach potential investors better as it is a successful way to cope with the ever-growing stream of new data sources and to respond to the wide diversity in user demands. Another key principle of the strategy is to pursue innovations, which the Internet brings as it

represents a fundamental change to the business environment. This requires a radical new approach to marketing that fosters development of locally customised products and services. Finally, it is expected to expose the Nigerian mineral resources to a wider market rather than a relatively isolated business environment.

The creation of the Ministry for Solid Mineral Development in 1995 is aimed at formulating policies and actions that will ensure an orderly development of the vast solid mineral resources through active private sector participation. In other words, the Ministry is to play the role of a facilitator and accelerator.

#### **4.3 Using the Internet to market the Nigerian mineral resources**

Internet is a new marketing paradigm that the Ministry of Solid Minerals needs to take advantage of in the marketing of mineral resources of the country. A wide range of skills is needed to respond to the diverse call for value added products. Such products increase in number and complexity due to the fact that investors can afford the new technology for analysis and visualisation. The information offered by the Ministry of Solid Mineral needs to be steadily improved to remain useful in all these new products since potential investors expect the information to be reliable, up-to-date and easily accessible.

So far, official mineral data have been regulated under the authority of the Ministry of Solid Mineral Development. These wide variety of heterogeneous mineral data however, are still distributed in the form of pictures, paper maps or schematic drawings through traditional distribution network such as Federal agencies retail map shops. But, the market potential of mineral data can no longer be developed through these traditional distribution networks. In order to disseminate these mineral data on a wider basis, Internet technology has to be applied.

### **5. THE BENEFITS**

Many users from the mining industry, educational institutions, public and private sectors will tremendously benefit from the Internet technology. One of the biggest benefits is that since the Ministry of Solid Mineral and their agencies are the single source of information, it will reduce administration and resource overheads.

With the incoming of digital maps and other geographic information, private investors and the public can do away with all paper maps and schematic drawings and concentrate on digital maps. The maps will offer an overview of the Nigeria Mineral Resources, new possibilities on economic information, risk management and best location of mining sites. Finally, this will function as a platform for new e-commerce and location based information services, which will provide equal access and shared information.

### **6. CONCLUSION**

Geoinformatics and Internet as a marketing strategy for Nigeria mineral resources will represent a milestone in the history of mineral resources development in Nigeria. The

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Nigerian mineral resource database will be viewed by clients on the internet and also be available on CD-ROM format that will provide a complete documentation of existing infrastructures, mineral type, location, relative description of quantity and quality of that particular mineral, etc. It will also serve as a platform for new e-commerce services as well as lure some first-time users into the market. Finally this Internet portal will provide a complete geographic information solution to the problem associated with getting information from hardcopies to the potential investors, educational institutions and interested members of the public.

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## **BIOGRAPHICAL NOTES**

Dr. P. C. Nwilo is a senior lecturer in the Department of Surveying and Geoinformatics, University of Lagos, Akoka - Lagos. He has over 48 papers in journals, conference proceedings and seminars. He has published extensively in the areas of coastal management, GIS applications, and curriculum development in surveying and geoinformatics, GIS laws, etc. He has B.Sc. and M.Sc. degrees in Surveying from the University of Lagos and a Ph.D. degree in Environmental Resources from the University of Salford, UK.

Dr. Nwilo is a surveyor with a strong interest in coastal/environmental management. His Ph.D. thesis was on "sea level variation and the impact along the coastal areas of Nigeria". This thesis is a very useful contribution to the understanding of coastal processes along the coast of Nigeria.

Dr. Nwilo is a member in the editorial board of a number of journals and papers such as the journal of Environmental Education and Information. He is a member of the University of Lagos Senate and several university committees. He has attracted several research and teaching facilities to the university.

Dennis A. Osanwuta has B.Sc. in Surveying, Geodesy and Photogrammetry from the University of Nigeria, Nsukka and M.Sc. degree from the Department of Surveying, University of Lagos. He has worked extensively with oil prospecting company as a senior surveyor as well as a consultant with GIS consulting company. He is presently pursuing his Ph.D. degree in the Department of Surveying and Geoinformatics, University of Lagos. His Ph.D. thesis is focussed on the use of geographic information in "the analysis of the impact of flooding in the Niger Delta area of Nigeria". He is member of Nigerian Institute of Surveyors.

## **CONTACT**

Dr. Peter C. Nwilo  
Department of Surveying & Geoinformatics  
University of Lagos  
Akoka, Lagos  
NIGERIA  
Tel. + 234 1 545 4891 ext. 1865 or 2707  
Email: pcnwilo@yahoo.com

Dennis A. Osanwuta  
Department of Surveying & Geoinformatics  
University of Lagos  
Akoka, Lagos  
NIGERIA  
Tel. + 234 1 775 8806  
Email: dennisosanwuta@yahoo.com