The Role of Surveying & Geoinformatics in Nation Building

ADEWARA M. B[1] **ADEDOKUN** A. M[1] **IRIVBOGBE** H. E[2]

[1]Department of Surveying & Geoinformatics, School of Environmental Studies, Federal Polytechnic, Ilaro, Ogun State, Nigeria. thawben@gmail.com +234 803 068 4742

[2]Hesi-Geomatics Limited, Lagos, Nigeria.

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Abstract

Surveying is one of the earliest professions of man which has and will continue to play significant role towards the social-economy of developed Nation. The Surveyors' roles have been underestimated and in some cases put to the back burner. This presentation tries to bring to limelight, the beauty of Surveying and Geoinformatics. In this paper, attempts have been made as much as possible to justify to a reasonable extent for the audience the roles of Surveying & Geoinformatics in Nation Building. It begins from the concept of the parent words that make up the title; Nation, Building and Surveying & Geoinformatics and concludes with the roles Surveying & Geoinformatics play in nation building.

Keywords: Surveyor, Geoinformatics, Nation-building, Infrastructure, Management

1.0 Introduction

Surveyors have always played important roles in national development. They set the information foundation that has integrity and is reliable, robust and can be used for socio-economic planning, land use planning, fiscal and other national development policy.

The foundation is built on the concept that land is the source of all material wealth and from it we get all the things that we use of value. It is the key to our existence and its distribution and use is of vital importance.

As a commodity, land has a unique feature, namely, it is immovable and cannot be destroyed. In creating a cadastral plan or map, cadastral records are created so that the unit of land can be located readily, surely and unambiguously at any time on the ground. In the circumstances, the land parcel is the fundamental unit in a cadastral information system/ land information system in a digital environment.

1.1 The Nation

The nation has been defined by many, especially from the academic perspectives. But it can be described as a group of people living together with sole aim of technologically advancing together

to achieve certain laid down goals. This idea establishes the belief that the success of a nation can be determined by how well that nation innovates and diffuses technology across its people.

1.2 Nation Building

Building a Nation-building refers to the act of constructing or structuring a national using the power of the state thereby causing such nation to become larger and more advanced through the systematic use of scientific and technical knowledge to meet specific objectives or requirements. It can involve the use of propaganda or major infrastructure development to foster social harmony and economic growth.

National building is the ability of a nation to improve the lives of its citizens e.g. by providing social amenities like quality education, potable water, transportation infrastructure, medical care, etc. The provision of these social amenities is achieved through scientific and technical knowhow of the professionals of which the surveyor is not left out.

1.3 Surveying & Geoinformatics

Surveying is the measurement and mapping of our surrounding environment using mathematics, specialized technology and equipment. Surveyors measure just about anything on the land, in the sky or on the ocean bed. It is the technique, profession, and science of determining the three-dimensional position of points and the distances and angles between them on, above or below the earth surface.

While Surveying deals with measurements on the earth surface using mathematical approach, Geoinformatics might be referred to the academic discipline or career working with different data types using different technologies, approaches, processes to interpret earth related issues for better understanding and interpretation of human interaction with the earth's surface. Geoinformation can combine different types of dataset, say from GIS, remote sensing and non-remote sensing, and socio-economic to generated results inform of maps or other forms of reports which allow better interpretation, management and decision making about human activities upon earth's surface

As one the fundamental objectives of national development, satisfaction of basic social and economic needs alone do not guarantee sufficient access to pure water, health services, education and other forms of social infrastructure, including opportunities for cultural enrichment (Adewara & Kolawole, 2017).

For this the role of a land surveyor cannot be overemphasized. Since this satisfaction of social infrastructural needs is a sine-qua non to developments, it became necessary to extend infrastructural developments across national frontiers. Following this new attitude, a number of laudable regional projects have been conceived. One such project is the channeling of some waters of Oubangui River at Palambo in Central Africa Republic, through a navigable canal, to Lake Chad in north-eastern Nigeria (Eugene, 2006).

A recent survey (IICA and IFAD, 1994) has shown that in the coastal areas of Guyana, 51 percent of the poor do not have their basic needs met, and an additional 19 percent of the non-poor also suffer that kind of deprivation, so the problem is rather widespread and its occurrence is not always linked to poverty *per se*. It is undoubtedly more serious yet in interior regions, but it also is increasingly evident *in* the capital, where the piped water supply leaves much to be desired from a viewpoint of public health and where disposal of sewage and solid wastes does not meet environmental health standards.

1.4 The Surveyor

A Surveyor is a personnel who has the academic qualification and technical expertise to practice the science of measurement; to assemble and assess land and geographic related information; to use that information for the purpose of planning and implementing the efficient administration of the land, the sea and structures thereon; and to instigate the advancement and development of such practices (FIG, 1991). Surveyors play an integral role in land development, from the planning and design of land subdivisions through to the final construction of roads, utilities and landscaping. Surveyors are the first people on any construction site, measuring and mapping the land. Surveyors also work with civil engineers, landscape architects, and urban and regional planners to develop comprehensive design documents. Some surveyors work in specialty fields to survey particular characteristics of the Earth. The truth is Surveyors are of enormous importance to the public and without surveyors, land ownership, land development and construction would be absolute chaos. The Surveyors of today (and tomorrow) are in a unique position to influence the societies of the future and they need to establish their role as the lead professionals in the area of sustainable land development. It appears that the profession in general is finally starting to realize that ‘business as usual’ is just no longer acceptable and something needs to be done to ensure that the

developments we create now and in the future do not have a detrimental effect on the surrounding environment.

1.5 Types of Surveying

The primary role of the surveyor is to find and mark certain locations on, above or below the land. For example, they could be interested in surveying the boundary of a certain property or finding the coordinates of a specific point on the earth.

1.5.1 Cadastral Land Surveys

These are related to land surveys and are concerned with establishing, locating, defining or describing the legal boundaries of land parcels, often for the purpose of taxation.

Topographic Surveys

The measurement of land elevation, often with the purpose of creating contour or topographic maps.

1.5.2 Geodetic Surveys

Geodetic surveys locate the position of objects on the earth in relation to each other, taking into account the size, shape and gravity of the earth. These three properties vary depending where on the earth's surface you are and changes need to be taken into account if you wish to survey large areas or long lines. Geodetic surveys also provide very precise coordinates that can be used as the control values for other types of surveying.

1.5.3 Engineering Surveying

Often referred to as construction surveying, engineering surveying involves the geometric design of engineering project, setting out the boundaries of features such as buildings, roads and pipelines.

1.5.4 Deformation Surveying

These surveys are intended to ascertain whether a building or object is moving. The positions of specific points on the area of interest are determined and then re-measured after a certain amount of time.

1.5.5 Hydrographic Surveying

This type of surveying is concerned with the physical features of rivers, lakes and oceans. The surveys equipment is on board a moving vessel with follows pre-determined tracks to ensure the entire area is covered. The data obtained are used to create navigational charts, determine depth

and measure tide currents. Hydrographic surveying is also used for underwater construction projects such as the laying of oil pipelines.

2 Surveyors' roles in Nation Building

Without proper planning by any government, any attempt towards National development is determinedly planning to fail. Planning involves an adequate knowledge of engineering, the legal systems, and significant local facts. These local facts include the characteristics of the natural environment, such as relief and topography, and information about the existing statutory conditions of land use, particularly as it relates to the land rights (Orit & Moshe, 2006).

2.1 National Infrastructures and Surveying

Surveyors have always played a key role in planning for physical developments, responsible for data collection and for the management of different design and engineering plans such as transportation, water system, and power system plans using proper metric standards (e.g., coordinate system, accuracy, drafting specifications, etc.). Transportation itself is as old as the existence of the universe. Transportation is one of the basic infrastructures, the commonest being transport by water, road, rail and air. Addressing the transportation and traffic challenges of a complex Nation like Nigeria has been a major priority of the current administration especially in complex cities like Lagos, Port Harcourt. The need to exploit alternative means of transportation mode cannot be over-emphasized given the complex nature of the sector in the Country. Modern approaches in Bathymetric survey have brought about large development in the ports and the charting of navigation channels. The long canal in the copper belt province of Zambia (mainly for irrigation) remains the longest within Africa. The linking up of this canal (which requires the input of surveyors) from the Congo River at Palambo in Central African Republic to Lake Chad in north eastern Nigeria will foster the replenishment of Lake Chad for irrigation and boost inland water transportation within the sub-regions (Eugene, 2006). The planning and design of all Engineering projects such as rails, highways, bridges, tunnels, dams etc are puzzles based upon surveying measurements. Without these professionally calculated measurements, we would not know how the puzzle looks when put together. Moreover, during execution, project of any magnitude is constructed along the lines and points established by surveying. Thus, surveying is a basic requirement for all Civil infrastructural projects.

Figure 1: Railway taking off from Yaba Lagos

Figure 2: Surveyors on a railroad project

Figure 3: Surveyor on a road project:

Preliminary requirements for the construction of air runways require setting out the frame work of the design drawing on the ground by the surveyor. The set out frame work on the ground is expected to be as accurate as the designed drawing on paper. For the purpose of the setting out, the Surveyors' controls are a prerequisite. The need for geodetic control is critical in ensuring the accuracy of the survey data gathered for a successful establishment of airport ground structures.

According to Africa and the Middle East (2005), Quoted by (Eugene, 2006), the International Air Transport Association (IATA) and the FAA have partnered in a project to develop Global Navigation Satellite System (GNSS) procedures for 26 air ports in 14 states in the Southern Africa Development Community. The project, scheduled to be completed in 2002, involved conducting geodetic (GPS 84) surveys at each of the airports. It also included the development of the 104

GNSS procedures for all the airports. These GNSS procedures will enable aircraft to approach and land at the SADC airports using satellite technology.

Figure 4: Surveyors setting out Airport facilities

Figure 5: DGPS observation at Helicopter landing

2.2 Urban planning and Surveying

Surveyors have always played a key role in urban planning, responsible for data collection and for the management of different design and engineering plans such as transportation, water system, and power system plans using proper metric standards (e.g., coordinate system, accuracy, drafting specifications, etc.). Technological advancements such as Geographical Information Systems (GIS) and Global Positioning Systems (GPS) have created an even greater need for surveyors in urban planning as spatial data administrators, organizing the different raster and vector files from the project inception till the final step of As-Build mapping and infrastructure maintenance using GIS. The figure below describes the different steps of urban development; steps that are performed by surveyors are drawn in light blue.

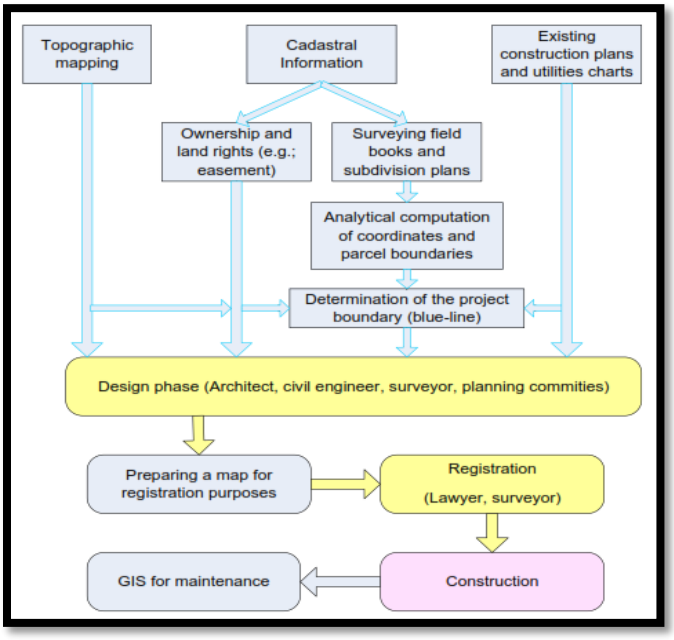

Figure 6: Steps in Urban development ((Orit , Shwarts; Moshe, Felus;, 2006)

In some roles the Surveyor would create computer maps of the landscape, using geographical information systems (GIS), satellite imaging and precision measuring instruments. Organizations would then use these maps to decide how best to develop the land for other uses, such as leisure, conservation areas, specialized food production or bio-fuel crops.

2.3 Energy Infrastructure

Surveying has also contributed greatly to energy especially in areas of power generation and power distribution. Hydroelectric power plants produce electricity through the constructed dams in which a power source is used to turn a propeller-like piece called a turbine, which then turns a metal shaft in an electric generator, which is the motor that produces electricity. Geodetic surveying systems are used to monitor any displacements at large concrete dams. These Geodetic survey systems must be carefully designed and materialized, not only as a response to required sub-millimeter accuracies but also in regard as to their lifetime, which is expected to last as long as the dam.

Figure 7: Survey Network station at Monte Novo dam site. ***Figure 8: Surveyor at a Dam site***
Source: (Henriques, Maria João & Casaca, João, 2004)

Also, laying pipeline in the wrong spot can cost any nation more than it should. Using the latest technologies for fast and accurate data collection for oil and gas development, Surveyors' pipeline development services can help find the most cost effective and efficient route to lay pipes. A new solution for gas leaks which is faster than traditional gas detection devices has evolved. This technology measures methane plumes in the air, automatically mapping and displaying results in real-time in a web browser for faster, more accurate leak detection, and then immediately alerts users and repair teams upon leak detection in real-time while traveling at normal driving speeds.

Figure 9a & b: Surveyors on site during gas pipeline Laying

2.3.1 Solar Energy

Solar energy has supplemented most electrical systems. Surveying can assist in the development of this emerging infrastructure by assisting in the mapping of the location and distribution of existing solar energy infrastructures so as to plan for favorable deployment of new ones. The Site Surveyor assists in obtaining the necessary technical data such as roof details, easement descriptions and exhibits, proposed road staking, Proposed Utility Line Staking, check out a

homeowner's property and confirm that what the solar energy consultant has designed is in fact the best possible solution etc, needed to facilitate the installation of solar photovoltaic systems. The surveyor also takes note of possible obstructions, like tall trees, on or near your property.

In the past, lot orientation and solar access were given little thought in subdivision design. Traditionally single dwellings will generally 'face the road' and be parallel to side boundaries, regardless of lot orientation. In addition to this, the majority of windows will also 'face the road' and standard boundary setbacks in NSW do not recognize the solar access needs of neighboring properties.

In countries with significantly variable climate were a large amount of energy is required to cool houses in summer and warm them in winter. The design and orientation of a house on a parcel of land is used to admit or exclude the suns heat/energy, thus land characteristics such as orientation, slope, size, shape and width are important considerations.

2.3.2 Power Transmission

Energy providers rely on accurate utility transmission surveys and maps to install and maintain the infrastructure needed to provide reliable energy and protect public safety. Existing power transmission lines require existing utilities maps that can be used in the design of the new utility lines. In cases such as this, reconnaissance and preliminary surveys are seldom necessary. By using advanced remote sensing technologies such as mobile and airborne LiDAR, conventional ground survey methodologies and subsurface utility engineering (SUE) techniques, surveyors can safely and efficiently collect the accurate, high-density data needed to map transmission line corridors, conduct distribution circuits planning and develop vegetation management plans.

Figure 10: Surveyors mapping power transmission lines

Figure 11: Electric power distribution

2.4 Telecommunications Infrastructure

It is obligatory that telecommunication companies submit a Certification for locations where they have installed antennas. This follows a telecommunications survey. This survey is required for the Collection of zoning information regarding height restrictions and setback requirements, accurately determine Flood-Plain information and comply with the latest FEMA regulations, and to Collect precise boundary information that complies with state/city regulations to get approval in order to construct a cell tower. Telecommunication surveys record and report easement, boundary, zoning, utility, access information and topographical data relative to tower location.

2.5 Health Care Facilities

The provision of adequate and equitable basic health services is becoming increasingly difficult due to rapid population growth, rising poverty levels and lack of available resources. One of the imperatives of health care provision is a concern for both social and spatial justice (Fanan U & Felix K., 2014).

Today, many health care planners and official can benefit from education and training in the GIS field and this will give them the chance of influencing the progress of health surveillance, environmental health assessment and the geographic allocation of health resources.

All of the above issues have encouraged many heath organizations to use GIS and to benefit from its tools and functions (Usman, Ado K & Ahmed, M, 2013).

Figure 12: Health facility location & health informatics

2.6 Research Communities and Surveying

Academic research, along with teaching, has long been recognized as a primary responsibility of faculty members, and research accomplishments often bear heavily on tenure decisions. It is a multi-step process that doesn't always go in a straight line and its purpose is not just to push the boundaries of knowledge, but to break free from limiting personal beliefs about the way things should be. Surveyors' Council of Nigerian (SURCON) and Nigerian Institution of Surveyors (NIS) commission researches to provide information, stimulate debate and promote leading-edge thinking among surveyors, policymakers and key influencers in business. This surveying research is not simply collecting data, evidence, or "facts," then piecing together this preexisting information into a paper. Instead, the research is about inquiry—asking questions and developing answers through serious critical thinking and thoughtful reflection. This is evidenced in the reports of their annual general meetings of the Surveyors.

2.7 Land Management Systems

Surveyors are the creators and keepers of the cadastre and the land administration systems of the future will need to be able to handle an increasingly complex combination of rights, restrictions and responsibilities over land due to environmental, social and economic issues (Underwood, 2010).

A Land Information System (LIS) is a geographic information system for cadastral and land-use mapping, typically used by local government. It is a tool for legal, administrative and economic decision-making and an aid for planning and development. Similar to a GIS, an LIS is designed

specifically to contain spatially references land related data for a defined area and procedures and techniques for the systematic collection, update, processing and distribution of this data.

As conservation became a more important public policy goal, and politicians became concerned about substantial corruption involved in earlier land sales, efforts to hand over large tracts of federal land slowed. Some land was set aside for parks, wilderness and conservation. This called for the need to delineate International, Interstate, consistency and Local Government area boundaries. This delineation requires a robust data system to house the least information pertaining to each delineation, thus the implementation of land Information systems (LIS).

2.8 Agriculture/Forestry

The need for crop classification, seeding dates, knowledge of ground depth, the comprehension of surface runoff and irrigation channels, and the calculations of estimated yields have shown that there exists a strong potential for Surveying & Geoinformatics activities for tracking agricultural growth. Geoinformatics can be used to monitor forest health and calculate loss caused by pests, disease and invasive species. The principles of land surveying are applied to soil and water management on agricultural, forested, and environmentally sensitive areas. Great forestry management includes knowing the resources the forest contains, calculating potential value, and planning operations. ArcGIS has a powerful suite of analytical tools to help agriculturists and foresters to understand and manage forests. It has robust data management capacity, visualization capabilities, modeling tools, and web applications.

2.9 Geology and Minerals

The discipline of geology includes the examination of the composition, properties, and history of the earth materials. The technique of their formation, movement, and changes involved are also studied. The geological survey has developed into a modern technology that utilizes the technological advancement of several disciplines of engineering and surveying. The geology survey techniques include geological and topographic mapping with the employment of robotic lasers, GPS, laser beams, and other modern systems. Geological mapping was a difficult procedure involving multiple complex technologies until researchers discovered the potential of GIS. With the application of GIS in geological mapping, it became very easy for surveyors to create 3D maps for any area with precise and desired scaling. Geologist have used surveying compass to produce some stunning geological maps in the past years. These maps are perhaps sobering to look at without the benefits of modern technology today. These techniques have increased the accuracy

of field geological surveying, and the speed with which it can be done, but they are of limited values unless underpinned with basic mapping skills.

2.10 Forensic mapping / Crime Scene investigation for National Security

The Surveying & Geoinformatics mapping and location data can assist with crime investigations. With the use of Surveying Instruments and mapping programs Surveyors are able to work with Forensic professionals and create a 3 dimensional environment based on Crime scene Logistics. This type of Surveying enables Law Enforcement Technicians to use these dimensions to calculate the height and weight of an assailant if captured on a Security Camera. In addition to rendering a 3 d environment using Video Surveillance, detailed measurements can also offer different perspectives as to how a crime was committed using exact locations and mathematical equations based on the crime scene conditions. Surveying is present in the military (army, navy, air force, marine corps, coast guard etc). The concept of Command, Control, Communication and Coordination in military operations is largely dependent on the availability of accurate, spatial information provided by Geoinformatics to arrive at quick decisions for operational orders. The military builds and repairs many airstrips, docks, barracks, roads, and other projects each year. Surveying, mapping, and drafting technicians conduct land surveys, make maps, and prepare detailed plans and drawings for construction projects. Surveys and maps are also used to locate military targets and plot troop movements.

Figure 13: A Crime suspect

Figure 14: A crime scene

2.11 Surveyor as Expert Witness in the Court of Law

Disputes have been with people and will continue to be with them. Likewise, it is reasonable to expect that surveyors will occasionally disagree, and litigation will sometimes be created because of such differences of opinion (Curtis, 1958).

Property disputes usually occur between neighboring property owners when there is a change in ownership of a home. The new homeowner may wish to install a new fence, driveway or landscaping that might seem to encroach upon adjacent lots, leading to protests from their neighbors. Nevertheless, a lawsuit is sometimes the only way to settle a significant boundary dispute. No Lawyer can help with your boundary dispute without the survey documents and the surveyor himself. The law will no doubt require the licensed surveyor surveyed the lands in dispute to give expert evidence in the court of law. Surveyors rely on an understanding of the science of surveying measurement and analysis, the legal principles of boundary location, the laws related to boundaries and land use, and applicable mathematical and computational theories and principles when performing this work.

Figure 15: Wooden gate forming part of a boundary

Figure 16: Surveyors' document as a tool for court judgment

3 Conclusion

Infrastructures as one major component of development exist in space and surveying is invariably required to establish their positions. This information on their positions is necessary for the planning and execution of associated projects (Eugene, 2006).

Building a Nation with respect to land acquisition, effective physical planning and land administration is hinged on the availability of up to date or current maps. Maps as important tools for national building, is a product of the Land Surveyor which can be acquired through either Remote Sensing) or ground surveying. This paper has described the contribution of surveying and Geoinformatics in the core spheres of the built environment. It briefly outlined the driving forces in surveying in other developmental professions including research.

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