NEXUS AMONG GEOSPATIAL PROBLEMS, EMERGING GEOSPATIAL TECHNOLOGY APPLICATIONS AND SUSTAINABLE SURVEY PRACTICE IN NIGERIA

Oluwole ADENIRAN, Saheed OLANIYI & Osaretin OGBEBOR

Key words: Sustainable Development, Geospatial Technology, Surveying Practice, Decision-making

SUMMARY

The practice of Surveying and Geoinformatics in most parts of Nigeria has been confined to a limited scope by the Practitioners, thus not making themselves fully relevant to the geospatial information needs for the development of the nation, Nigeria. Such practice cannot be sustainable overtime and can lead to diminishing role of Surveyors in the society. This discourse serves as a springboard to providing Sustainable Survey Practice in Nigeria. Prevailing increase in development problems in the nation is initiated by stress in land, air and water due to rapid increase in population growth and lack of proper management of natural and human resources of the country. These problems are geospatial in nature and require the use of geoinformation as critical input in the development decision process, especially in the implementation and achievement of Sustainable Development Goals. The confinement to a limited scope of practice is not unconnected with insufficient knowledge capacity and geospatial skills. Many of the Private Practicing Surveyors engage mainly in cadastral aspect and plan production. The Statutory offices /unit are struggling with core data set production due to lack of development concepts, inappropriate methodologies and slow process of map production. Surveyors in public and private sectors have the greatest and most effective roles to play considering the importance of their needs in securing a better future to the practice of surveying in the country and changing the narrative of the present limited scope of practice. The sustainability of Surveying and Geoinformatics practice in Nigeria requires the capacity of the practice for continuance into long term future which can be achieved through Surveyor's contribution to the implementation and achievement of Sustainable Development Goals. This can enhance Sustainable Survey Practice by enlarging the coast of practice thus increase the breadth and diversity of the practice. In order to protect our environment and sustainably manage our resources, Surveyors need a good grasp of geospatial technology applications and spatial thinking/reasoning to overcome the traditional mapping concept still so often found in the definition of products. Surveying and Geoinformatics education needs to be tailored through the review of curriculum to accommodate the needed change. There should also be a review of the nature of the prevailing surveying practice and the laws and regulations guiding such practice to create an enabling environment to widen the scope of Surveying Practice in Nigeria.

1.0 INTRODUCTION

The geospace consists of earth's land, air, and water that support human beings and other bio-geographic systems. A place on the geospace implies a location on the earth's surface; the relationship between it and other locations, and the processes affecting changes in those relationships. The processes affecting changes occurs in a particular place at a particular time, making its spatio-temporal dimension critical. According to Enemark (2010) "Place! matters! Everything happens somewhere. If we can understand the nature of 'place' where things happen, along with its impact on people and assets on that location, we can plan better, manage risks better and use our resources better". Land is the foundation of all forms of human activities; from which we obtain food to eat, shelter and space to work, the road to drive cars and room to relax, among others. Land is finite in extent and permanent by nature, and it is man's most valuable resource (Ojigi et al,2011).

Most of man's earthly problems are initiated by stress on land due to anthropogenic factors, especially, the rapidly increasing human population. The world's population increased from less than three billion at the beginning of the last century to pass six billion at the beginning of the new millennium (Onsrud 2001). The global population is predicted to be over 9 billion people in 2050 and this represents an increase of 2.8 billion worldwide (Dewberry 2008). In Nigeria, the population grew from just over 30 million in 1952 to around 120 million in the year 2000 and over 160 million in 2012 (Filani, 2012). It was predicted to be about 206.139 million in 2020 (World meter, 2020). As the human population expands, the land-population ratio decreases and land values appreciate. Material resources therefore dwindle while human activities continue to stress the quality of land, water and air. Consequently, the importance of measuring, monitoring and management of land, air and water in our environment cannot be overemphasized and is becoming increasingly critical.

These problems which are majorly geospatial in nature require the use of geospatial information as critical input in the development decision process especially in the implementation and achievement of Sustainable Development Goals (SDGs), involving all aspects of biophysical, cultural and socio-economic development. Myriads of geospatial problems bedeviled Nigeria and these require urgent solution for the nation to move forward. Though the nation is Africa's most populous country and with much potential for rapid development which could boost the continents economy, instead it is dragging it down. Geospatial Information is increasingly needed as Decision Support in solving a lot of these overwhelming problems resulting from population explosion and its attendant decision problems.

Examples abound in various aspects of national development that cannot be implemented and achieved without the use of geoinformation in the development process. Improving revenue generation in a developing grassroots economy (e.g in the Local Government Areas) through land use charge becomes an uphill task without a framework that could produce current and accurate geospatial information to enhance correct property assessment and general planning. Nigeria is facing power problems which is affecting all development facets of production and management. Power Utilities companies are seeking new methods to improve system reliability, power quality and customers satisfaction. There is a need to keep comprehensive and accurate inventory of their physical assets, both as part of normal service provision (extending the electricity network, undertaking maintenance, etc) and as part of their obligation to inform third parties in particular, other utilities or construction agencies with information on the location of their installation, which is vital for damage control. Also there is an increasing

need for geospatial information production and management for planning, designing, building, and maintenance of infrastructure like roads, bridges, dams, private and public buildings, estates etc. In other sectors of the economy like agriculture, politics and government business, security, environment, health etc, geospatial information is needed as critical input for effective decision making. Thus Geospatial Information being an infrastructure is required as foundation for further development of a nation. Surveyors and Geoinformation Practitioners have a major role to play in geoinformation production, management and utilization, with a need to add intelligence to geospatial decision making process in national development.

2.0 THE SURVEYING PROFESSION

Surveying is one of the oldest professions known to humanity and has been important since the beginning of civilization (Fajemirokun,1976, 1978). The practice of Surveying in Nigeria can be described to be as old as Nigeria itself. Surveying is one of the oldest professions practiced in the country. In fact there is evidence of the practice of the profession before the amalgamation of the Northern and Southern Protectorates in 1914. For example, map of old Calabar town was produced on scale of 1/93000 by the Presbyterian Church as far back as 1868 (Ayeni, 1981). Also, Survey Department existed in Lagos and Kaduna as early as 1899 and 1900, respectively. Much of the activities of these departments were mostly cadastral. The establishment of a public Survey Department in Nigeria dated back to the latter half of the 19th century (Adebekun, 1981). Fajemirokun (1988) defined Surveying as that branch of geosciences which deals with the location of points on the earth surface, the graphical representation and visual representation of such points, and the determination of the figure of the earth and its gravity field using the method of applied mathematics and physics as basic tools. Here Surveyors were assumed to be confined to taking measurement with little or no concerns for capacity to process, produce and manage the necessary geospatial data and information that will be useful ingredients in addressing geospatial decision problems of today's world in all ramifications, especially of the Sustainable Development Goals.

The International Federation of Surveyors (FIG) according to Ghilani and Wolf(2008) however define a Surveyor as one who is able to do more than taking measurements but that with capacity and qualifications to conduct one, or more of the following activities.

- Determine, measure and represent the land, three-dimensional objects, point's field, and trajectories.
- Assemble and interpret land and geographically and economically related information.
- Use the information for planning and efficient administration and management of the land, the sea and any structure thereon.
- Carry out urban and rural development and land management and conduct research into and develop them.

Consequently, the FIG further stated that the Surveyor's professional task may involve one or of the following activities which may occur either on, above or below the surface of the land or the sea and may be carried in association with other professionals.

I. The determination of the size and shape of the earth and the measurements of all data needed to define the size, position, shape and contour of any part of the earth and monitoring any change therein.

II. The positioning of objects in space and time as well as the positioning and monitoring of physical features, structures and engineering works on, above or below the surface of the earth.
III. The development, testing and calibration of sensors, instruments and systems for the above-mentioned purposes and for other surveying purposes.
IV. The acquisition and use of spatial information from close range, aerial and satellite imagery and the automation of these processes.
V. The determination of the position of the boundaries of public or private land, including national and international boundaries, and the registration of those lands with the appropriate authorities.
VI. The design, establishment and administration of geographic information systems (GIS) and the collection, storage, analysis, management, display and dissemination of data.
VII. The analysis, interpretation and integration of spatial objects and phenomena in GIS, including the visualization and communication of such data in maps, models and mobile digital devices.
VIII. The study of the natural and social environment, the measurement of land and marine resources and the use of such data in the planning of development in urban, rural and regional areas.
IX. The planning, development and redevelopment of property, whether urban or rural and whether land or buildings.
X. The assessment of value and the management of property, whether urban or rural and whether land or buildings.
XI. The planning, measurement and management of construction works, including the estimation of costs. (Ghilani and Wolf,2008)

In application of the foregoing activities Surveyors take into account the relevant legal, economic, environmental, and social aspects affecting each project" (Ghilani and Wolf,2008). The breath and diversity of the Practice of Surveying (Geomatics) as well as its importance in modern civilization are readily apparent from this definition. When compared with other contemporary definitions of surveying, the FIG definition promotes the breaking into new frontiers of Surveying and Geoinformatics practice.

2.1 THE LEGAL FRAMEWORK FOR SURVEY PRACTICE IN NIGERIA

In Nigeria, the Surveying Profession is strictly regulated by law. The profession is currently being regulated in accordance with the provision of the 1999 constitution of the Federal Republic as amended, being the grundnorm, as well as Surveyors' Council of Nigeria (SURCON) Act CAP S18, LFN, 2004.

Item 49 of the Exclusive Legislative List of the Nigerian Constitution vest absolute power in the Surveyors Council of Nigeria (SURCON) as the Federal Government Agency, to regulate and make subsidiary legislation on the "*Professional Occupation* of Surveying in Nigeria through the SURCON Act. Besides, Paragraphs 25 and 26 of the Concurrent Legislative List of the Nigerian Constitution vest power in the Federal Government (SURCON) and State Government to legislate only on three (3) branches of Surveying, that is trigonometrical, cadastral and topographical surveys. However, the law is clear that if any State Government in

Nigeria needs to legislate on any of the three (3) branches of Surveying itemized, it must align with the one made by SURCON, while all other branches of Surveying are "a no go area" for the State to legislate upon. **AG Abia State & Ors v. AG Federation (2002).** More so, by the constitutional law doctrine of covering the field, once there is a federal enactment on a matter contained on the concurrent legislative list of the Constitution, the state is not expected to make any enactment at all on it. See the case of AG Lagos State v. Eko Hotel Ltd. & Anor (2017 Sc). Therefore, the power of SURCON to regulate all the branches of Surveying in Nigeria is absolute.

It is also important to state that the SURCON Act has placed absolute power in SURCON to regulate and control the practice of Surveying Profession in all its ramifications. Regrettably, the regulatory body has not exercised its control in all the ramifications of the Surveying profession in Nigeria. In fact over the years, the regulatory body has only been paying attention to the regulation of the Cadastral branch of Surveying, with less emphasis on the other branches of Surveying, which is grossly against the Constitutional and Statutory power vested in SURCON and indirectly, undermining the Sustainability of the Survey Practice in Nigeria.

It is expected that the regulatory body of Surveying in Nigeria, that is SURCON, takes the bull by the horn, by making subsidiary policies to cover all issues on Surveying Practice, while regulating all the branches of Surveying as mandated by the Constitution and the SURCON Act, in order to keep alive the relevance of Surveying Practice, and creating an enabling environment to widen the scope of Surveying Practice in Nigeria for a viable sustainable development of the country.

3.0 GEOINFORMATION TECHNOLOGY AND APPLICATIONS

Geoinformation technology comprises the technology and disciplines involved in geopositioning, mapping, and application of spatially oriented data and information. The technology relies on theories of mathematics, physics, geography, astronomy, satellite technology, etc. It adopts tools of data management, computer graphics, artificial intelligence, etc.

Geoinformation Technology involves fields like Geodesy, Surveying and Geoinformatics (or Geomatics), Hydrography, Remote Sensing, photogrammetry, GIS, Cartography, Global Navigation Satellite System (GNSS), Unmanned Aerial Systems/Vehicle (UAS/UAV) such as drones, etc. Geospatial information resulting from these various field of the technology are used as Decision Support in identification, assessment and management of land, air and water resources in our environment. Geospatial technology is open to valued application in many other disciplines, once they are involved in the use of geospatially-referenced data and information (e.g agriculture, environmental management and control, forestry, geology, civil engineering, utilities, health, geodemography, security, etc). It is required that it cooperates in a multidisciplinary manner with those who have a better understanding of the particular application field.

It does appear that the human race has reached the stage where our daily decision making process of resolving and supporting development problems, most of which are geospatial, being a function of our understanding and interaction with the real-world, is mediated through geoinformation and communication technology. Information (especially geospatial information) has thus become both a raw material and a tradable commodity output of production (i.e a commodified product with a time bound currency).

The field of Surveying and Geoinformatics emphasizing on 'location' is a major part of geoinformation technology. The field therefore forms an important source of information and provides the frame work of many Spatial Decision Support Systems (SDSS) for development, at organizational and strategic levels.

4.0 SUSTAINABLE DEVELOPMENT CONCEPT AND GOALS

Sustainable Development is a concept that originated from the World Commission on Environment and Development (WCED), 1987 Report (also known as the Brundtland Report) titled "**Our Common Future**". The report defined Sustainable Development as "development that meets the needs of the present without compromising the ability of the future generation to meet their own needs."

The world today, particularly many developing nations face development conflicts reaching a near-crisis situation with respect to economic, biophysical and social environment. Many development activities were leaving growing numbers of people poor, vulnerable and hopeless, while at the same time degrading the environment. It is increasingly difficult to formulate development policy programmes that could work under situation of escalating population on one hand and diminishing resources on the other. In such a situation of unsustainability, the limits of the biosphere carrying capacity are exceeded and not all of the environmental functions can be fully fulfilled anymore.

The overall goal of sustainable development is the long-term stability of the local, regional and national economy and environment, and it is only achievable through the integration of economic, environmental and social concerns through the decision-making process. Sustainable Development can thus be described as an organizing principle for meeting human development goals while at the same time sustaining the ability of the natural systems to provide the natural resources and ecosystem services upon which the economy and society depend.

The United Nations comprising of governments of many nations have prompted the ideas of implementing sustainable development policies in order to achieve sustainability and stability of development projects. This was done by encouraging the countries to pursue the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) in their development efforts.

The MDGs is the first ever global strategy with eight accompanying objectives which includes a. Eradicate extreme poverty and hunger, b. Achieve universal primary education, c. Promote gender equality and empower women, d. Reduce child mortality, e. Improve maternal health, f. Combat HIV/AIDS, malaria and other diseases, g. Ensure environmental sustainability, h. Develop a goal partnership for development.

The year 2015 marked the completion of the monitoring period for the MDGs, bringing with it the need for a more comprehensive, holistic and strategic framework, the Sustainable Development Goals (SDGs). The SDGs are an intergovernmental set of aspiration that is forced on seventeen (17) Sustainable Development Goals, 169 associated targets with 230 indicators are transformative steps which are urgently needed to shift the world onto a sustainable resilient path. The Sustainable Development Goals seek to build on the MDGs and complete what they did not achieve. Presented below are the seventeen (17) Sustainable Development Goals:

1. End poverty in all its forms everywhere.
2. End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

3. Ensure healthy lives and promote wellbeing for all at all ages.
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. Achieve gender equality and empower all women and girls.
6. Ensure availability and sustainable management of water sanitation for all.
7. Ensure access to affordable, reliable, sustainable and modern energy for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
10. Reduce inequalities within and among countries.
11. Make cities and human settlement inclusive, safe, resilient and sustainable.
12. Ensure sustainable consumption and production patterns.
13. Take urgent action to combat climate change and its impact (noting agreements made by the UNFCCC forum).
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss.
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

5.0 ATTEMPTS IN IMPLEMENTING SUSTAINABLE DEVELOPMENT GOALS AND SURVEYORS ROLES

There had been several attempts by world bodies; regional and national interests aiming at implementation of sustainable development goal. All these are not unconnected to Surveyors playing an important role in geospatial information production, management and the usage (applications) contributing to sustainable development achievement. These attempts include among others, the United Nations conferences on housing and habitat, FIG AGENDA 21, the South-East Asia Survey Congress (SEASC), The United Nations initiative on Global Information Management (UN-GGIM), GEO4SDGs.

United Nations Conferences on Housing and Habitat occurring in bi-decennial cycle from 1976 were convened to address (i) the need for sustainable human settlement and consequences of rapid Urbanization due to migration especially in the developing world. (ii) Two themes of equal global importance. “Adequate shelter for all” and “Sustainable Human Settlement Development in an urbanized world” and (iii) the need for re-invigoration of the global commitment to sustainable urbanization, to focus on implementation of a new “Urban Agenda”.

These objectives involving a lot of use of geospatial information could not be achieved without the involvement of Surveyors on whose expertise and products success or otherwise rest.

FIG Agenda 21 aims at showing that the international federation of Surveyors is committed to doing its utmost to encourage the surveying profession and the individual Surveyor to act in accordance with the principle of sustainable development. The federation is further committed to collaborate with all relevant United Nations agencies and with other non-governmental organizations in developing mutual understanding on how surveying in all its aspects as well as related techniques, products and services may best contribute to the implementation of Agenda 21 worldwide.

At the 8th **Southeast Asia Survey Congress (SEASC)** in 2005, the FIG president Prof. Dr. Ing. Holger Magal in his key note address was of the view that 'Surveyors should play a viable role in society, and then try to become actively and additionally involved in the field of spatial planning, urban and rural development, valuation, real estate management and decision making', in fields which are traditionally not regarded as Surveyors' domains. Also, during the final session of the 9th SEASC in 2007, a statement was issued and agreed to by more than 400 delegates that "Surveyors as members of a profession that has leading influence on land and built environments of today's and tomorrow's communities must commit themselves to:

- Developing and implementing strategies to deliver environmental sustainability.
- Embracing the best practice to achieve sustainability.
- Supporting and promoting education for best practice in sustainable development.
- Facilitating and promoting collaboration between clients, councils, consultants and communities as to achieve mutually beneficial outcomes.
- Supporting the collection and responsible use of scientific and technical information that will lead to informed decision-making.

A good number of international organizations and fora, for example, the United Nations initiative on Global Information Management (**UN-GGIM)** and **GEO4SDGs** are working to actualize Sustainable Development in the economic, social and biophysical environments by constantly stressing on and advocating the need for aggressive use of geospatial information and technology to enable societal benefits of SDGs.The UN-GGIM advocates the need for an integrative framework where very different types of information on the environment and socio-economic development could be integrated into a common framework involving a sound and robust database for SDGs (Fig1) which could be critical for understanding of human/environment relationship.

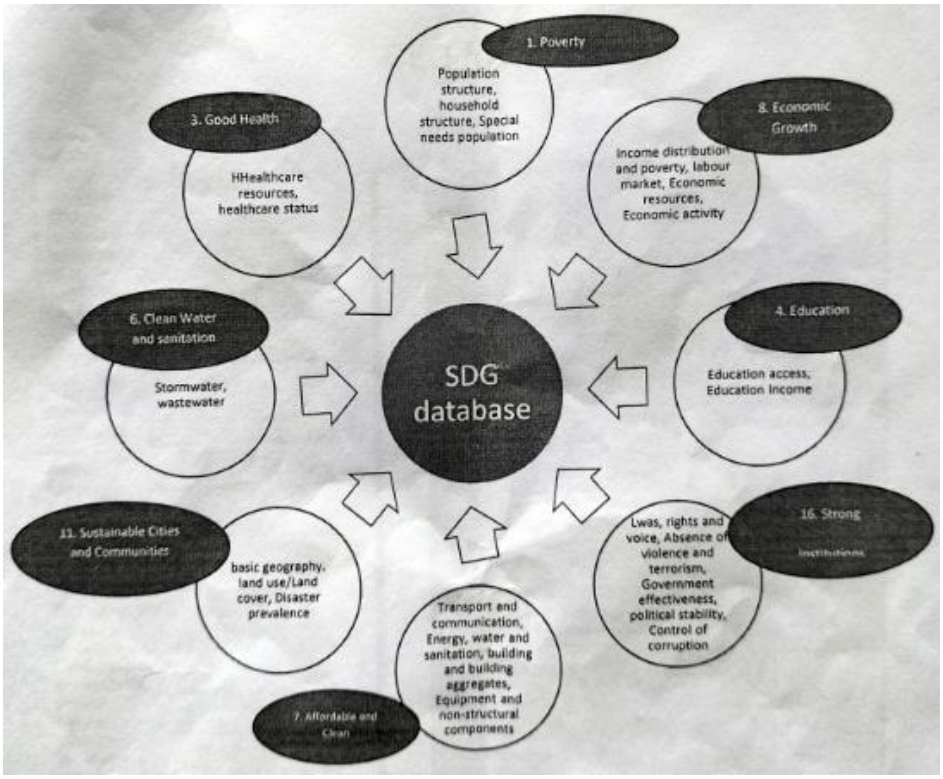

Figure 1. Sustainable Development Goals (SDGs) Database
(Source: UN-GGIM)

GEO4SDGs first introduced in geospatial world forum 2018 is also a platform for stakeholders that are discussing the integration of geospatial data into SD agenda in a holistic manner (Fig.

4).

Fig. 2. GEO4SDGs (Source: Geospatial World)

All these views and concepts should be very much considered in the pursuit of SDGs in Nigeria. Decision-makers at all levels of National, Geopolitical zones, States and Local Governments, Ministries, Departments and Agencies (MDAs) in Nigeria are increasingly required to make sound decisions over shorter time cycles on problems of overpopulation, food security, erosion, flooding and other environmental problems due to global warming and also in national security, poor infrastructure and many more using accurate, current and timely geospatial information and to do so with minimum duplication.

6.0 CONSIDERATIONS ON SUSTAINABILITY OF SURVEY PROFESSIONAL PRACTICE

In simple terms, Sustainability of Survey Practice means the capacity of surveying practice for continuance into the long-term future.

The sustainability of survey practice in Nigeria (and elsewhere in the world) is majorly hinged on surveying profession's contribution to the implementation of the Sustainable Development Goals (SDGs). A Modern Surveyor, in addition to determining the relative positions of natural and man – made features on or near the earth's surface, storage, retrieval and management of these data in a usable form, should also be interested, to some extent, in other areas (Fajemirokun 1988). These areas include amongst others, geosystems and processes and other environmental issues, infrastructures and Building Information Modeling (BIM), spatial Planning and other human activities. It should also include generation of geospatial information from integrated earth related data which can be utilized in Decision Support systems of nation's development. Surveyors are a critical mass in every aspect of providing explicit solutions to geospatial problems. Because of the knowledge gap, majority of the Surveying Practitioners are bottle-necked with a very narrow spectrum of the practice, (especially cadastral practice) and unable to think and operate outside the box.

To address the SDGs and how FIG works with the SDGs the Council established a new Task force for 2019 – 2022 focusing on FIG and SDGs chaired by Ms Paula Dijkstra (from the Netherlands) and noted that "The SDGs and related land-indicators will reshape and influence our profession profoundly in this decade. It is of crucial importance that FIG Member Organizations and Surveyors are aware and prepared on how their (daily) work contributes to the achievement of the SDGs and how the implementation and achievement of the SDGs will enhance a Sustainable Survey practice by enlarging their coast and increasing the breath and diversity of their practice".

Surveyors' participation in the implementation and achievement of SDGs is the journey or means of achieving the goals of sustainability of survey practice. Both represent separate but connected systems of interest.

The vast majority of the SDGs can be related to Geospatial data and thereby the profession of Surveyors and Geospatial Professionals. Surveyors and Geospatial Professionals can with a continuously distributions of precise and timely data support the measuring of SDG – related performance.

In Nigeria Surveyors participation in national development is still far from being effective, but can be improved upon. Nigeria is endowed with a lot of natural, human and material resources which are basic ingredients for development. They include;

i. Vast arable land exists for rainfed and irrigation agriculture,
ii. Fluid and solid minerals abound to support industrial activities,
iii. Suitable climate is available for production of wide range of crops and livestock,
iv. Forests with rich biodiversity,
v. Network of rivers that can be harnessed for power production and transportation,
vi. Large growing population provides not only sources of man power training for development, but also for viable market.

All these constituting a 'life support system' for the country (Emovon, 1999), are assets that have not, to any reasonable degree, been judiciously exploited. If Nigeria is going to develop, manage, exploit, and use these resources for the nation's development benefits, adequate data and information of which a greater percentage of them is geospatial are required. If Nigeria Surveyors are up to the task of producing such data and information, it will definitely expand the breath and diversity of their practice and enhance the sustainability.

In other to be able to inculcate the idea of geospatial problem solving and solution provision capabilities into Survey Practice thereby increasing its relevance in Nigeria, Federal School of Surveying (FSS) a notable higher institution of learning in Nigeria has introduced a course on Sustainable Survey Practice at the Professional Diploma Level. This is in order to produce students that will meet up with current clients' needs, and societal challenges of paucity of relevant geospatial information in national development decision process. Other departments of Surveying and Geoinformatics in Nigeria Universities and Polytechnics are being encouraged to follow suit.

An intimate connection between Survey Professional Practitioners and the inspiring world of Academics is also being encouraged. Academia teaches how to think critically and 'see' the world through new lenses and professional practice teaches how to translate those ideas into reality. Academia allows one to often be immersed in a world of critical thinking, questioning and analysis and such one seemingly sponges for knowledge.

Academia benefits from a very powerful culture of discovery, but often lacks real-world constraints of executing projects that can only be gotten from professional practice; and with the emerging geospatial technology and new methodologies, Surveying Practice must always be in complete harmony with Academics to inject new ideas into practice. There should be a balance of ideas coming from both sides, when critical thinking, visionary ideas and execution of reality are running congruently with one another and neither takes a back seat to the other.

There is the need for Surveyors Council of Nigeria (SURCON) and Nigerian Institution of Surveyors (NIS) to be more proactive in breaking the dichotomy between Academic and Professional Practitioners, since all can stand to gain from the union of the two (i.e academia and professional practice). The handling of the Mandatory Continuing Professional Development Program (MCPD) needs to be improved on in other to be made more effective. The reason for the MCPD is that Surveyors must continuously update their knowledge and technical skills to remain competent and abreast of current development in Surveying and Geoinformatics. The MCPD is therefore a skill renewal process and a channel of knowledge acquisition through training and retraining. There is the need for assessment and grading to make it more effective and also making the trainee to be serious about the program.

Surveying and Geoinformatics departments in higher institutions of learning should keep in contact with their Alumni and their Organizations for further knowledge transfer and continuous relevance in their professional practice. They can jointly conduct Applied Research with notable Alumni and their Organizations and this can be fed from strategic fundamental researches carried out by the schools. This will certainly have a lot of impact on the performance of such organizations by adapting new techniques to improve their performance.

The institutions Educational link programmes to the organizations can be supported by Advisory Services to help improve Performance and modernize Practicing Surveyor's role in a modern Information Society.

Educational institutions can also be of immense help to mapping organizations, for example, The Office of the Surveyor – General of the Federation (OSGOF), where there may be hard time to keep pace in terms of production rates with the fast development of the country, since the conventional and traditional approaches are too slow. Alongside the introduction of emerging new mapping techniques, the institutions could be of assistance in the development of new concepts and methodology for Core Data Sets production and provision and avoiding the slow process of traditional map production.

Institutions partnering with OSGOF will so much enhance OSGOFs capability of providing core fundamental dataset for sustainable development of the nation. Hand of fellowship can also be extended to other offices like Independent National Electoral Commission (INEC), National Population Commission (NPC), Federal Ministry of Transport etc. seriously in need of geospatial information for decision making.
Connection to academia makes better survey practice and vice visa.

7.0 FUTURE AND CHALLENGES OF SURVEYING PROFESSION

Since increase in user's geospatial requirements and advances in technology continually change the way surveyors work, surveyors should be encouraged not to operate a close mind. Past and present success of most Surveyors can be greatest obstacles to future innovations. Buzz Aldrin, (2016) in his book 'No Dream is too high' emphasized that 'Even brilliant people can become entrenched in the statusquo, stuck in the usual ways of doing things, which is one of the greatest impediments to discovery.
Surveyors should keep an open mind in order to be relevant, so there is the need of changing of Surveyor's mindset with respect to change. Open mindedness must be learnt to evaluate and fulfill users' needs instead of producing traditional products, otherwise other professionals will take over irrespective whether they skilled or not.
The traditional map concept still so often found in definition of products which majorly involve the mapping of objects on the earth surface (i.e., discrete terrain state, at a particular time) alone is no longer sufficient in today's world with varying complex geospatial problems.
Recent advances in technology are having a great impact on the practice and instrumentation of surveying so much that the Professional Surveyor now confronts a number of challenges. Given the expected and continued improvement, the methods and instrument for survey (not requiring too much skill and which has made every operation easier), the traditional Surveyor is under pressure of competition from allied professionals and non-professionals. The threat of the competition is getting fiercer, since the traditional data acquisition which had been the preserve of the Surveyor, is continually being turned into a blackbox, thus posing a challenge to the Professional Surveyor. This is fast eroding the Surveyors' professional status. Currently, one of the major challenges for Surveyors is to show dearly why their professional knowledge is needed to secure and interpret data and optimize the use of emerging technologies.
There should be a continuous widening of the narrow scope of the training curriculum for Professional Surveyors. The understanding of geospatial problems and the impact of computing and other continuously emerging geospatial technologies need to be appropriated in the training and re-training of Professional Surveyors. This will help in surmounting the challenge for Surveyors' knowledge empowerment to function effectively in the modern social economic order.
Another challenge includes the rapid pace of technological change and the transformation of our market and products into becoming more open and less restricted. This can also present an opportunity, because geospatial products are now used by everybody (e.g Google maps or navigation for self-driving cars) and seen as part of a beneficial and necessary infrastructure for development and wellbeing of the society.
Emerging trends in the use of drone technology, Artificial Intelligence (AI), Building Information Modeling (BIM), Augmented Reality (AR)……etc. are new technologies that are impacting and driving new innovation in Surveying industry of today, providing a cost effective

solution to previously time consuming task. Their effective application will continue to change the Surveying industry, and professionals in the field will be required to adapt if they hope to keep up with this continuously emerging trend. Because Surveying has become such a dynamic field, it is up to the professional to continue his education and to stay up to date with the latest geoinformation technology.

Most institutions of learning have low intake of students. There is the need to attract young minds who are a key demographic that we must value and encourage to participate for future development of Surveying Profession.

CONCLUSION

Surveying as a profession has grown from providing knowledge of the shape and size of the earth to include the understanding of earth related processes and problems and the production and management and the use of geospatial information. Surveying, using geospatial technology as an innovative sector, is the key to brighter future for the world, looking at the huge range of opportunities Surveying industries offer, and the relevance of surveying in solving world development problems, and implementing, monitoring and measuring the achievements of Sustainable Development Goals. Advances in geospatial technology means professional Surveyors should have key roles to play in the future development and implementation of the 'SMART' concept of city (smart cities and urban informatics), food, transportation, etc. All these result in increased breath, diversity, and importance of survey practice and thus contributing to Survey Practice sustainability.

Looking at the world through the lens of global forces that are shaping it now and in the future, it should be a thought for Nigeria Surveyors and Geoinformaticians to continue to build concepts and find ways of change in order to inculcate sustainability into Surveying Practice in the country. These Surveyors have the greatest and most effective role to play considering the importance of their needs in securing a better future to the practice of Surveying in Nigeria, and changing the present negative narrative of limiting Surveying Practice to only a part of Cadastral Practice.

A huge mass of uncritical Surveyors is an affliction to a nation's development interest due to lack of required geospatial information in development decision process. It devalues the process since most development efforts are not geospatial information-driven and the results are mostly catastrophic. Sustainable Surveying Practice demands a holistic approach.

Let us build a System that will make the present and the next coming generation of Surveyors to be Creators, Thinkers and Problem-solvers, with a vision to extending the usefulness of Surveying for the benefit of society, environment and economy; not making Surveyors role to diminish, but projecting and enhancing a Sustainable Survey Practice.

REFERENCES

Adebekun, O.A. (1971) Training of Surveyors In Nigeria" Paper Presented at the Department Seminar Series, Department Of Surveying University of Lagos.

Buzz Aldrin, (2016) No Dream Is Too High: Life Lessons From a Man Who Walked on the Moon. National Geographics Washington D.C.

Constitution of the Federal Republic of Nigeria, as amended. (1999)

Dewbery, S.O, (2008) Land Development Handbook, Planning, Engineering And Surveying. Third Edition. McGraw Hill N.Y.

Emovon E.U. (1999):"National Policy and Sustainable Development Capacity for Sustainable Development" in Adeniyi P.O (ed) Research Capacity Building for Sustainable Development In Nigeria" (Lagos, Unilag Consult).

Fajemirokun, F.A. (1976): "The Place Of University in Surveying Education". Paper Presented at The Symposium on Surveying Education, PC Meeting of the FIG University of Ibadan, Nigeria, August.

Fajemirokun, F.A. (1981): "Surveying Education in Nigeria" Proceedings of Commission-2 of FIG – Professional Education, XVIth International Congress, Montreux, August 9-18.

Fajemirokun, F.A. (1988): "Of the Figure of the Earth, Surveying and Mapping, and National Development". Sixth of Inaugural Lecture, University of Lagos, August 24.

Filani, M.O.(2012): "Role and Future of Geography for Sustainable Development In Nigeria in L.K. Jeje, A.O. Ajula, T.O. Odekunle, O.Babatimehin and N.O. Adeoye (eds) Geography in Nation Building, Ife Experience, Department of Geography, OAU., Ile-Ife.

Ghilani C.D., Wolf P.R. (2008): "Elementary Surveying, an Introduction to Geomatics" 12th Edition, Pearson Practice Hall, Upper Saddler River, NJ 07458.

Ojigi, M.L., Olaleye, J. B., Ogundele, R.A. and Adeniran, O. (2011): GIS and Land Administration in Nigeria (An Integrated Approach). Nigerian Institution of Surveyors (NIS) Mandatory Continuous Professional Development (MCPD) programme, October, 2011.

Onsrud, H. (2001): "The Role of Surveyors In Sustainable Development." THE FIG AGENDA 21. GIM International-November, 2001.

Stig Enemark (2010) Spatially Enabled Land Administration: Addressing Societal Needs and Responding to Global Agenda. Realizing Spatially Enabled Societies GSDI-12 World Conference Singapore 19-22 October,2010.

Surveyors' Registration Council of Nigeria (SURCON) Act, CAP S18, LFN, (2004)

World Commission on Environment and Development (1987): Our Common Future-OUP Oxford,

England.
www.worldmeter.infor accessed as at 2021

BIOGRAPHY

Oluwole ADENIRAN is a retired Chief Lecturer at the Department of Geoinformatics, Federal School of Surveying Oyo, Nigeria, and presently a Director at DeNexus Geospatial Intel Ltd., Akure, Ondo State Nigeria. He studied Geography at University of Ife (now OAU) Ile-Ife, Nigeria; Surveying and Geoinformatics at University of Lagos, Lagos; GIS at University of Ibadan, and Remote Sensing at RECTAS (now AFRIGIST) Ile-Ife Nigeria. He is a Registered Surveyor and a member of Nigerian Institution of Surveyors, a Continuing Professional Development (CPD) training facilitator, a Resource person at ARCSTEE, and Examiner with Surveyors Council of Nigeria (SURCON). A passionate teacher of Geoinformatics and a creator of a thought provoking course titled 'Sustainable Survey Practice' at Federal School of Surveying Oyo. He has served as a Consultant on notable GIS and Remote Sensing projects.

Saheed OLANIYI is Senior Lecturer at the Department of Surveying and Geoinformatics, Federal School of Surveying, Oyo. He studied Surveying and Geoinformatics with specialization in Remote Sensing and GIS. He is a Registered Surveyor and a member of Nigerian Institution of Surveyors, a CPD training facilitator/resource person and a Consultant on Engineering Surveying, GIS and Remote Sensing.

Osaretin OGBEBOR is seasoned private practicing Surveyor and a Legal Luminary who is passionate about meeting the Legal needs of Surveying Profession in Nigeria. He studied Surveying and Geoinformatics at Federal School of Surveying, Oyo and studied law at Obafemi Awolowo University (OAU), Ile-Ife Nigeria. He is an associate lecturer in the Department of Surveying and Geoinformatics, Faculty of Environmental design OAU, Ile Ife as well as a Contract lecturer in law at the department of Surveying and Geoinformatics, Federal School of Surveying Oyo. He is a Registered Surveyor, a member of Nigeria Institution of Surveyors and Nigeria Bar Association. He is Legal Consultant to SURCON, and other private corporate and government organization.

CONTACTS

Oluwole ADENIRAN
DeNexus Geospatial Intel Ltd,
Plot 77, Block XVI,
Adegoroye Avenue, Off Olukayode Str.
Alagbaka GRA,
P.O.Box 1671,
Akure, Ondo State, Nigeria

E-mail: woleaden@gmail.com
Phone: +2348033934225
Saheed OLANIYI
Department of Surveying and Geoinformatics,
Federal School of Surveying, P.M.B 1024, Oyo. Oyo State, Nigeria.
E-mail: sagasofts@yahoo.com
Phone:+2348038078266
Osaretin OGBEBOR
Osaretin Ogbebor &Co
20 Mojidi Sreet, Off Toyin Street, Ikeja, Lagos State.
E:mail:osaretinogbebor@nigerianbar.ng
Phone: +234802297824.