Quest Journals
Journal of Research in Environmental and Earth Science
Volume 3 ~ Issue 11 (2016) pp: 17-22
ISSN(Online) : 2348-2532
www.questjournals.org

Research Paper

Geospatial Training, Career and Competencies: A Case For Polytechnic Education

Ishola, K.O.[1] Surv.Oyinkolade, S. P.[2]
Department of Surveying & Geo-Informatics, Faculty of Environmental Studies, Federal Polytechnic, Ado-Ekiti, Nigeria.

Received; 18 October 2016 Accepted; 18 November 2016; © The author(s) 2016. Published with open access at **www.questjournals.org**

ABSTRACT: *This worksurveysissues related to education and training, competence and career in geospatial technology with a particular reference to Nigeria. It is founded the basisof two sources of data, namely the authors' collective experience in geospatial education and training, on a broad literature review from published materials, reports on issues that relate with geospatial technology, internet materials, journal article and text books. This survey adopted both explorative and evaluative approaches. Its objectives are to: articulate the needs for geospatial technology in Nigeria; analyze the trends of capacity building in geospatial technology vis-à-vis technical education and; identify various challenges of geospatial knowledge and suggest likely solutions to the challenges identified. The paper concludes by making some recommendations in the areas of training, funding, update of academic of academic curricular and disparity in our academic programmes towards in the improvement of geospatial capacity development.*

Keywords*: Geospatial, Technology,Training, Programme,Capacity Building, Information, Polytechnic, Curriculum*

I. INTRODUCTION

Spatial data is very essential and valuable for planning and development,in that they are useful in describing the geographic distribution of economic resources, population, and other relevant sectors. However, the collection, management, and application of spatial data can present unique and seemingly insurmountableproblems for either governments or sectors seeking to leverage this data (Mennecke & West Jr., 2001). Hence, there is an unquenchable thirst for geospatial technology. Geospatial technologyis gaining wider prominence and can be applied to virtually every human endeavour, in the sense that it is a transdisciplinary field, a branch of knowledge which cut across various professions. Geospatial technology is a term used to describe the range of modern tools contributing to the geographic mapping and analysis of the Earth and human societies (American Association for the Advancement of Science, 2016).Geospatial technology, information technology field, acquires, manages, interprets, integrates, displays, analyzes or otherwise uses data focusing on geographic, temporal, and spatial aspects of the world's environment (U.S. Department of Labour, 2015). The industry includes basic and applied research, technology development, education, and applications to address the planning, decision-making in the areassuch as industrial engineering, biodiversity conservation, forest fire suppression, agricultural monitoring, humanitarian relief, and much more.

As noted by Chigbu &Onukaogu (2013), geospatial technology offers a wide range of innovative and cost effective solutions for environmental sustainability; hence, many countries of the world now appreciate the relevance of geospatial technology in the sustenance of our environment. The rapidly expanding industry therefore urgently seeks skilled technologists. U.S. Department of Labour (2015)of recent supplies the list geospatial personnel or occupations as follows: Surveyors; Surveying Technicians; Surveying and Mapping Technicians; Cartographers and Photogrammetrists; Geospatial Information Scientists and Technologists; Geographic Information Systems Technicians; Remote Sensing Scientists and Technologists; Remote Sensing Technicians; Precision Agriculture Technicians; and Geodetic Surveyors. Further noted that many occupations such as urban and regional planning, many careers associated with location-based services, environmental management, landscape architecture and geo-design, transportation engineering and others rely heavily on geographical data and technology. Also, geographical data and technologies are found useful for selected tasks such as in public health (for infectious disease modelling and health care accessibility analysis), energy

*Corresponding Author: Ishola, K.O.[1]
Department of Surveying & Geo-Informatics, Faculty of Environmental Studies, Federal Polytechnic, Ado-Ekiti, Nigeria.

industries (to analyze distribution of oil and gas reserves or plan shipments), disaster management (to plan for and respond to events), and criminology (to identify crime hotspots and allocate patrols).

II. OBJECTIVES OF THE PAPER

The broad objective of the paper is to examine geospatial training, career and competencies in Nigerian polytechnics. While the specific objectives include:

i. To articulate the needs for geospatial technology in Nigeria;
ii. To analyze the trends of capacity building in geospatial technology vis-à-vis technical education;
iii. To identify various challenges of geospatial knowledge and suggest likely solutions to the challenges identified.

III. METHODOLOGY

This paper is predicated on two sources of data, namely the authors' collective experience in geospatial education and training, on abroad literature review from published materials, reports on issues that relate with geospatial technology, internet materials, journal article and text books. Due to the nature of the data required for the study, and considering the exploratory phase and the evaluative nature of this research, mixed method design becomes very necessary and relevant to the study. The research work adopted both explorative and evaluative approaches. It was explorative in the sense that carried out investigation into the trend in geospatial technology. On the other hand, it adopted evaluation approach in the sense that measuredthe qualities of manpower training in the Nigerian polytechnics.

The Needs For Geospatial Technology In Nigeria

The place occupied by education and training in spatial science for creating adequate levels of capacity in the developing countries is substantial and forms a fundamental part of a nation's development.Education and training improves the ability to acquire, assimilate and apply knowledge in order to advance the survival and competitiveness. Van der Heiden *et al*(2015) note that education is primarily concerned with the development of mental ability and mental power, thus pertaining to the attitude of persons. While, the objectives of training are primarily to teach individuals to carry out specific tasks based upon an accepted methodology and for which known techniques are available.Training brings the individual to a desired standard of efficiency and is achieved through instruction andpractice.

Cohen &Levinthal (1990) argue that the adoptive capacity of a country for advanced technology depends largely on the country's ability to recognize and appreciate the value of new, external information or technology, assimilate it and adopt it successfully. In consonant with this fact, Mennecke & West (2001) stress that the potential for using any technology to support governmental decision making is driven by the match between the capabilities of the technology and the needs of its potential users.However, spatial data of interest to governmental decision makers can be collapsed into three categories, physical, political, and socioeconomic. While, physical data is about features of the ground, land masses, bodies of water and waterways, roads, railroads, forests, mountains, etc. Political data is about artificial designations that define an area as being part of a political entity, and socioeconomic data is about populations, economics, and social patterns.

The value of geospatial data is becoming appreciated in all sectors of the economy all over the world. The advent of geospatial technology has made it less cumbersome to capture, store utilize geospatial data for decision making processes.Hence, this technology has been an integral part of the decision-making process in advanced countries and thus every sectors of the economy have now felt the effect of location science, which is known as geospatial information (Ademola, 2015). However, the dearth of qualified and trained personnel in Remote Sensing and allied fields has not only hampered proper exploitation of the available data but has also affected related research programmes in various application areas. Therefore, there is an urgent need for strong emphasis of geospatial technology in educational curricula so that future generation is given required training for application of this modern technology (Fajemirokun & Idowu, 2006).

Also, due to the broad applicability of geospatial data and technology, it must be reinforced in our school system. In Nigeria, technological institutions such as polytechnics should be provided withnecessary assistance and level ground to trife in terms of training and capacity building regarding this technology. Since the use of geospatial techniques and data is very germane in areas like national planning, economic and resourcesmanagement, environmental control and management, natural disaster management and others. Therefore, issues regarding the actual condition of the applications and methodologies permit the identification of gaps in usability and opportunities to facilitate data use. Hence, the establishment of formidable ground for training more qualified technologists and experts is highly necessary.

Capacity Building in Geospatial Technology

As defined by UNCED (1992), capacity building encompasses a country's human, scientific, technological, organizational, and institutional resources and capabilities. At one with the view of Lal *et al* (2008), capacity development can be basically measured at three levels, the individual, institutional, and the systemic. At the individual level, capacity building connotes the process of changing attitudes and actions that provides an opportunity to enhance the knowledge developing skills while maximizing the benefits of participation, knowledge exchange and ownership. At the institutional level it focuses on the overall organizational performance and functioning capabilities, as well as the ability of an organization to adapt to change. It intends to develop the institution as a total system, including individuals, groups and the organization itself. Thus, interactions among these levels are also important to improve the overall capacity. Capacity development further accentuates the overall policy framework in which individuals and organizations operate and interact with the external environment, as well as the formal and informal relationships of institutions. In general context capacity can be expressed as the ability of individuals and institutions to make and implement decisions and perform functions in an effective, efficient and sustainable manner. Capacity building is often concerned with training to advance individual knowledge, in some cases introducing new infrastructure, or quite often exposing staff to better environment through short term exercise and long term programmes or study tours to improve resource management skills and capabilities.

The process of developing a competency plan establishes a system that provides skills advancement with feedback and accountability (U.S. Department of Labour, 2015).In building capacity, expert mentorship will be provided in order to enhance the quality of training. Apprentices gain the benefit of receiving technical training and hands-on experience at the same time. The training also encompasses organizational and interpersonal skills. U.S. Department of Labour (2015) stresses that the systematic process for performance improvement results in trained personnel who will hold a nationally recognized credential. Keeping the training curriculum current is an issue to ensure that the skills of geospatial specialists remain up-to-date. As geospatial technology becomes more widely adopted by employers, and is integrated into diverse academic and professional training disciplines, the training content of the Geospatial Specialist Certificate must continue to evolve.

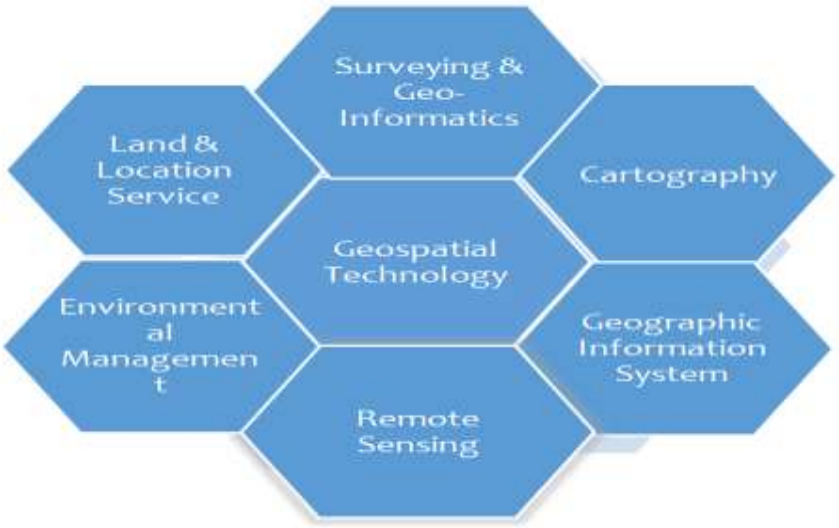

Fig I: Geospatial field. Source: Authors motivation

1. Geospatial Technology and Technical Education

As geospatial technology becomes more widely adopted by employers, and is integrated into diverse academic and professional training disciplines, the training content of the geospatial specialist certificate must continue to evolve (U.S. Department of Labour, 2015).Geospatial technology training in Nigerian polytechnic earns the trainees either a technician or technologist cadre. In round one, two-year of training a National Diploma is awarded, while the second round, two-year leads to the award of Higher National Diploma.The two-phase training allows students to acquire expertise and skills in the technology.The professional training is designed to promote competent and ethical practice in the field. Polytechnic has incorporated the NABTEB framework into its accreditation guidelines for programmes in the field. When applying for accreditation, technical (polytechnic) education programmes must demonstrate how their courses align to ensure they are teaching the competencies required by industry. By providing a framework for industry skill needs, the polytechnic is serving as a valuable workforce development resource. With its minimum requirements, it helps industry define itself, expand its workforce, and strengthen its education and training infrastructure.

Of the list of the geospatial disciplines, the following are currently available in the Nigerian Polytechnic system: Cartography, Photogrammetry, Surveying & Geo-informatics (National Board for Technical Education, 2014).Currently, eighteen universities are offering degree programmes in Surveying and Geo-informatics, while twenty-nine polytechnics and four specialised institutions are offering ordinary and higher national diplomas and postgraduate courses. Kufoniyi (Undated), noted that the surveying and mapping community in Nigeria feels the necessity to review the curricula once again to fully reflect the today's geospatial technology, and the two national agencies in charge of quality assurance within university and technical education have this recommendation on their agenda. Accordingly, the higher institutions offering geospatial technology are now saddled with the task of developing new curricula to train surveyors and professionals from other fields of study. In line with the development in colleges of Education and polytechnics, the National University Commission (NUC) had also directed all institutions offering surveying to modernise their curricula.

2. Career Prospects in Geospatial

Geospatial technologies are more than computer hardware, software, and data (Ofori-Amoah (2009). The potential of the geospatial technology is so as it has contributed to various aspects of human endeavour. In a bid to gain insight to the potential of geospatial field, Kufoniyi (1998) identified four broad focussed areas for geospatial education, which include:

i. Spatial data acquisition through computer-aided Surveying, analytical and digital photogrammetry, remote sensing, conversion of analogue map and other geospatial data into digital form using manual digitizing and scanning, and attribute data collection methods.

ii. Spatial data management which requires knowledge of database design and creation, database management systems, data transfer and exchange, spatial query development, spatial statistics, etc.

iii. Cartography and geo-information visualisation, dealing with data formats and information presentation: and

iv. Geospatial information infrastructure and management, dealing with aspects such as spatial standards, GIS policy, implementation issues.

Professional career may involve multiple employment relationships, participation in a "virtual" organization, self-employment, or pursuit of many types of jobs during one's lifetime. Careers prospects as recognized in different occupations or fields of geospatial technology will be enumerated accordingly:

Photogrammetry

This refers the science and technology of obtaining reliable measurements, maps, digital elevation models, and other GIS data primarily from aerial and space photography. Professional photogrammetrists are responsible for all phases of mapping projects and provide spatially accurate base maps that form a foundation for many applications of GIS. Their functions may include planning and supervising ground and aerial surveys, interpreting and making measurements from remote sensing imagery, designing maps and cartographic presentations, reproduction and distribution of map products, and managing general business and organizational aspects of photogrammetric projects.Some photogrammetrists are employed in the design and manufacturing of specialized data acquisition, analysis, and measurement equipment. In this modern era, the photogrammetrists must be well proficient in mapping from a variety of source data types: conventional and digital aerial photography, satellite imagery, laser ranging (lidar) and radar to name a few.

Remote Sensing

Remote sensing is concerned with any technique whereby information about objects and the environment is obtained from a distance. Remote sensing in the context of obtaining geospatial information is based on measuring variations in how electromagnetic waves interact with objects.

Remote sensing is a very broadly based field. Professionals with backgrounds in such diverse areas as agriculture, archaeology, business, ecology, engineering, forestry, geography, geology, range management, urban and regional planning, water resources, wetland ecology, wildlife management, manufacturing and machine vision, meteorology, and oceanography use the information processed from remotely sensing data. In addition, many remote sensing scientists are involved in basic research developing new sensor systems, other instruments, and defining new analytical techniques. Many such people are also actively engaged in the area of digital image processing, which is changing rapidly with major improvements in the power of computer systems, networks, and visualization techniques.

Geographic Information Systems

Geographic Information Systems (GIS) are computerized systems that allow the user to work with, interrelate, and analyze virtually all forms of spatial data. Typically a GIS consists of three major components: a database of geospatial and thematic data and information, a capability to spatially model or analyze the data sets, and a graphical display capability. GIS technology also crosscuts many disciplines and applications ranging

from the medical profession to natural resource management. It integrates remotely sensed and ground-based information into powerful decision making analytical tools. Knowledge and experience is often desirable in one or several application areas such as biology/ecology, resource management, facilities management, planning, or engineering.

However, the 2-year academic and technical (polytechnic) institutions in Nigeria offer education and training in surveying and geo-informatics, cartography, photogrammetry, remote sensing and GIS, and inrelated fields. Diploma programmes in GIS, surveying, photogrammetry also provide a sound foundation forwork experience or for transfer to other academicinstitutions for further education. There is asubstantial demand for technicians in geospatialinformation technology, for individuals who do notwish to pursue an advanced degree.
Apart from the aforementioned careers, University of Lagos Prospectussupplied a list of place where geospatial experts can be relevant:

i. Federal Ministry of Works and Housing.
ii. Federal Housing Authority and State Housing Development Corporation
iii. State Ministries of Works and Housing.
iv. Federal Environmental Protection Agency.
v. Banks and other Mortgage Finance Institutions.
vi. National Electric Power Authority
vii. Water Corporation and River Basin Development Authorities.
viii. Nigerian Telecommunications Plc.
ix. Nigerian Ports Authority.
x. Oil Exploration and Marketing Companies.
xi. Oil Service: Seismic and Oil exploration and Offshore Engineering PrivateCompanies.
xii. Universities, Polytechnics and Similar Institutions.
xiii. Private Consulting Firms and Individuals.
xiv. Agricultural Development Agencies.
xv. Dredging and Marine Resource Agencies.
xvi. Engineering Construction Companies.
xvii. Armed Forces (Army, Airforce and Navy)
xviii. Federal Capital Development Authority

However, geospatial technology and capacity developmentan array of challenges. Despite the lofty benefits of geospatial technologies, capacity building in these technologies is still at low ebb in Nigeria. Institutions offering geospatial programmes especially the states owned are not financially sufficient either to run the programmes or fund necessary research as this is the period of economic hardship. Inaccessibility of necessary useful data may equally pose a challenge to the functionality of geospatial technology in Nigeria. It should also be emphasized political interference on the key players including the professional bodies in the geospatial technology development is an identified constraint. More importantly, the disparity that is currently in existence between polytechnic trained professionals and their university counterparts is a very big challenge to the development of the technology. More often than not, the potentials of the polytechnic graduates are not fully explore, on many occasion they are denied the opportunity of showcasing their worth.

IV. CONCLUSION & POLICY RECOMMENDATION

Aligning training programmes with the skills required by industry is essential to developing the necessary expertise. Therefore there should be a synergy the 'gown' and the 'town' for a worthwhile capacity building in geospatial technology which will in turn translate to quality manpower. To therefore maximize the potential for successful training and competence even in the face of all odds, this paper suggest by the way of recommendations as follows:

1. There should be conscious effort on the parts of the government and major players in capacity development towards bridging the gaps between the demand and supply of the required professionals and trained specialists. As geospatial technology's know-hows have expanded, so our nation and organizations need for specialists with complex,enterprise-level, application proficiency. Therefore, a strategy in terms of funding, manpower development and provision of enabling environment is required to fill the training challenges while providing skilled geospatial personnel to meet our mandate.
2. As currently existed in the Nigerian system, the universities' academic programmes and trained personnel are morewidely recognized and more respected than the polytechnics'. This disparity should as a matter of urgency be eradicated in order to make a remarkable land mark in geospatial technology.
3. The growth of the market demands required accurate and up-to-date know-how and expertise of geospatial professionals and specialists. Therefore, the existing geospatial academic programmes curricular should be

constantly review to meet the current required and actual performance of the competent specialists. Keeping the training curriculum current is an issue to ensure that the skills of geospatial specialists remain up-to-date.

REFERENCES

[1]. Ademola A. (2015). The Crucial Role of Geospatial Technology in Nigeria - Buhari's Administration (Online) available at https://www.linkedin.com/pulse/crucial-role-geospatial-technology-nigeria-buharis-administration (Accessed on August 24. 2016).

[2]. American Association for the Advancement of Science (2016). What are geospatial technologies? (Online) available at https://www.aaas.org/content/what-are-geospatial-technologies (Accessed on August 23, 2016).

[3]. Chigbu N. & Onukaogu D. (2013). Role of Geospatial technology in Environmental Sustainability in Nigeria-an overview. FIG Working Week 2013 Environment for Sustainability Abuja, Nigeria, 6-10 May, 2013

[4]. Cohen W. M. & Levinthal D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation, Adm.Sci.Q.3, 128–152.

[5]. DiBiase D. (2011) Reflections of a GISCI Past President. The GIS Professional 243, May/June, pp. 8-9.

[6]. Fajemirokun F. & Idowu T. (2006). Impact of Digital Technology and the Need for Curriculum Review in Surveying Education. Shaping the Change XXIII FIG Congress Munich, Germany, October 8-13, 2006

[7]. Kufoniyi J. (Undated). Nigeria Needs Federal Commitment to its Geodata Policy. GIM International Article (Online) available at https://www.gim-international.com/content/article/nigeria-needs-federal-commitment-to-its-geodata-policy?output=pdf (Accessed on August 25, 2016)

[8]. Lal S., Manzul K. H. & Yoko I. (2008). Effective Approach for Capacity Building in GIS and Remote Sensing Technologies in Developing Countries. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B6a. Beijing

[9]. Mennecke B. E. & West Jr. L. A. (2001). Geographic Information Systems in Developing Countries: Issues in Data Collection, Implementation and Management. Supply Chain and Information Systems Publications. (Online) available at http://lib.dr.iastate.edu/scm_pub (Accessed on August 23, 2016).

[10]. National Board for Technical Education, 17th Edition (2014). Directory of Accredited Programmes Offered in Polytechnics, Technical and Vocational Institutions in Nigeria (Online) available at http://www.nbte.gov.ng/downloads/DIRECTORY_2014.pdf (Accessed on August 25, 2016).

[11]. Ofori-Amoah B. (2009). Building Capacity to Use Geospatial Technology for Development in Africa: Lessons from the Uganda GIS Project (Online) available at http://2001-2009.state.gov/documents/organization/110978.pdf (Accessed on August 25, 2016).

[12]. U.S. Department of Labour (2015). Strengthening our Nation's Workforce with Demand-Driven Solutions (Online) available at https://www.doleta.gov/oa/brochure/Geospatial_new.pdf (Accessed on August 23, 2016).

[13]. Van der Heiden P., Pohl C., Bin Mansor S & Van Genderen J. (2015). The Role of Education and Training in Absorptive Capacity of International Technology Transfer in the Aerospace Sector. Progress in Aerospace Sciences 76, 42–54