

Surveying and Geoinformation in Africa: Problems and Prospects

Peter C. NWILO and Dennis A. OSANWUTA, Nigeria

Key words:

SUMMARY

Surveying profession is one of the oldest professions in Africa. In most of the countries, it was initially a profession that was connected with the military. This has to do with the colonial histories. For example, countries that have colonial links with Britain had their first set of surveyors trained in British Military Survey Schools. In the past, surveyors were people who came from other fields such as mathematics, physics, civil engineering and geography. Not many universities in Africa offer Surveying and Geoinformatics at degree level. Even in Nigeria where up to 11 universities offer Surveying and Geoinformatics at degree level, it is not as popular as other professional courses such as electrical/electronics engineering, computer science/computer engineering and chemical engineering. A number of reasons can be attributed for this lack of interest. These include:

- The historical development of the profession;
- Conservatism amongst surveyors;
- Lack of well-trained academics within the profession;
- The fact that the profession is associated with several hours of fieldwork under the intense African heat; and
- Poor funding of surveying and mapping in Africa.

Technological developments in the field of computer science, information technology and satellite technology have created new hopes for surveying and geoinformatics. For the full potentials of these developments to be realised however, there is a need for manpower development and training, funding of Surveying/Geoinformatics and mapping activities in Africa and expansion of professional boundaries to bring in information technology, communication and environments as major issues to be addressed within the profession.

Holding on to very strict professional boundaries may not be of benefit to the profession. The profession should be willing to accept some peripheral courses such as remote sensing and environmental management as being part and parcel of the profession. Regular curriculum changes to take cognisance of new developments attract young people seeking admission into the profession. Finally, engaging lecturers with backgrounds in areas such as cartographers, computer science and environmental science will assist the profession in expanding and increasing young people's interest.

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1. INTRODUCTION

Surveying is one of the oldest professions known to human. Historical references are available of the existence of boundary pillars in ancient Egypt and Babylon around 1400 BC. There must have been some surveying in the design and construction of the great pyramid of Khufu BC in Giza around year 2700 BC. This pyramid is so accurately squared and perfectly oriented to the cardinal points of compass to suggest some form of surveying during its construction (Fajemirokun, 1976; Fajemirokun & Nwilo, 1996). One could imagine the role of the surveyor some 1000 years.

Surveying in most of the developing countries in Africa and Asia, started with advent of Europeans in these countries. The practice of the profession simply followed what obtained in those countries of Europe. The survey practices were geared towards economic exploration and exploitations.

In Nigeria survey practices were in the areas of cadastral surveys were essentially for the acquisition of land for the Crown and for developments of estates, mineral resources, road and rail designs, and survey control establishments. The discovery of coal in Enugu area in the east and tin and columbite in plateaux in the north in addition to the need to move agriculture products such as groundnuts and cocoa from the hinterland of the north to the ports of the south provided the impetus for the developments of rail lines in the north-south directions. These essentially created the need for the establishment of survey controls along the rail lines. This was later followed by the establishment of framework controls using triangulation, traversing, trilateration, and geodetic levelling and trigonometric levelling methods. Triangulation methods were used in the open and hilly parts of the Northern and limited areas of the South-Eastern parts of Nigeria, while traversing methods which generally followed existing roads/routes were used predominately in the forested Southern part and flat regions of the Chad basin. It is important to note that a common practice in most part of south of the Sahara is to follow the economic interest of the colonies. The Nigeria horizontal geodetic network has its origin at a station near Minna, designated L40. Its geodetic coordinates were arrived at after taking the mean of astronomical values projected through four arms of the Nigerian triangulation network and the astronomically derived coordinates of L40 (Fajemirokun & Nwilo, 1990).

The surveyor profession was such an important profession in the colonial era to the extent that in most commonwealth countries of Africa, the surveyor-general was the highest ranking public officer after the governor-general. In Nigeria for example, there used to be a ministry called Federal Ministry of Works and Surveys. This ministry had since transformed to Federal Ministry of Works and Housing from where it changed its current name from Federal Ministry of works. In other words, it was the survey profession and other professions such as civil engineering, urban and regional planning, lands, mechanical engineering, architecture and quantity surveying. The significance of surveying, had so significantly dropped that the

survey department is only one amongst about 8 other departments in the present Federal Ministry of Works. Also, it is only the federal ministry of works that has provision for full developed career prospects for the surveyor. Most of the other professionals have got well defined career prospects in other ministries such as transport, housing, and mine and power. The funding for surveying and mapping in Nigeria had become so small that mapping a large portion of the country was done last only in the 1970s at scale of 1:50,000. The only other mappings of national interest since then have been to complete some map sheets of scale of 1:50,000 which were needed for census in the early 90s and the boundary surveys of a portion of Nigeria – Niger and Nigeria-Benin borders. This kind of situation has been responsible for current lack of interest in Nigeria and other parts of Africa. This aspect has prompted the lack of interest by the young people in surveying in Africa (Ruther, 2001 & 2003).

2. DEVELOPMENT OF SURVEYING PROFESSION IN NIGERIA AND AFRICA

Surveying and Geoinformatics development in Africa is facing some hard times. It is not as popular among students seeking admission into the universities as other professional courses such as electrical/electronics engineering, computer science/computer engineering and chemical engineering. There seems to be more interest in courses that are IT or industrial based.

2.1 Development of Professional Surveying Education in Nigeria

It is often claimed that the Nigerian Surveyor was the first professional man to be exposed to formal training locally. Indeed, a school for the training of surveyors was first opened in 1908 in Lagos. That school was later moved to Ibadan in 1927 from where it finally moved to Oyo in 1935. When the Yaba College of Technology was established around 1932 as the highest institution in Nigeria, a provision was made for prospective surveyors to undergo basic educational studies in the institution for two years, followed by two years of surveying at the Survey School, Oyo. Successful candidates were subsequently awarded diploma of the College. The first exposure to University education came in 1947 when the first university in the country was established as the University College of Ibadan. There, provision was made for the training of professional surveyors for the country. The programme was later discontinued following a change in the policy of the colonial administration (Nwilo *et al*, 2000).

In 1962, the Nigerian College of Technology, Enugu became part of the then two year old University of Nigeria, Nsukka and the Nigerian Surveyor was again exposed to University education. The first set of 5 students of surveying from the University graduated in 1966, 58 years after the first Survey school was opened in Lagos (Fajemirokun, 1976).

The Department of Surveying and Geoinformatics of the University of Lagos started as a sub-department of Civil Engineering Department in 1970. The initial programme of the sub-department at the time was a two-year postgraduate course of studies and research leading to an M.Sc. (Surveying) degree. Graduates in fields cognate to surveying were admitted into the programme (Department of Surveying and Geoinformatics, Unilag, 1999). Prior to all these,

the Faculty of Engineering of the University of Lagos in 1967 arranged for a few students who were surveying undergraduates of the University of Nigeria, Enugu Campus and who were displaced by the Civil War, to complete their degree programmes in the Faculty, and earn a degree of the University. In 1974/75 session, the department started the B.Sc. degree programme.

The Department of Surveying, Ahmadu Bello University, Zaria was set up at about the same time that the University of Lagos started offering Surveying at postgraduate level, and had since been turning out graduates in surveying. University training in surveying is also offered at the Enugu State University, Enugu, Federal University of Technology Minna, Rivers State University of Science and Technology Port-Harcourt, Abubakar Tafawa Balewa University Bauchi, Imo State University, Owerri, University of Uyo, Uyo, the Federal University of Technology, Yola and the Anambra State University of Science and Technology, Uli. This makes it a total of 11 universities offering professional training in the field of surveying in Nigeria at present (Fajemirokun et al, 2002). There are also 16 Polytechnics and one Monotechnic.

2.2 Technical and Technology Education

There are currently sixteen Polytechnics and one Federal School of Survey running the National Diploma programme in Surveying at the technician levels; four of these institutions also run the Higher National Diploma programme at the technologist level (Bardi, 1996). In Nigeria, the National Board for Technical Education (NBTE) curriculum is used by all Polytechnics and similar institutions to train survey technicians and technologists. Thus, the main role of the Polytechnics in Nigeria is the training of technicians (National Diploma Certificate holders) and Technologists (Higher National Diploma Certificate holders) on production work and technical management for direct employment in industry and public service.

The structure of the National Diploma (ND) programme consists of four semesters of classroom, laboratory and workshop activities in the institutions, and a semester of three to four months duration of supervised industrial training. The structure of the Higher National Diploma (HND) programme is similar to that of the ND except that the supervised industrial training is not compulsory.

2.3 Development of Surveying Education in Other African Countries

In other African countries the number of institutions is not as large as it is in Nigeria. Ruther (2003) stated that there is as at today no University department that is entirely for Geomatics in South Africa and only one Chair of Geomatics in the restructuring of academic programmes that have taken place. This is a far cry from 5 independent departments in the early 1970s and 10 chairs of Surveying or Photogrammetry. The departments in Pretoria, Johannesburg and Fort Hare were closed as a result of poor student intake while that of Durban was merged with Civil Engineering department. The Cape Town department was recently incorporated into the School of Architecture, Planning and Geomatics situation is as a result of poor. He went further to say that in Zimbabwe, there are two departments, one in

University of Harare and the other at the state University of Midlands. Table 2.1 shows a summary of the current situation of universities in Africa in Sub-Saharan.

Country	No. of Departments	Names of Universities
Nigeria	11	i. University of Nigeria, Enugu Campus ii. University of Lagos, Lagos. iii. Ahmadu Bello University, Zaria iv. Federal University of Technology, Yola. v. Federal University of Technology, Minna. vi. University of Uyo, Uyo. vii. Rivers State University of Science & Technology, PH. viii. Enugu State University of Science & Technology, Enugu. ix. Abubakar Tafawa Balewa, University, Bauchi. x. Imo State University, Owerri. xi. Anambra State University, Uli.
South Africa	1	University of Pretoria, Pretoria
Botswana	1	University of Botswana, Gaborone
Zimbabwe	2	i. University of Zimbabwe, Harare ii. State University of Midlands
Zambia	1	University of Zambia, Lusaka
Tanzania	1	University College for Land and Architectural Studies
Kenya	2	i. University of Kenya, Nairobi ii. Jomo Kenyatta University of Technology, Thika
Uganda	1	Makerere University, Kampala
Democratic Republic of Congo	1	University of Kinshasa, Kinshasa
Sudan	1	University of Khartoum, Khartoum
Ghana	1	University of Kumasi

Table 2.1: Summary of Universities in Sub-Saharan Africa (Adapted from Ruther (2003))

3. PROBLEMS AND PROSPECTS CONFRONTING SURVEYING PROFESSION IN AFRICA

It has been recognised that human resources produce much more profit than any other investment. However, there are some factors causing major setbacks in Surveying and Geoinformation education in Africa. Some of the factors if addressed will provide changes necessary to reengineer the profession and provide the basis for an overall need for lifelong learning. They include: lack of well-trained academia; conservatism; lack of teaching facilities; excessive man-hour on the field; inadequate funding; rigours of the profession; employers need; lack of IT experience; and lack of awareness to the public.

3.1 Problems Confronting the Profession

3.1.1 Historical Development of the Profession

The need formal training in surveying for would be surveyors is now generally accepted. This has not always been so. The alternative to formal education, which is apprenticeship was a popular and acceptable way to rise to be a surveyor, since many of our past candidates were not otherwise qualified to undergo formal courses. It must also be recognised that most of the people who came into the profession came in from other fields such as mathematics, geography and physics. In a number of cases, they came into the profession to improve their lots. The other issue here too is that particularly for countries with British colonial history, the first generation of surveyors had their roots in the military. Their trainings were in the military schools essentially to solve military tasks. All these issues affected the professional growth of surveying.

3.1.2 Lack of Well-trained Academia

One of the greatest problems facing Surveying and Geoinformatics profession and education in Africa is the lack of well-trained academia to teach or train both old and new students. According to Fajemirokun *et al* (2002), most of the personnel available for teaching are well grounded in the traditional survey techniques, but need to be re-trained in the new emerging geoinformation techniques. Although through continuous Professional Development Programme and other in-house training programmes many continued to grasp the new techniques in geoinformation education. This is too small when compared to the number needed.

3.1.3 Conservatism

In surveying certain concepts and conventions have been almost universally accepted by the surveying profession. Although some of these policies, concepts and conventions may be termed differently by different individuals, but there should be a general agreement about their meaning and interpretation as well as scope of application. The desire to maintain status quo, lack of ambition and culture of excuses are all forces of conservatism which may eventually lead to serious underdevelopment. Therefore, professionals as well as teachers should work hard to ensure and maintain enough flexibility in the profession. In fact, they

should be proactive in developing initiatives and visions as the astronomical and accelerating growth of knowledge sharing of all areas of technology and science has broken the boundaries between disciplines which makes education and training at various levels to become interdisciplinary (Nwilo and Osanwuta, 2003).

3.1.4 Inadequate Funding and Lack of Facilities

According to Fajemirokun, et al (2002), the problems of adequate funding of surveying institution is critically affecting surveying and geoinformatics education in Africa. The universities and polytechnics are grossly under funded such that many are rendered virtually ineffective. The various governments do not seem to accord the surveying and geoinformatics profession the important place it should be occupy and the priority it deserves in view of the indispensability of its products to sustainable development. Ruther (2003) after an assessment of the situation in other African countries stated that there can be little doubts surveying and geoinformation education in Africa and subsequently the profession itself is under severe threat.

Modern digital surveying equipment for an effective surveying and geoinformatics education and practice are also in short supply. Such equipment includes hardware like digitisers and scanners, high speed computers, GPS receivers, total station and digital levels; and software such as CAD and GIS packages. These basic equipment and software are expensive to acquire due to high exchange rate and poor funding of the profession by the various governments.

3.1.5 Rigours of the Profession

The fact that the profession is associated with several hours of fieldwork under the intense African heat is enough reason to discourage the new comers. This is coupled with the fact that the remunerations are not commensurate to the amount of time and energy put into each survey work. The other issue is the high cost of purchase of surveying and geoinformatics equipments. It is difficult for both the professionals and institutions afford even on a rental basis. This is coupled with the fact that the models of surveying equipment change very frequently. In a continent with so much poverty, it will be difficult to cope with the cost of purchasing new equipment almost every two years.

The other is the know-how on the application of the relevant software. The other issue to deal with is the inconsistent supply of electricity to power the computers for the processing of the field data. In the case of manual equipment, manual computations and final presentations becomes an inevitable puzzle. The combination of the above act negatively on the survey products in terms of the delivery time and values to be added.

3.1.6 Employers Need and Lack of IT Experience

Employers need and what educators must teach has to have some degree of relationship. This relationship must be in the form of constant dialogue between what is in vogue with respect to new survey equipment and experiences from the field. In the view of Nwilo and Osanwuta

(2003), knowledge must be shared between professionals, students and teachers of surveying and geoinformation profession. Since surveying and geoinformation organisation contains a small number of relatively large firms and very large number of small firms, it will be wise to have both integrative and interactive methods of meeting our needs. Websites from agencies like FIG, RICS, GPSWorld, POB, ACRSM, ISPRS, IHO, ESRI, EIS, CARIS, etc will assist to educate geomaticians on current development, training opportunities, articulated and codified experiences and findings, visualise demonstrations of most surveying equipment usage in the development of the profession in Africa.

3.1.7 Lack of Awareness

There should be vigorous campaign on the roles and importance of surveying and geoinformatics profession in the mass media, secondary schools, amongst politicians and governments of various African countries on the part it occupies in any sustainable development. In otherwords, it should be emphasised that the bedrock of any development is surveying and geoinformatics. With the evolution of GIS which have served as a decision making tool, it now makes it imperative to emphasis more on the role a geomatician will play. The authors believe that emphasis on the consequences of relegating surveying and geoinformatics profession into other profession or to the background will be too high to pay in the near future.

3.2 Prospects

It is our view that in spite of the seeming lack of prospects for surveying, the authors are of the view they are issues that if properly addressed will provide a lot of prospects for the surveyor in Africa and globally. Africa is largely unmapped for development. In Nigeria for example, the last maps series at a scale of 1/50,000 were in the 70s. These maps apart from being outdated are in analogue formats and so do not meet todays standards. So, we would look at the prospects from several perspectives.

3.2.1 Modification of Programmes

Modification of programmes should always be a regular practice if the practice of surveying. This will assist in the training of professional that will be in tune with the realities of the time. The modification of the curricula in surveying for polytechnics and universities in Nigeria offering Surveying has led to improved students' interest. This was done through addition of courses in spatial information and data management, environmental and coastal management and digital technology. The Federal Survey School Oyo is currently being well funded by the Federal Government. This is as result of modification of the curricula of the School in line with current realities. The school is well equipped with modern equipment and software to facilitate geoinformatics education. The various training programmes being organised by the school is also attracting more people into the profession. The school plans to run higher degree programmes in collaboration with other training institutions in Nigeria (Nwilo & Badejo, 2002).

The Department of Surveying & Geoinformatics, University of Lagos together with a number of other departments in our universities offering surveying have also substantially modified the programmes. This has led to a substantial increase in the number of students seeking admission into our undergraduate and postgraduate programmes. In the last four years, average 75 - 100 students were admitted annually into the undergraduate programme of Surveying and Geoinformatics at the University of Lagos, leading to a current population of about 450. The situation is likely to remain so for some time.

3.2.2 Introduction of New Programmes

Introduction of new courses that incorporate incorporates digital technology; Geographic Information System and which emphasises data and information management can have very positive effects. Besides the normal postgraduate courses at M.Sc., M.Phil. and Ph.D. levels, the Department in 1999 introduced a Professional Master of Geoinformatics programme which admits a wide range of candidates from different backgrounds. The programme is open to graduates in Surveying, Engineering, Physical Sciences, Social Sciences, Environmental Sciences, Business Management and Forestry. This programme is also attracting many people from different backgrounds. It is important to mention here that the Department of Geography at the University of Lagos and at the University of Ibadan have also started a Masters programme in Geographic Information System. The essential difference between the Geoinformatics programme and the Geographic Information System programmes is in the background of the proponents of the programmes. While the Geoinformatics programme is mounted by academics that are rooted in Surveying, the GIS programmes are mounted by academics with Geography background. The emphasis in the programmes may therefore be slightly different. But, both programmes are meant for the same market. The response has been very good attracting 24 – 32 candidates in the last three years.

3.2.3 Collapse of Boundaries between Disciplines

Development in the field of computers, satellite and information technology has led to a form of collapse of boundaries between professional fields. It is no longer certain where for example a surveyor start and a civil engineer takes over. This situation is seen as an opportunity for surveyors to expand her boundaries away from the core surveying fields into fields such as environmental management, coastal management, geographic information system and remote sensing. This will widen the scope of the practice and attract new intakes into the profession. There is certainly no reason why people with background in photogrammetry, remote sensing and geodesy cannot be brought into the fold of surveyors and registered to practice in their special areas of interest.

3.2.4 Conversion of Analogue Maps to Digital Formats

Many countries in Africa have not converted their basemaps to digital formats. Nigeria is a typical case. It was only recently that the Federal Government awarded contracts for the conversion. This project is ongoing. It does not include updating. This will provide a lot of opportunities for surveyors in Africa who are knowledgeable in digital map conversion

3.2.5 Impact of Technology and Development of New Concepts

The coming of global positioning system (GPS), total station and digital theodolites has made the acquisition of data much simpler and faster than hitherto was the case. This has made acquisition of data an all comers affair. But instead of looking at this as a disadvantage, we see this as creating an enormous potential for mapping several unmapped parts of Africa. What is needed is retraining of surveyors who hitherto were used to only analogue theodolites and electromagnetic distance measuring equipments. This is where the professional bodies have very important roles to play through continuing professional development (Nwilo & Adebisi, 2001).

The concept of spatial data infrastructure in a unique opportunity for surveyors as major players in the acquisition of spatial data to take the lead. This is because SDI is a field that integrates several disciplines. Several young graduates trained in the field of surveying and geoinformatics have found very good jobs as spatial information experts. SDI is an emerging field that has the potential to create a very large market like any other infrastructure and therefore has a lot of promise for Africans. The only draw back is that most of the professional are not yet grounded in the concept. This the institutions can take care off through retraining. It can also be part of the course contents in surveying and geoinformatics in universities and polytechnics.

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CONTACTS

P. C. Nwilo
Department of Surveying & Geoinformatics
University of Lagos
Lagos
NIGERIA
Tel. + 234 1 493 8638, Ext.1865.
Email: pcnwilo@yahoo.com

D. A. Osanwuta
National Inland Waterways Authority
Lokoja
NIGERIA
Tel. + 234 58 221 560
Email: dennisosanwuta@yahoo.com