# A Career in Hydrography: The Intricacies and its Make-Up

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**Key words**: Hydrography, hydrographer, hydrographic organization, career, specialties.

## SUMMARY

The issue of career choice is a serious challenge for secondary school students and young school leavers. The choice of specialty in most instances becomes even more challenging to aspiring career makers in fields of broad specialization options such as surveying. In situations where traditional surveying specializations co-exist with current Geoinformatics sub-fields with its attendant versatility, it is necessary to spell out the content, prerequisite and prospects of the various specialties. This holds for hydrography as one of the core specialism of the survey profession. Hydrography basically deals with the determination of depths and configurations of bottoms of water bodies using specialized instruments. It is a multidisciplinary field that has expertise and specialties. The ethics and practice of the profession is regulated and coordinated by regulatory and professional bodies. However, entry into the profession requires an appropriate balance between individual's aptitude and skills as well as career and educational prerequisites. In this paper, the definition and principles of hydrography, scope and methodology as well as the basic trait for a potential hydrographer is provided. The various benefits and applications, challenges and prospects including training and educational requirement of the discipline is properly articulated.

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## 1. INTRODUCTION

The department of Education, Training and Employment State of Queensland define career as the sequence and variety of occupations which one undertakes throughout a lifetime; it includes life roles, leisure activities, learning and work (State of Queensland, 2004). That is to say, a career is an occupation or vocation regarded as a long-term or life-long activity. It is the series of jobs that a person has in a particular area of work and usually involves more responsibility as time passes. A career in hydrography involves measurement and description of a variety of characteristics that affect marine construction, maritime navigation, offshore oil exploration and a variety of marine tasks. The work of hydrography is carried out in a wide range of differing situations and applications ranging from inland waters and rivers to ports and deep oceans. The Hydrographer is expected to have a number of skills in seamanship and safety with the potentials for good vision, detail orientation, accuracy and precision with the ability for effective visualization. Educationally, the hydrographer must have broad knowledge in sciences such as physics, mathematics, geography, statistics, engineering, technical drawing and technological designs, electronics and computer applications with a view to acquiring professional training and vocational skills in navigation, global positioning and geographic information system. To define hydrography, the definition given by the International Hydrographic Organization which is all encompassing is adopted here to fit the purpose of this paper. Thus, Hydrography is define as "the branch of applied sciences which deals with the measurement and description of the physical features of oceans, seas, coastal areas, lakes and rivers, as well as with the prediction of their change over time, for the primary purpose of safety of navigation and in support of all other marine activities, including economic development, security and defense, scientific research, and environmental protection" (International Hydrographic Organization, 2012).

Hydrography is an applied and a marine science distinct from others in this sphere. It serves as a foundation upon which other marine sciences such as hydrology, oceanography, etc., are built. It may generally be referred to as the science of "Sea Geography". Objectively, hydrography deals with the acquisition of information on the sea bed configuration and composition, water movement (current, tides, and waves) for marine resource exploration; shorelines, water depth and other characteristics for compilation of nautical chart used for maritime operations and related activities. It is also conducted to support coastal engineering and management as well as offshore resource development.

### 1.1 Principles and Scope of Hydrography

Fundamentally, all hydrographic surveys are based on some fundamental principles namely:

- Establishment of vertical controls consisting of chains of bench marks near the shore line for referencing of heights;
- Establishment of horizontal controls for position referencing; and
- Location of irregularities and obstructions in shoreline and island using normal surveying methods (Bannister and Raymond, 1992).

Hydrographic surveying involve a wide range of activities and services that serve as core and fundamental in infrastructural, social and physical development of the marine zone. It ranges from the traditional nautical charting to contemporary delimitation and delineation amongst;

- Marine/coastal and inland water surveying with depth measurement and position determination
- Measurement of water current, tides and water levels
- Geophysical survey for sub-sea bed profiling
- Determination of sub aqueous filling and dredging
- Acquisition of data for planning of engineering and coastal constructions
- Marine cartography- representation of measurement result as chart (electronic and manual), thematic maps and manuals.

To carry out these, several surveying methods and measuring techniques are employed. These include sounding, bathymetry, geophysical surveys, position fixing, etc.

-Sounding is one of the major operations in hydrography. It is the process of measuring the depth of the sea bed in order to portray relief – a 'wet' equivalent of leveling in land surveying. Soundings are usually related to a sounding datum which is a reference point (mark) for heights and positions. This operation is often done simultaneously with position fixing using the EDM, Total Station, and/or the Global Positioning System (GPS) equipment. Soundings are used in determining and monitoring channel depths, planning pipeline routes and in controlling dredging operations, etc.

-Bathymetry is the measurement of the depth of water bodies as well as the determination of positions with respect to a datum and involves the acquisition of geometrical information of the sea bed for the depiction of coastal configuration. It is a marine equivalent of topographic surveying. Data from this survey is used in the production of the bathymetric chart- a topographic map of the ocean floor used in navigation, resource exploration and exploitation and in pipeline/ cable routing.

- Geophysical Survey/Seismic Profiling: These involve the determination of the geologic properties of the ocean constituents and sea bottom composition as well as the establishment of leveling datum for sub-sea bed profiling. Here, three-dimensional mapping of the geologic profile and geotechnical information acquisition is achieved by recording medium to high frequency acoustic pulses by a towed transducer. Seismic operations for marine construction and resource exploration is done using instruments such as grabs, dredgers, barges, gravity corer, sub-bottom profiler and magnetometer.

-Current metering: This is the determination of rate and direction of flow of water current for the location of sewer outfalls, scour and silts. Data captured from this hydrographic process is invaluable for many applications including:

- Prediction of siltation, current patterns and regimes for siting and design of coastal structures such as jetties, platforms, culverts, bridges, etc.
- Baseline information for projects involving water supply and irrigation, flood/erosion control and hydroelectric power generation.

Besides, hydrographic surveying also include tide and wave observations. These parameters are measured directly or indirectly to determine their regimes with respect to coastal formations and other hydrographic processes. More information on FIG Publications No. 56 and S-5.

### 1.2 Instruments and Vessels

In hydrography, simple and less expensive equipments are available which are used in minor operations. Instruments in this class include; sounding poles, lead lines, tidal gauge, grabs, barges, drogues, sediment sampler. Others are theodolite, EDM, gravity corer, magnetometer, dredgers, pressure actuated meter and survey boats/vessels.
However, with modern technological advancements, sophisticated and digital instruments with higher capabilities have been produced. Some of these include; ultrasonic flow gauge, high resolution boomer, multi-beam and swath sounding systems, multi-beam and angle-discriminating sonars, GPS instruments, etc. Specialized survey systems and vessels that incorporate these instruments are also available.

### 1.3 Hydrographic Specialism

Based on the IHO specifications, the core hydrography is subdivided into nine specialties. These are Deep Sea Specilaist, Seismics, ROV Operator, Oceanography, Software Specialist, Position fixing, Geodesy, Research and Development, Coastal Engineering. To specialize in any of these fields, basic knowledge in the core hydrography in addition to ability, skills and training is required. Nevertheless, these specializations exist with no rigid boundaries as they are often practiced simultaneously in four broad sectors as military hydrography, nautical charting, port management and coastal engineering, offshore construction and inland waters hydrography.

**Nautical charting hydrography -** Nautical charting is the oldest specialty in the field of hydrography. It involves the collection, processing and presentation of data to support marine navigation. Nautical charting is made up of surveying and cartography.
**Military hydrography -** This is hydrographic specialty involved with anti-sub marine and amphibious operations. It is taught in naval schools and other specialized institution for maritime belligerency.
**Industrial/ offshore hydrography -** This embodies hydrographic activities in national and inland waters for the purpose of marine exploration and construction.
**Port and near shore hydrography -** Port and near shore hydrography deals with port and coastal engineering, mapping and management.

## 2. TRAINING AND REGULATIONS IN HYDROGRAPHY

To specialize in the field of hydrography, basic education and training should be undertaken and at appropriate institutions of learning. Hydrographic education programmes provide a comprehensive knowledge and understanding of the scientific and technical basis of hydrography. It provides a foundation for a career in hydrography through established degree and certificate programs both at the undergraduate and graduate levels and continuing education programs. These training are based on standards which are provided and regulated by standard Hydrographic organizations and regulatory bodies.

### 2.1 Educational Programs

To undertake an undergraduate course in hydrography, different institutions and different countries set the entry requirements/standards based on the academic standard and educational levels of the respective institutions and countries. At the national levels and in countries where hydrography forms part of a military formation (e.g. India) or coastal science department (as in New Zealand and Japan), training are usually carried out in special institutions based on certain qualifications. The content and length of the training programme differs but addresses all aspects of training in hydrography while the student is expected to have a good academic background in mathematics and other related sciences and be proficient in the language in which the training is given.

In Nigeria, hydrography is taught as part of the general survey (geomatics) course in the undergraduate level and as a specialty in post graduate level. The entry requirement for undergraduate programme include five 'O' level credit passes in English, Mathematics, Physics, and two other related science subject such as Geography, Economics, etc. with a pass grade in the University Matriculation Examination (UME) and university aptitude test (Student's Information Handbook, 2012). A bachelor degree or a combination of Higher National Diploma (HND) and a Post Graduate Diploma in Surveying is a prerequisite for admission for Post Graduate program.

At the international level, the FIG, IHO and the Nautical Cartographers through the International Advisory Board on Standards of Competence for Hydrographic Surveyors sets and develops (and also updates) standards of competence for various training courses and also facilitates accreditation of the different programs based on published guidelines and syllabus. According to the Board, these Standards are to provide guidance whereby individual surveyors may be trained and qualified in accordance with internationally accepted levels of competence. The Standards indicate the minimum level of knowledge and experience considered necessary for Hydrographic Surveyors and provide a set of programme outlines against which the Board may evaluate programs submitted for recognition (Publication S-5, 2011).

It also reviews the academic programs of educational institutions that are seeking IHO accreditation of their hydrographic training courses. Based on these specifications, hydrographic programs are divided into three categories according to theoretical background and working knowledge.

**CATEGORY "A" PROGRAMME**

This is a training course which provides a comprehensive and broad based knowledge in all aspects of the theory and practice of hydrography and allied disciplines for individuals who will practice analytical reasoning, decision-making and development of solutions to non routine problems. The category "A" programme is a higher degree (e.g. Post Graduate Diploma, Masters or Doctorate Degree) programs meant for Surveyors who might have had University degree in Geomatics, Hydrography or any other related Surveying courses. Approved courses in this category comprise of Nautical Cartography, GIS and Nautical Science; Classical Geodesy; Marine Geology for Hydrographers; Applied Oceanography/ water levels; Remote Sensing/Kinematics positioning; Hydrographic data management; Practical hydrographic science/hydrographic science field project (Courtesy: University of Southern Mississipi). Specialized fields in category "A" course include Nautical charting surveys, Port and near shore surveys, and Industrial offshore surveys.

**CATEGORY "B" PROGRAMME**

The category B is a higher technician level program that awards Higher National Diploma and Bachelor Degree certificates. It is a practical based training program for individuals with skills to carry out the various hydrographic surveying tasks and for a better comprehension of hydrographic surveying. Courses offered at this level include; Core Mathematics, Statistics and Computing; Theoretical and Applied Physics; Environmental Sciences; Cartography and Maritime Law.

**UNCLASSIFIED PROGRAMMES**

The unclassified program is meant for further training of survey personnel such as survey technicians, technologists, sailors and for persons employed in hydrographic operations in marine survey ships. It is usually undertaken at community colleges, technical institutes and vocational schools e.g. polytechnic, school of surveying, and usually last between one to three and four years. Certificates awarded include national diploma and ordinary certificates. Prerequisite subject and background knowledge are required in mathematics, geography, drafting and design. Courses directly related to this class of training include;

- Earth Science with Ocean Mapping Option
- Hydrographic Science
- Marine Science and Technology
- Computer Information and Technology
- Navigation and Charting Technology (Transportation & Technology)
- Watershed / Hydrology

## 2.2 Educational Institutions

At the interntional level some of the institutions where hydrography is studied as recognized and accredited by IHO include:-

- RAN Hydrographic School, Balmoral Australia
- Royal Naval Hydrographic School, Plymouth UK
- National Institute of Hydrography GAO, India
- L'ecole des Hydrographes, France

- University of New Brunswick Canada
- US Naval Post Graduate School Montery, USA
- The Hydrographer SA Navy, Republic of South Africa

In Australia, the RAN Hydrographic School undertakes the H2 Hydrographic Officers Course which is recognized by the FIG/IHO/ICA as Category B; Intermediate Hydrographic Surveying and the Basic Hydrographic Surveying Courses whereas the Hydrographer SA Navy, Republic of South Africa offers Survey Recorder (SR) Part 1, 2, 3 and Basic Survey Course for Officers (Publication C-47).

In Nigeria, some institutions offering hydrography at post graduate level include:-

- University of Lagos, Lagos
- University of Nigeria, Nsukka
- Nnamdi Azikiwe University, Awka

These institutions besides the postgraduate programmes also offer general Surveying and Geoinformatics courses that lead to specialization in hydrography. Schools such as The Nigerian Institute for Oceanography and Marine Research, University of Uyo, Uyo; Ahmadu Bello University, Zaria; Federal University of technology, Minna; Federal School of Surveying, Oyo; Federal Polytechnic Kaduna; etc. also offer the general survey and related courses. Details of institutions, courses and entry requirements for some countries can be obtained from the IHO Special Publication C-47.

## 2.3 Hydrographic Organizations

To bring about co-ordination of activities in the hydrographic specialism and provide standards for training and practice for the purpose of ensuring competence in the profession, several hydrographic organizations and regulatory bodies are formed both at national and international levels. At the international level, three outstanding hydrographic bodies exist: International Federation of Hydrographic Societies, International Hydrographic organization and FIG Commission 4.

### 2.3.1 International Federation of Hydrographic Societies (IFHS)

The International Federation of Hydrographic Societies formerly known as Hydrographic Society is a learned body of national and regional Hydrographic Societies. It is an international umbrella organization for both individual and corporate hydrographic communities that foster the establishment and growth of new national societies. The IFHS provides a global platform for promoting free exchange of information between members and related disciplines. The organization is manned by an executive committee which comprise of a director, operations and publications manager, treasurer and representatives of associate members as ex-officio. It has membership across 70 countries of the world.

The IFHS objectively promotes the science of surveying through specialist seminars and technical workshops; promote career development and opportunities through publication of relevant career guides, web-based employment and work placement advertisements; and promote improved education and training for individuals engaged and intending to engage in hydrography through distribution of information and educational awards. IFHS has a quarterly

publication 'Hydrographic Journal', and Information Bulletin" as well as a website for information dissemination.

2.3.2 International Hydrographic Organization (IHO)

This is an intergovernmental consultative and technical forum established in1921 through an international convention to support safety of navigation and the protection of the marine environment. IHO has membership consisting of eighty one coastal States. The Organization is run by an elected directing committee of three senior Hydrographers and supported by bureau staff. The head office is at Monaco.
IHO has the main objective of coordinating the activities of national hydrographic offices and fostering exchange of technical and nautical information among nations. It has a bi-annual journal "The Hydrographic Review" which carries articles of important issues in the world of hydrography and an 'International Hydrographic Bulletin' – that carries information on chart and other publications from the national charting establishments.

2.3.3 International Federation of Surveyors (FIG) Commission 4

The International Federation of Surveyors is an international premier, UN-recognized, and non-governmental organization established in 1878 with the aim of representing the interest of surveyors globally. Objectively, FIG supports a worldwide collaboration of progress of surveying in all fields and applications while ensuring that the disciplines of surveying and practitioners meet the needs of the market and community (FIG Profile, 2011-2014). Membership of FIG span across 120 countries of the world
The FIG activities are grouped within ten technical and scientific commissions of which commission 4 is concerned with Hydrography. FIG Commission 4 has the aim of
– Promoting the aims and objectives of FIG to Hydrographers through the active involvement of national delegates from member associations and other interested parties in the activities of the commission.
– Fostering closer links with all sister organizations currently active within the global hydrographic community.
– Developing guidelines and standards that will assist Hydrographers in the provision of their services.
– Disseminating information relevant to the profession through participation in international meetings, conferences and committees.

The objectives of the commission are met by four working groups that handle several aspects of the commission's terms of reference which include: – Hydrographic surveying; Hydrographic education, training and Continued Professional Development (CPD); Marine environment & Coastal Zone Management (CZM); Data processing and management; Nautical charting and Bathymetric maps. Communication and information dissemination is through the 'Article of the Month', FIG e-Newsletter, FIG profile and the Commission's website (FIG 2012).
Other internationally recognized and national Hydrographic Organizations include:

International Maritime Organization (IMO), Nigerian Hydrographic Society (NHS), The United Kingdom Hydrographic Office, Australian Hydrographers Association (AHA), Canadian Hydrographic Association, The Hydrographic Society of America (THSoA), Norwegian Hydrographic Service, State Hydrographic Service of Georgia and German Hydrographic Society (DHYG), etc.

However, some national surveying organizations embodies specialist that cut across the geoinformatics profession including hydrography specialism. They include amongst others:

- Nigerian Institution of Surveyors - Nigeria
- Royal Institute of Chartered Surveyors - London
- The Institution of Surveyors - Australia
- Chartered Institution of Civil Engineering Surveyors- UK

## 3. RELEVANCE OF HYDROGRAPHY

As a multi-disciplinary profession, hydrography provides variety of products such as charts, maps, tables, almanacs, manuals etc. to a vast majority of users. Hydrographic information provides bases for engineering project, safety for navigation, maritime delimitation, national sovereignty and defense. Areas of application include among others:

### 3.1 Marine Resource Exploration and Exploitation

With water constituting the largest part of the world total area (70%), the marine environment constitute a reservoir/habitat for most natural resources such as water, mineral oil and gas, sands, gravels, fishes, etc. To harness and develop these resources, essential information of the marine environment is needed.

Fishermen require maritime information both for safe navigation of their vessels and for deployment of their fishing gear in order to prevent costly losses and damages. With hydrography, information such as location/position of wrecks, obstructions, forbidden areas, ocean current and maritime boundaries are made available to the fishing industry. Researches in fisheries use bathymetric data/products for aquaculture, seabed classification, habitat mapping and in environmental impact assessment.

Marine and inland waters perform a large number of vital ecological functions in the supply of water and food; transport routes and in the regulation of climate/weather. Granted this, hydrography gives reliable information such as volume, depth and direction of flow of water and discharge employed in the development and conservation as well as in hydropower generation.

In a country such as Nigeria where oil serves as the main stay of the economy and where oil patches are located in the coastal area, the importance of hydrography in various stages of oil and gas exploration, exploitation and transportation cannot be overemphasized. The precise nature and configuration of the seabed, its geographic relationship to land, the characteristics of dynamics (tide, currents, waves), geology and offshore positioning are carried out to locate oil ‘dirids’ and oil “patches”. Rock strata and slope faults from sound reflections on hydrophones are used to position oil and gas reserves deep beneath the sea bed. Oil well sitting, drilling rigs positioning and access is made through offshore rig site surveys. Offshore

production platforms and related seafloor transmission systems as well as pipeline routing/laying require hydrographic data. Application is also made in mining and extraction of sand, gravels and other marine resources (Moka, 1997).

### 3.2 Coastal Zone Management and Engineering

The coastal zone is defined as a zone of varying width including the shore and extending to the landward penetration of marine influence, the crest of a cliff, the head of a tidal estuary or the solid ground that lies behind coastal dunes, lagoons and swamps. Coastal zone management involves the integrated development of the coastal region both in economical, ecological and social terms. Coastal zone management activities include:

- Construction and establishment of near shore infrastructure and marine facilities such as beaches, marinas, ports, jetties, platforms, wharfs, harbors etc and the maintenance of existing ones.
- Establishment and monitoring of dumping grounds for industrial waste.
- Dredging operations for the maintenance, monitoring and improvement of charted depths, channels and land reclamation.
- Control of pollution in near shore water and conservation.
- Control of coastal erosion and flood.

These activities are supported by hydrographic data and products such as bathymetric chart, nautical chart, acoustic pictures, seabed profiles and sonar pictures. For instance, in Nigeria several towns and places have been reclaimed through land reclamation. In Siapem Camp Bayelsa State, hydrographic processes of bathymetric and geologic survey was carried out to determine the area and quantity of dredging required for the reclamation of the area. This in effect led to a successful reclamation of the land thus extending land capacity and providing land for use (Etuonovbe, 2011 in FIG Publication No. 57). The proposed deep sea port at Ibaka- Akwa Ibom State is another project that benefits from hydrography. Based on the sounding and bathy metric work carried out on the sea, it was discovered that this region could be harnessed in this regards. The port when completed will bring about economic growth in the region, increase revenue for government, employment and avenue for international trade.

### 3.3 Maritime Transport/Navigation

Presently about 80% of international trade is carried out by sea (www.hydrographicsociety.org). There exist challenges in the transportation of goods from one country to another with potential hazards to the marine environment, human lives and cargo. Howbeit, hydrography plays a major role in this sector by providing hydrographic information such as depths, navaids, wrecks and tides/tide levels. Thus, safe approaches to ports, safe berths and anchorage, saving of time and money resulting from use of shorter and deeper routes and the potential of using larger ships or loading ships more deeply all depends on these hydrographic information. Besides, a novel application of GIS, GPS and satellite communications allow real time and electronic navigation charting (ENC) with an internationally coordinated network of radio broadcasts containing information such as

navigational safety alarms. This together with the Tide Tables for the coastlines and estuaries has brought improvements and safety to maritime transport in many countries and has also lead to timely updating of charts which has made navigation through previously inaccessible port possible.

### 3.4 Maritime Delimitation and Delineation

Maritime delimitation is the demarcation of limits of maritime juridical boundaries and jurisdiction for legal and management purposes. Maritime delineation involves the detail description of the extents, boundaries and limits of maritime zones/spaces for purpose of exercising rights in marine space and resource exploitation and development. These processes are dependent upon some geospatial references or baseline which is closely related to coastlines or the mean low water and on the United Nations Convention on the Law of the Sea (UNCLOS) specifications and standards. In practical and legal implications, it is only the marine chart that provides the baseline information for delimitation and delineation as specified by UNCLOS. The bathymetric chart (and datum) provides basic information for the determination and demarcation of the Continental Shelf, Contiguous Zone (CZ), Exclusive Economic Zone (EEZ) and other marine space and boundaries.

### 3.5 Defence and National Security

For national defense, safety and naval operations, vital parameters of national waters such as point coordinates, marine zones and boundaries are obtained and used in submarine mines and amphibious operations by the Navy. This baseline information also aids in naval operations against terrorism, piracy, smuggling and other illegal and anti-safety activities as well as in decision making that ensure national and international security.

### 3.6 Marine Science

Marine sciences such as limnology and hydrology depend to a large extent on bathymetric information. Production of global tide and circulation models for a variety of scientific researches and studies; marine geology/geophysics; deployment/placement of scientific instrument; and many other aspect of marine science depend on this data.

Besides, hydrography has applications in many other areas such as environmental protection, resource management, tourism, recreational boating. Hydrographic information is also vital instruments for decision making both in governmental and the private sector.
For further information on the relevance, economic benefits and applications of hydrography, the reader is referred to the FIG publication No 57.

## 4. CAREER OPPORTUNITIES, CHALLENGES AND PROSPECTS

As is obtainable in the Geomatics world, it should be noted that hydrography specialty is dynamic in all ramifications. Opportunities for advancements exist much so are challenges. In

this section, the opportunities, prospects and challenges faced in the profession are highlighted.

### 4.1 Career Opportunities

Since Hydrographic Surveying is a core factor in maritime delimitation, coastal zone management and trade, career opportunities exist in various fields, industries and companies. In countries where oil and gas exploration is extensively done offshore, the hydrographic surveyor has unlimited opportunities in the oil and gas industry for deep seismic research, drilling rig survey and emplacement, pipeline survey and construction.
Opportunities also exist in maritime shipping, boating and management, national and international boundary delineation and delimitation, EEZ and coastal management, environmental studies, monitoring and protection. Hydrographers have relevance in the Military (e.g. Naval Hydrographic Departments), equipment and software development, academic research and studies as well as in nautical and navigational charting. Freelance surveying and consultancy is also a sector of high career prospect (www.hydrographicsociety.org).

### 4.2 Challenges

Currently, the hydrographic profession is facing challenges ranging from work environment to instrumentation, expertise and the best way to ensure high standards and best practices based on minimum standards of competence, education and training. Again it is pertinent to state here that the environment in which hydrographic measurements are carried out is a dynamic one. Thus while all data remain useful to a certain extent, much may have a limited life span of primary quality and this subsequently leads to repeated measurements, observations and reduction in accuracy and standard.
The problem of inadequate personnel whereby few people are actively involved in hydrography is a major challenge. Despite the expansion in data usage and applications, there has not been a parallel increase in trained personnel thus making the profession under staffed. The poor number of educational institutions offering hydrography is a major setback in this regard. However, it has been observed that the reasons for the difficulty of maintaining hydrographic courses are varied, and for institutions offering them, the challenge is in the number of students applying for the course - or rather - a lack of sufficient numbers to sustain such specialist as well as the high cost of training and education (Armstrong et al, 2012).
Nonetheless, although hydrographic equipments and survey vessels are witnessing a tremendous development and advancements in recent times, they have high capital and operating cost thus posing a major financial challenge to the growth of the profession.

### 4.3 Prospects

Despite the challenges, developments in hydrography just like other areas of surveying is far from complete as new technological discoveries and innovations are emerging with time. Presently, the International Advisory Board on Standards of Competence for Hydrographic

Surveyors is on the process of reviewing the S-5 to cater for challenges in hydrography and nautical cartography. The review is expected to be completed by 2014 (Armstrong et al, 2012) The IHO is also undertaking the release of the new Hydrographic Geospatial Standard for Marine Data and Information which is to be known as S-100. This together with its supporting geospatial information infrastructure (GII) is under development and implementation to take care of the 3.1 ENC and any subsequent IHO data transfer standard (Ward, et al 2009).

Also, the profession is recording major advancements in instrumentation and measurement technology. For instance, instruments such as multi beam, multi channel acoustic and laser systems that provide fast and cost effective data acquisition are manufactured with the dawn of each day. This is augmented with the availability of satellite positioning systems. With these innovations, data acquisition and processing will become less rigorous while providing an unprecedented data and information for development of the maritime region, policy/decision making and research among other things. The convergence of technologies of digital data collection, processing and dissemination with sophisticated computers will lead to the development of hydrographic system which will enhance the integration of activities on a single platform. The amalgamation of topographic and hydrographic database will lead to global standardization of hydrographic data and e-hydrography.

Industry-wise, employment of hydrographic professionals is changing from life-time careers to project and contract employment. This requires retraining and sharpening of skills to meet up with new technology-based competencies. Besides, career prospect in hydrography is typically excellent. The US Bureau of Labor Statistics in its publication declared that job prospect in Hydrography is good especially for those with extensive experience and that employment of Hydrographic Surveyors is expected to increase by 18% by 2018. As of 2012, the Bureau declared average annual salary for hydrographic surveyors to be $52,000. This varies on location, employer, education, experience and benefits.

## 5. CONCLUSION

A career in hydrography involves the mapping of varieties of bodies of water and the determination of the topography of the bottom, water depth, shorelines and other marine and coastal characteristics. Hydrography has various methodologies, instrumentation and specialism. Its products have diverse use and applications in different sectors of the economy including maritime boundary delimitation, marine resource exploration and exploitation, marine transport and navigation, coastal zone management, defense and national security. It stands a better chance among other surveying specialism as it carries high intellectual development, professional competence and financial buoyancy. Challenges to efficient and effective career accomplishment exist that require utmost attention.

For entry and success in the career, skills and information can be acquired through training in appropriate institutions of learning, technical and scientific publications and also through participation and involvement with the regulatory and professional bodies both at the national and international levels.

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