

The Training & Development of Naval Hydrographer in Taiwan

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Abstract

Hydrography provides necessary information on nautical chart for navigation safety to vessels and ships sailing around any channel of the port, coastal area, and the open sea. Because the navigation safety is extremely important to national economic development, the quality of hydrographic surveyor also indirectly affects a national infrastructure and economy. In the context, the history and work of Taiwan Naval Meteorological and Oceanographic (METOC) hydrographic surveyors are introduced, and then its training program and *International Hydrographic Organization* (IHO) certification system are presented. We propose a future framework for position development in the Navy. The scope of Naval METOC system is presented at the end of the article.

Introduction

Taiwan Naval METOC office is responsible for the survey of the surrounding waters around the country. The task in hydrography is providing a variety of characteristics that will affect naval base facilities, maritime navigation, and for multi-marine military tasks. Beyond military tasks, the range of hydrography is widely from inland and ports waters to deep oceans, depending on different applications. Among these applications, marine navigation safety assurance is the major purpose of hydrography survey for Naval METOC office. The survey result can be used to support all other marine activities, including economic development, security and defense, scientific research, and environmental protection (IHO, 2012). For educational perspective, *hydrographers* should have knowledge in engineering, physics, mathematics, geography, statistics, mapping, adjustment, electronics and computer science. They should be under a series of on-job training in navigation, hydrography, global positioning and geographic information systems.

In Taiwan, surrounded with waters, is geographically located at strategic position. However, Taiwan must rely on imported materials for manufacturing and exporting the products around the world due to dense population and lack of petroleum and other natural resources. Consequently, hydrographic surveying is extremely significant to the navigation safety, and important for economic factor.

The history and evolution

Generally, most national hydrographic services around the world are affiliated to the Navy. In Taiwan, the Navy takes charge of publishing paper nautical charts which is responsible for maritime safety investigation (Shiahn-Wern Shyue, 2003). The Navy is the foundation of hydrographers in Taiwan.

The Republic of China, Taiwan Hydrographic Office was established in 1922, named '*Naval Hydrographic Office*' and located at Shanghai. At first, the Office employed a British expert, Miruth, who worked in Customs Administration, served as the Deputy and managed the whole hydrographic technology and training. In 1924, the first Hydrographic Research Vessel, Atlantic, from the United Kingdom was obtained. During that period, the mission of the Office was territorial sea definition, river and harbor surveying, lighthouse and navigational signal erecting, and navigation, etc. In the meantime, the Office joined IHO meetings hosted by International Hydrographic Bureau (IHB) in Monaco.

The Hydrography Office was suspended temporally about 7 years due to the World War II, the survey ships were joined to battle ships. After the WWII, the Hydrographic Office recovered and restarted hydrographic surveying. It also began training courses, raising hydrographic surveyors and cartographers, surveying the downstream of Yangtze River, and developing navigational publications. The hydrographic surveyors of Navy had been stably growing up since that time. Then in 1985, the Naval Hydrographic Office renamed as '*Naval Hydrographic & Oceanographic Office*'. From 2005, it combined with former '*Naval Meteorological Center*' and set up a new unit '*Naval Meteorological & Oceanographic Office, METOC*' until now (Naval METOC Office, 2013).

Hydrographic surveying, including nautical charting, oceanographic researching, and hydrographic technology for modernization. With GIS technology, the Navy attempts to add more information including a variety of environmental elements such dangerous weather, in-situ sea state, and other bathymetric measurement to create a new generation of electronic navigation chart (ENC). This integration provides not only better data quality of the chart, but also useful integrated information for improving navigation safety.

The training in Taiwan

In Taiwan, the METOC office manages and operates battlefield environment. The Naval hydrographic surveyor should understand comprehensive marine environmental information, and to know how to analyze it with proper tools, for decision support. We have assisted and cooperated with the United States for technical training for many years. This also contributes to professional development for hydrographic surveyors.

- **Internal training**

Following the U.S. system, our R.O.C. Navy designs a unique hydrographic operation system fitting Taiwan Naval framework. With this system, Navy also designs a variety of training classes for naval officers graduated from Chung-Cheng Institute of Technology (CCIT). Officers or noncommissioned officers in each position have specific task and clearly defined work to do in the team. The junior officer plays as trainee, who can always become qualified educators or trainers after long-term working experience and rank promotion. Up to now, this internal training system still works effectively.

- **External training**

International Hydrographic Management and Engineering Program (IHMEP) provides practical, professional training in hydrographic survey management and engineering at ‘Naval Oceanographic Office, NAVOCEANO’ in U.S. Navy, Stennis Space Center in Mississippi. For people who completed this six-month course, one can received the International Federation of Surveyors /International Hydrographic Organization Advisory Board on Standards of Competence for Hydrographic Surveyors *Category B* certification. Every year, through the channel of ‘Foreign Military Sales’, IHMEP accepts international trainees who are naval hydrographic officers from the world. In 90’s, the Taiwan Naval Hydrographic Office started to send line officers to attend IHMEP in NAVOCEANO. Since 2008, Taiwan Naval METOC Office gets qualified IHMEP Graduates every year continuously.

The trainees in the IHMEP program can learn how the sensor, device work when operating, what the best solution or method are used when surveyor encounter problems, and when facing the error happened in computation. The trained officers who return Taiwan from IHMEP can revise and advance current principle and operating rules in unit. At the same time, who have the knowledge and vision to plan what the next modern sensor, device, or software worth to update, or to purchase should be suggested. Nowadays, most of the hydrographic officers in the METOC Office have trained in IHMEP in the U.S. Navy, and all of them keep the IHO *Category B* certificate.

- **Foreign R/V observation learning**

Due to lack of natural resource and energy in the world, more and more foreign country started to explore the undersea resource globally in recent years. They make a large investment for physical and geophysical oceanography research, such as internal wave phenomenon, mud volcano, vapor of hydrogen, etc. And they make the ocean bottom mapping, sediment coring, seismic surveying, sound-velocity collection all over the world. Taiwan Navy dispatches officers in the cruise when the foreign research vessels

come near Taiwan. Being the observers, the officers practically join these scientific works and learn modern observation methods, such as bottom mapping, ocean mooring, sea-glider diving, etc., and collect the data from shipboard hardware systems. In addition, these dispatched officers have good opportunity for professional development, as well as experiencing foreign culture.

The way to Certification

There are several IHO accredited organizations and institutions, which have Category A & B programs for hydrographic surveyor in the world. They are certified for issuing certificate to international trainees (Publication C-47, 2010). Categories of program and scheme for hydrographic personnel are defined with respect to the theoretical background and working acknowledge of those who successfully graduate from such programs. That divides into 3 categories of programs, included 'Category A', 'Category B' and 'unclassified' Programs (Publication S-5, 2011).

The primarily education of METOC is following the U.S. system. In the United States, the institutions accredited by IHO include two universities, *University of New Hampshire* (UNH) and *Southern Mississippi University* (USM). There are two levels of category, one is category A, the other is category B.

● Category A

For the IHO 'Category A' training program, *International Hydrographic Science and Applications Program* (IHSAP), most students follow the accelerated one-year track, which includes one semester of application, and two semesters of classroom lectures and practical exercises, combining for about 50 continuous weeks of study. Students may also choose to complete the program in two years and conduct research with the *Hydrographic Science Research Center* (HSRC). Only two-year students are eligible for assistantships. The awarded degree is a non-thesis master in hydrographic science.

The Hydrographic Science Field Project consumes the last six weeks of the program. Although the actual project is conducted at the end, many practical exercises completed during the year are directed towards the area where this project will be executed. The goal of project is aim to complete a nautical chart, and associate hydrographic survey including data planning and preparation, data collection, data processing and analysis, quality assurance, field nautical chart production, electronic navigation chart production, and complete comprehensive report of survey, etc. Data collection platforms include the USM research vessels, as well as *The Naval Oceanographic Office* (NAVOCEANO) multi-beam training vessel. These systems provide the students to explore the state-of-the-art technology, and the opportunity to use a fully functional hydrographic

survey platform. The final charts and reports of surveying are submitted to the *National Ocean Service* (NOS) for evaluation and assessment.

● **Category B**

USM also provides IHO 'Category B' training program. This program is primarily focuses on basic hydrographic field work. The goal of IHMEP is to train each student the ability to plan, execute and manage the collection of maritime geospatial and environmental data, to create nautical charts and products for military operations and exercises. IHMEP is available to help international students through the International military education and training program to certify at the 'Category B' level according to standards of the *International Advisory Board* (IAB) on standards of competence for hydrographic surveyors.

The program includes 30 hours of classroom training and field projects per week for totally six months curriculum which focuses on establishing a working knowledge of hydrography through practical training in numerous fields, including mathematics, computer science, geodesy, nautical cartography, meteorology, tides and GPS.

Most of the trainers in IHMEP come from *Fleet Survey Team* (FST), NAVOCEANO. It performs hydrographic surveys around the world in responsible for combatant commanders' requests in areas where Navy operations will take place or where charting accuracy is uncertain. FST is a subordinate command of NAVOCEANO, which provides oceanographic products and services to all elements within the Department of Defense.

Military position development

Military position development refers to the personal work experience and performance, then the military rank and positions could be promoted. Hydrographic commander is the highest rank of commanding officer. He need longer experience and specific capability to acquire. And the petty officer is the main source of manpower and base of troops. With the years of experience, Sergeant Major can promote to senior hydrographer, and finally become Hydrographic Expert/Consultant. This human resource development system takes for many years in the Navy and works well.

There are two tracks existing in the naval rank system, one is officer and the other is petty officer. The petty officer always plays the role of the actual operator. The major job for hydrographic office is planning, coordinating, and decision making for field survey.

International R/V Boarding

Taiwan Navy has experiences of foreign research vessels (R/V) boarding, and it could expand its scope of working on the sea. Selection of trainees boarding foreign research vessels

becomes a trend. Taiwan naval ship 'Da-Quan' survey ship (AGS-1601) was built by Italy in 1995. Although, she is equipped with advanced and sophisticated oceanographic research equipment such as the deep-sea and shallow-water multi-beam echo sounders, side-scan sonar, underwater remote-controlled vehicle, acoustic Doppler current profiler, automatic weather observation system etc. But the technical mission in 'Da-Quan' is different from the foreign research vessels. Her missions are primarily collection of oceanographic, hydrographic data and surveying of waterways/shipping channels in surrounding waters as well as in the South China Sea (Navy Command R.O.C., 2017).

Education Statistics and Human Resource Structure Redesign

After lots of commanding and staffing experience, the hydrographic surveyors need to apply for graduate school in university for obtaining more academic knowledge and studying more theories about hydrography and oceanography. A lot of Navy METOC hydrographic surveyors were graduated from master program of U.S. Naval Post-Graduate School, University of New Brunswick in Canada, Southern Mississippi University in U.S., and *Nation Central University* in Taiwan, *Chung Cheng Institute of Technology National Defense University* etc. After that, METOC also encourages hydrographic surveyors to study Ph.D. According to statistics, the naval hydrographic surveyors have 31.4% got master's degree and 8.3% hold Ph.D. With the master's degree or PhD, the hydrographic surveyors will have more chances to be a qualified commander. However, to petty officers, there still rare levels of position for them.

At present, there are 10% hydrographic officers in METOC who is certificated with IHO Category B program. But, only 1% METOC personnel has certificate of Category A program. Limited by the political constraints, manpower reductions, and defense budget cut, the management for naval hydrographic surveyors confronts with a serious challenge. And, there will be less and less position for these hydrographic officers. Relatively, the petty officers will replace the officers' position and play the roles which the officers played. The new human resource structure and management system need to be redesigned as soon as possible in the Navy METOC office

The vision for the future

The FIG/IHO/ICA International Board for Standards of Competence (IBSC) for Hydrographic Surveyors and Nautical Cartographers have guided the delivery of education and training for them since it was formed in 1977. The standards, as promulgated in IHO Publications S-5 (Publication S-5, 2011) and S-8 (IHO, 2010) (formerly M-5 and M-8), recognize two levels of hydrographic (or cartographic) competence - Category A and Category B (Armstrong, et al., 2012). Now, the following management frameworks are proposed based on these S-5 and S-8 standards stated above.

- **The Hydrographer Competency Certification**

The necessity in accrediting the competence of hydrographic individual, rather than the education program, has been widely identified. Armstrong & Johnson (2006) stated that the FIG/IHO/ICA International Advisory Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers had been studying the feasibility and desirability of drafting standards for national, regional, or industrial schemes of individual recognition of hydrographers. The American Congress on Surveying and Mapping (ACSM) / The Hydrographic Society of America (THSOA) hydrographer certification program began in 1981 in response to concern about unqualified bidders getting hydrographic surveying work. (THSOA, 2013). South Africa has ‘South African Qualifications Authority(SAQA)’ for certification. (SAQA, 2001) In Australia, the certification of individual is provided through ‘Australasian Hydrographic Surveyors Certification Panel’ (AHSCP) accredited the competence of hydrograph so far. (Nairn & Jasbir, 2010)

In Taiwan, professional certification including engineer, architect, and others, is under the supervision of Ministry of Examination. Current engineering hydrographic survey jobs are signed by survey engineers who most are not familiar with hydrography. Therefore, a national certification program for hydrographic survey and charting is strongly recommended for Taiwan. This will not only contribute to naval personnel, but also to the civilian hydrographic professionals.

- **Distance Learning and Certification**

Distance education with web based tools provides promisingly an opportunity to alleviate the geographic and time constraints. If it works, it has several advantages to save time, especially for private individuals, full-time employees (Shih, et al., 2011). Establishing an international distance learning program for hydrography and the certification of hydrographic surveyors is a good idea for today's internet convenient era. The program is based on industry standards (FIG/IHO/ICA ‘Cat. A / B’) and developed by recognized and certified organizations.

A course module named ‘Continuing Professional Development (CPD)’ including hydrographic field surveying and education seems work successfully, according to Ventura stated. The delivery of such CPD and education through a modular web-based course offers many advantages over traditional classroom instruction and opens a potentially large market (Don Ventura, *et al.*, 2012). With potential participants consisting of private individuals, full-time students, company employees and corporate organizations, the on-demand and modular nature meets today’s lifestyle well.

Conclusion

Maintaining qualified hydrographer is a critical issue for Taiwan METOC. The need for the manpower structure adjustment is urgent. Internal training, external training, distance learning, and international R/V boarding observation learning, are all required as providing professional development channels. Establishing IHO Category A and Category B certified training programs in Taiwan would be the best solution to build local hydrographic capability. National hydrographic surveying certification could also be established through either governmental agencies or national hydrographic society. These two certification schemes are expected to provide an effective evaluation mechanism.

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