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The study of Hydrography at French institutes ENSTA Bretagne, Cnam/Intechmer and Shom/UBO

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Every year, around 60 highly-qualified hydrographers graduate from the French institutions ENSTA Bretagne, Cnam Intechmer and Shom/UBO. These complementary teachings address both civilian and military demands. The survey practice is a key part of the training which ensure students' ability to be quickly operational in the professional world. This paper outlines major fieldwork conducted by each school, where trainees acquire technical skills. To face these growing needs in terms of staff and equipment, French facilities actively cooperate. In particular, there are some bridges between educational programmes and also more global expertise and materials sharing.

hydrography education | practical training | ISBlue | Hydro3 | Category A | Category B
enseignement de l'hydrographie | formation pratique | ISBlue | Hydro3 | Catégorie A | Catégorie B
Hydrographieausbildung | praktische Übungen | ISBlue | Hydro3 | Kategorie A | Kategorie B

Les établissements français à savoir l'ENSTA Bretagne, Cnam Intechmer et le Shom/UBO forment chaque année une soixantaine d'hydrographes. Ces formations complémentaires répondent à la fois aux besoins civils et militaires. La composante pratique de la formation est fondamentale pour rendre ces futurs diplômés rapidement opérationnels dans le monde du travail. Ce papier présente un projet terrain d'envergure propre à chaque école dans lequel les étudiants développent leurs expertises techniques. Pour faire face aux besoins importants tant en termes d'encadrement que de matériel, les instituts collaborent activement entre eux. Il existe ainsi des passerelles inter-établissements sur la formation, et des partages de compétence sur les enjeux actuels et futurs de l'hydrographie.

Jedes Jahr schließen rund 60 hochqualifizierte Hydrographen ihre Ausbildung an den französischen Institutionen ENSTA Bretagne, Cnam Intechmer und Shom/UBO ab. Diese sich ergänzenden Ausbildungen decken sowohl den zivilen als auch den militärischen Bedarf ab. Die Vermessungspraxis ist ein zentraler Bestandteil der Ausbildung, um die Studierenden schnell in der Berufswelt einsetzen zu können. In diesem Paper werden die wichtigsten von den einzelnen Schulen durchgeführten Feldarbeiten beschrieben, bei denen die Studierenden technische Fähigkeiten erwerben. Um den hohen Bedarf an Personal und Ausrüstung zu decken, arbeiten die französischen Einrichtungen aktiv zusammen. Insbesondere gibt es einige Brücken zwischen Bildungsprogrammen und auch einen globaleren Austausch von Fachwissen und Materialien.

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Introduction

Training capacity

For years now, feedbacks from industry show a discrepancy between the strong demand of high-qualified hydrographers and the limited annual number of graduates. Marine activities, especially in energy and civil engineering sectors, are growing and changing fast. In fact, new technologies are redesigning the traditional ways of surveying by increasing the degree of technical skills. As a consequence, teaching facilities must keep high and up-to-date standards of education, so the young graduates would not be reliant to black-box solutions but able to face complex hydrographic surveys.

Sadly, the instruction capacity is not indefinitely extendable. It is driven by the ability to deliver high-quality practical trainings, which imply significant resources, both human and financial. In France, by regrouping the three main institutions, namely ENSTA Bretagne, Shom/UBO and Cnam Intechmer, the annual number of graduates is about 65. Among them, 17 are servicemen. So roughly 50 students would be professionals available for civilian needs.

Keep in mind that this number hides a wide range of career possibilities as further detailed later. Part of this diversity is explained by slightly different status, schooling goals and areas of expertise of the French academies. This paper will show how these trainings are complementary.

Practical training: A mandatory but challenging task

As a lecturer of the »Standards of Competence for Hydrographic Surveyors« (IHO 2018, 2017) would notice, the overall teaching in hydrography surveying contains a solid multidisciplinary scientific background, with hundreds of hours of theoretical courses.

However, a meaningful part of the job cannot be learnt by reading manuals and only a regular practice achieves a good understanding of some prerequisites. So, it is absolutely compulsory to provide a progressive practical training simultaneously. Being a surveyor implies the use of advanced sensors and survey technics in changing environments or applications. The adaptability is a key criterion. The hydrographer must therefore embrace the hydrographic system as a whole in order to choose and configure the adequate sensors considering the targeted performances. He must also have a good knowledge and understanding of calibration procedures designed to ensure that the expected data quality is reached. All these skills call for an extensive survey experience to be mastered. The practical training must provide enough tools and fieldwork projects, so that the graduate students will be quickly autonomous and efficient in the professional world.

As a consequence, education institutions have to invest in sufficient material means to achieve these training goals, including survey platforms, software and high-end sensors. So, contrary to other field of study like computer sciences, hydrography courses involve substantial budgets and staff. Another consequence is the limitation of the maximum number of students. Indeed, to guarantee high level of practical skills of their postgraduate students, the institutions must ensure that every trainee spend enough time on practice. An efficient format consists of keeping small groups of students working on fieldwork projects. The number of sensors, platforms and teachers being limited, it leads to class with modest capacity (around 30 students). But despite these expensive equipment and capped class size, for now the academies have found a way to keep moderate admission fees.

Part 1: Overall picture of French institutes ENSTA Bretagne, Intechmer and Shom

The institutes

Built on a legacy of training on its Brest campus since 1819, ENSTA Bretagne (ex-ENSIETA) has become in 1971 a multidisciplinary graduate and postgraduate engineering school, under the auspices of the French Government defence procurement and technology agency (DGA). Since the 1990s, ENSTA Bretagne has grown into both a public engineering school and a research institute with almost 300 new graduates each year in defence, high-tech and maritime sectors. Even if originally only military students could be admitted, nowadays the majority of applicants are civilians. Research and training activities are allocated between high-level departments with a wide-range expertise: Autonomous Robotics, Hydrography, Pyrotechnic Systems, Human Sciences, Naval Architecture, and so on.

The Conservatoire National des Arts et Métiers (Cnam) is a French public higher education institution, national research centre and a Grand Etablissement/Grande Ecole of Engineering under the supervision of the Ministry of Higher Education. Founded in 1794 by the French bishop Grégoire, Cnam's core mission is dedicated to provide training throughout life (lifelong education) and conduct research for the promotion of sciences and industry. Created in 1981 in Cherbourg (Normandy), the Cnam Intechmer is dedicated to marine sciences and technologies and hold the same missions in these specialities.

Shom is a public administrative establishment (EPA) under the supervision of the Ministry of the Armed Forces, with three missions:

- national hydrography, to ensure the security of surface navigation in the waters under the cartographic responsibility of France;
- defence support, characterised by hydro-oceanographic expertise provided to the French Government Defence procurement and technology agency and Operational Support of Naval Forces;
- support for public policies on the sea and coastline, by making its heritage data and expertise available to public authorities.

As the Shom's responsibility can be engaged, it is imperative to master the entire data production chain; this cannot be done without integrating the very specific skills and training of the staff. Since hydrography for nautical safety purposes and marine cartography, at the technician level, are not taught in any school in France, Shom has created its own school with its own training resources in its fields of competence. In order to open its training to civilians, Shom and UBO have signed a partnership agreement since 2017, making it possible to deliver an Earth Sciences Bachelor diploma (BSc) to civilians and military personnel in addition to the Category B certificate. Since 2017, the course has been attended in average by one third military personnel and two third civilians, with gender parity respected.

The available trainings in hydrography

ENSTA Bretagne

ENSTA Bretagne provides an educational programme in hydrography recognised at »Category

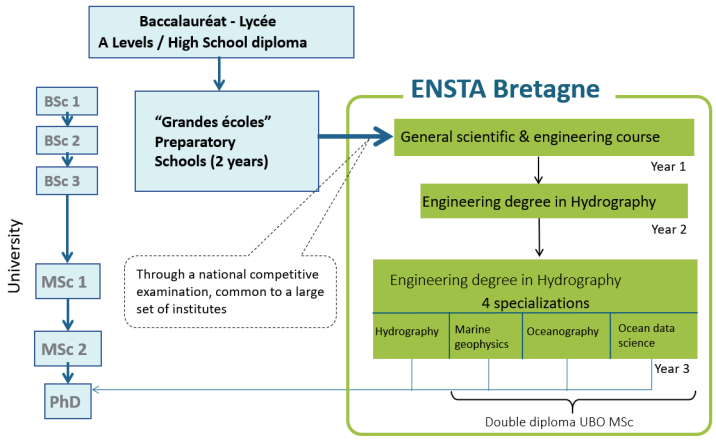

Fig. 1: ENSTA Bretagne application process for hydrography Cat. A programme

A level« by the International Hydrographic Organization (ENSTA 2022).

The classical way to get into a French engineering school requires to spend two years in a preparatory programme giving intensive education in basic sciences (i.e. Mathematics, Physics …). These preparatory years are followed by a national competitive examination, giving the opportunity to join a graduate and postgraduate engineering school for a three years engineering training programme. At ENSTA Bretagne, the core scientific training is completed by specialisation in the 2nd and 3rd years. Indeed, at the end of the 1st year, the students have to choose between different paths: Hydrography, Autonomous robotics, Vehicle Architecture, etc. After completion of this total amount of five years of study, ENSTA Bretagne delivers an engineering degree in Hydrography Cat. A.

External students, including international ones, holding a BSc or a 1-year MSc in a relevant discipline are welcomed to apply to ENSTA Bretagne course in Hydrography. The admission process consists of a selective examination of candidates' scientific background (Fig. 1).

Inside the hydrography cursus, ENSTA Bretagne and the University of Western Brittany (UBO) offer to 3rd-year ENSTA students the possibility of a double diploma (MSc from UBO) in marine geophysics or oceanography (Fig. 1).

Each year, up to 32 students graduate from ENSTA Bretagne »Hydrography« specialisation and start their career in a wide range of fields: applied research world, survey/dredging/offshore companies, hydrographic offices, equipment resellers or sensor manufacturers. The two military students become officers for the French Navy's Hydrographic and Oceanographic Service (Shom).

Cnam Intechmer

Cnam Intechmer provides three diplomas in marine sciences open to students with a scientific, technological or professional baccalaureate or with an equivalent scientific level for the deliverance of 180 ECTS. Among them, the Bachelor Océanographe-Prospecteur (BSc OP) is a three-year programme more focused in marine geology and geophysics (Fig. 2).

Cnam Intechmer Bachelor Océanographe – Prospecteur
3 YEARS / 180 ECTS / HYDROGRAPHY FIG OHI ACI CatB

FR le cnam intechmer

Bachelor OP – YEAR 1	ECTS
BCP001 OUTILS POUR LA PHYSIQUE	6
BCP002 GEOLOGIE GENERALE	6
BCP003 GEOLOGIE ET CHIMIE DES OCEANS	6
BCP004 OCEANOGRAPHIE GENERALE	6
BCP005 OCEANOGRAPHIE DYNAMIQUE	6
USTM16 INTERFACAGE ET LOGICIEL	6
USTM17 TRAITEMENT DES DONNEES	4
USTM18 GEOMATIQUE	6
USTM19 GEOLOGIE APPLIQUEE	6
USTM1A OCEANOGRAPHIE APPLIQUEE	6
USTM1B INSERTION PROFESSIONNELLE MARITIME ET INTERNATIONALE	2

Bachelor OP – YEAR 2	ECTS
BCP006 POSITIONNEMENT	5
BCP007 GEOPHYSIQUE MARINE APPLIQUEE	4
BCP008 DYNAMIQUE DES OCEANS	5
BCP009 GEOLOGIE ECONOMIQUE - AMENAGEMENT DU LITTORAL	4
BCP010: SEDIMENTOLOGIE	3
BCP011 ACTIVITES LIEES AU SURVEY	4
USTM1C ELECTRONIQUE EMBARQUEE ET INTERFACAGE	6
USTM1D : ANALYSES DE DONNEES OCEANOGRAPHIQUES	6
USTM1E MISSIONS EN MER	5
USTM1F PROJET PROFESSIONNALISANT	8
UA412S STAGE PROFESSIONNEL	10

OCEANOGRAPHY – MARINE SURVEY

EN HZS GHENT UNIVERSITY

Bachelor OP – YEAR 3	ECTS
HB300 INFORMATION AND COMMUNICATION TECHNOLOGY	3
HB310 NAVIGATION	6
HB320 INTRODUCTION TO SAFETY	3
HB330 SEAMANSHIP	3
HB340 WATER LEVELS AND FLOW	3
HB350 GEODESY & CARTOGRAPHIC SYSTEMS	3
HB360 HYDROGRAPHIC SURVEYING	6
HB370 DATA MANAGEMENT	3
HB380 GEOLOGY & GEOPHYSICS	3
HB390 LEGAL ASPECTS	3
HB500 HYDROGRAPHIC PRACTICE	24

HYDROGRAPHY

Fig. 2: Cnam Intechmer BSc OP's structure of course and certification in Hydrography FIG/IHO/ICA Cat. B. Note that learning units in pink are theoretical units – UE – and in blue practical units – US/UA – for a distribution of 50/50 of the ECTS credits each year

Since its creation in 2004, the Cnam Intechmer BSc OP propose two years on Cherbourg site to become a polyvalent technician/surveyor and a year on another site in English language in partnership with a foreign university to bring a speciality. Previously co-leaded with South Wales University (UK) until 2020 with a focus on Marine Renewable Energy, the collaboration is now shared with Ecole Supérieure de Navigation d'Anvers and Ghent University (Belgium) for hydrographic speciality with the recognition of FIG/IHO/ICA Cat. B level.

Each year, up to 18 students are graduated and find easily and quickly a position in industries, survey companies, ports and scientific institutions in a wide international context. They can also continue in Master degrees and Engineering Schools such as ENSTA Bretagne.

Shom

Shom provides a one-year programme in hydrography and a one-year programme in marine cartography (Fig. 3), both of them recognised at »Category B level« by the International Hydrographic Organization (Shom 2022).

The programme in hydrography is the third year of Earth Sciences BSc of UBO.

Military students following the Cat. B hydrography programme are selected by internal recruitment (within the French Navy) or external recruitment, at baccalaureate +2 level, as for the civilians. Each year, up to 15 students graduate from Shom hydrographic programme.

At the end of the course, the military students are assigned on the French hydrographic fleet at Shom. The best civilian students can enter a Master's degree or even one of the Cat. A programme in hydrography at ENSTA Bretagne. Civilian students enter professional life very easily (100 % of permanent position at the end of the year).

The students of the Cat. B marine cartography course are selected through a competitive examination by the Ministry of Defence. At the end of their training they become civil servants and are assigned to the cartography department at Shom.

After completion of their training, Shom delivers a degree in Hydrography Cat. B and a degree in marine cartography Cat. B, according to the programme followed.

External students, including international ones, with required scientific level (usually scientific baccalaureate + 2 years) are welcomed to apply to those Shom certified curriculums. Foreign students are admitted to the Shom school either as part of the French cooperation programme or through bilateral partnerships with foreign hydrographic services (Fig. 3).

In addition to its long courses approved by the IHO, the Shom's catalogue of continuing education courses also offers a wide range of short courses to improve the skills of personnel in particular fields of hydrography, marine cartography, oceanography or marine geophysics.

Educational means

ENSTA Bretagne teaching staff consists of eight teachers sharing complementary qualifications in

Fig. 3: Shom training courses

Morpin and Debese (2019)

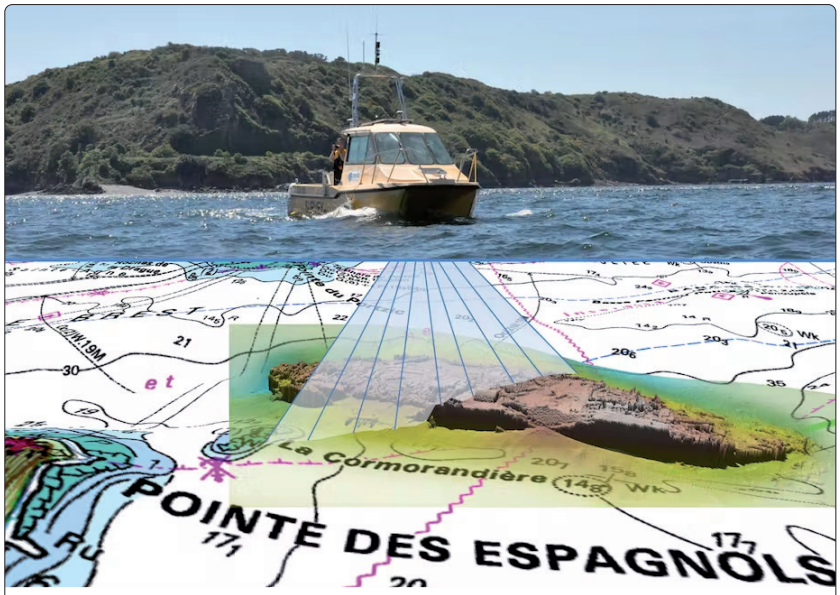

Fig. 4: ENSTA Bretagne survey vessel *Panopée*

data processing, inertial navigation, geodesy and underwater acoustics and so on. On top of this, external guest lecturers regularly give classes, and are mainly recruited from among French marine science institutes located within the Institute's vicinity: Shom, Ifremer, UBO, IUEM or from the industry. A noticeable amount of the training is about practical skills and requires students to achieve some experiments and surveys.

For that purpose, ENSTA Bretagne owes multiple platforms and sensors. The main platform is a 7 metre long survey vessel called *Panopée,* with a maximum speed of 15 knots and a short draught of only 40 cm, making very shallow waters survey possible (Fig. 4). The maximum capacity of six crew members allows training sessions for up to four students. The launch carries high-end hydrographic sensors mounted inside a moon pool: an inertial navigation system SBG Navsight and a multibeam echo sounder Kongsberg EM2040C lent by Shom. If necessary, additional SBES or ADCP sensors can be set up simultaneously on side poles. In addition, an amphibious vehicle named *ARGO* provides the ability to achieve coastline surveys with a 3D laser scanner Leica HDS6200 and a motion unit iXBlue Octans IV. For some years, these means are completed with autonomous vehicles, the most noticeable being a 3 metre long catamaran combining LiDAR and sonar.

Thanks to partnerships with QPS and Caris companies, ENSTA Bretagne trains its students on professional survey and data processing software solutions.

The Cnam Intechmer BSc OP course relies on ten permanent teachers at Cherbourg (France) and in Belgium, most of them are university lecturers and professors, but also more than thirty professionals from French or foreign companies and institutions delivering an up-to-date teaching at the nearest of the needs of the professional area.

The Cnam Intechmer is ideally located on the seaside, near Cherbourg's harbour. The sheltering position given by the Cherbourg artificial roadstead allows all-weather navigation (Fig. 5). Coastal vessels are made available each year by the French Oceanographic Fleet (Cherbourg site) or by survey companies (Ostende site) for our educational purpose. The O/V *Côtes de la Manche* is a 24.50 metre oceanographic vessel frequently assigned for pedagogic missions and designed for multi-purpose missions such as mapping with various equipment (Fig. 5): shallow-water multibeam echo sounders, hydrological measurements, underwater video, sampling by grab and dredge, acoustic and seismic trials.

The Cnam Intechmer is already well equipped for operational missions but the continuous technological evolution drives us to rent or use up-to-date equipment with industrial or academic collaborations, like sensors (Boskalis, Cadden, Aquatopo, Cnam ESGT, UBO, UniCaen …) or professional software solutions (QPS, IXBlue, Ifremer).

Shom school pedagogical team consists of three permanent teachers, one Cat. A hydrographic engineer and Cat. B hydrographic surveyors and around eighty temporary Shom staff who deliver courses in their field of expertise. This staff is complemented by university teachers. For practical training, Shom school uses one of the Shom hydrographic

Fig. 5: Cnam Intechmer location in front of the sea (left) and O/V *Côtes de la Manche* (right)

Fig. 6: Shom's school and Shom training facilities location

launch (Fig. 12), equipped with a multibeam echo sounder or the *Albert Lucas* launch (Fig. 13) from the UBO/IUEM for the civilian students, equipped with multibeam echo sounder from instrumental service »Pole Image et Instrumentation« of IUEM. French military students are also trained (during their complementary training) to operate French navy compact military hydrographic system (SDHM) used for rapid hydrographic assessment before beaching operations (Fig. 6).

Part 2: The practical training

ENSTA Bretagne CMFP in Lake of Guerlédan

ENSTA Bretagne practicals aim to gradually increase the level of autonomy and expertise throughout the hydrography programme. In their 2nd year, students are tasked to calibrate sensors, then to survey some dedicated areas close to Brest harbour with three different systems: a single-beam echo sounder, a multibeam echo sounder and a side-scan sonar. Based on their theoretical knowledge, trainees are responsible to establish a methodology for survey planning, data processing and quality assessment. In their 3rd year, students are in charge of a more complex and innovative project described below.

Since 2016, ENSTA Bretagne teaching staff has built a common practical training for last year students in hydrography and in mobile robotics. This complex multidisciplinary field project (CMFP) takes place at the artificial Lake of Guerlédan, centre of Brittany, France. The lake dam and its turbines are exploited by EDF, the France's main energy company, to produce electricity. With a depth up to 40 metre, significant slopes and underwater old structures (houses, trees, wrecks, lock), the area is quite challenging for surveys and robots' navigation.

The overall project lasts 132 hours over a period of six months. There are two practical sessions of intensive fieldwork at the lake: one week in October, one week in February (Fig. 7). The remaining time consists of preparation of experiments and data analysis at ENSTA Bretagne. It involves around 75 students and up to 25 teachers.

Thanks to funds from ISBlue (The interdisciplinary graduate school for the blue planet), some MSc students from IUEM (The European Institute for Marine Studies) joins the training on an annual basis. Scholars from other institutes are also welcomed.

Students are divided into small teams from three to five members, working on a wide range of topics, often suggested by companies or research institutes. The teaching staff encourage the submission of subjects merging hydrography and robotics advanced problems. A large amount of survey equip-

Fig. 7: *Panopée* survey vessel with the Guerlédan dam in the background

Fig. 8: Multiple platforms, some of them autonomous, for surveying the lake

Fig. 9: Amphibious vehicle *ARGO* surveying Guerlédan lake's dam

ment and robots are available on site (Fig. 8, Fig. 9) and students enjoy a high level of autonomy.

The local environment being quite tricky, students deal with complex situations:

- some very shallow water areas;
- low reflectivity seabed (soft mud) combined with significant slopes;
- GNSS multipath issues;
- varying water levels.

An equally important challenge is to learn how to work with people from other scientific communities. Indeed, because of their various scientific background, trainees share heterogeneous knowledge and have to learn to work efficiently as a team. During field experiments, some constraints stimulate synergy between groups:

- the number of platforms being limited, students have to share them;
- some tasks are interdependent (e.g., a group is in charge of a GNSS base station establishment);
- students deliver a daily oral report about their activities (Fig. 10).

Fig. 10: Recording of a daily podcast on students' fieldwork progress

All this acts to build up essential skills for team working: planning, organisation and communication.

The overall project come to an end in March, where all students give a restitution of their work in the form of a full day of presentations open to the public.

The project received sponsorship from ISBlue, AFHy (Francophone Association of Hydrography) and private sector (EDF, QPS, iXBlue, Kopadia …). ENSTA Bretagne is very grateful to all these contributors. More information about the project can be found on a dedicated website: guerledan.ensta-bretagne.fr.

Cnam Intechmer practical at sea aboard coastal missions

The practicals are the core of Cnam Intechmer BSc OP's training, with different practice learning sequences placed within the three years of the course:

- practical works in laboratory/computing/fieldwork;
- personal professional project in 2nd year;
- practicals at the sea in supported by French Oceanographic Fleet (FOF) in France and survey companies in Belgium;
- internship period (20 weeks in 2nd year, 6 × 5 weeks possible – at least 90 days needed in 3rd year).

The study of the marine domain requires technical skills in instrumentation (multibeam echo sounder, sonar, current meter, sensors), sampling methods (water column, sediment) and in analysis of georeferenced data (SIG, CAD/DAO). These techniques must be acquired during the training, and the practical works at sea are a key moment to integrate both knowledge and savoir faire. During the course, Cnam Intechmer organises two coastal missions supported by the French Oceanographic Fleet (FOF). Each academic year, the FOF affects us

Fig. 11: Cnam Intechmer 2021 teaching missions supported by the French Oceanographic Fleet (FOF)

two campaigns, classically December and March, for a total of approximately 20 days including mobilisation/demobilisation (Fig. 11). We can work during one week with six students and two teachers (night and day shift) or with ten students and two teachers for the daily operations. This allows students to work in real conditions they will encounter in their future professional position.

For the period dedicated to bathymetric acquisition, the task is to set up a complete acquisition with a MBES: from the material mobilisation to data storage. More than looking to data quality, we pay attention to the way the future technician deal with problems and solve it in an operational context. For our bathymetric mission, we work with a R2Sonic 2020 – SBG Systems *Apogée* solution. The students install, connect and configure all the equipment themselves in the ship. They monitor offsets measurements and apply patch test. A collaboration with QPS enables students to carry out the database for the acquisition with Qinsy and, during and after the survey, the data processing with Qimera.

Shom practical training

Practical works and field projects are performed in Brest surroundings and in the Brest roadstead. This sea area is appropriated for training: it is a nearly closed basin, which waters are protected from average winds by the local topography.

The Cat. B hydrographic programme includes a eight-week final project. The objective of the final year project is to allow each student to apply a large part of the theoretical courses and to gain experience in the realisation of the tasks entrusted to the hydrographer.

The project consists in a complete hydrographic survey that includes different types of surveys, among them a bathymetric survey using one hydrographic launch made available to the military students by Shom hydrographic fleet (Fig. 12) and

Fig. 12: Fassmer hydrographic launch, operated by the military students during the Final project

Fig. 13: N/O *Albert Lucas* of CNRS and Flotte Océanographique Française

the *Albert Lucas* launch (Fig. 13) from the UBO/IUEM for the civilian students.

For the acquisition work (bathymetric survey and topographic fieldwork), students are divided into small groups responsible for carrying out a number of defined tasks. In the data processing phase, each student works alone and prepares the final documents, data sets and reports corresponding to the surveys carried out. In the final phase, each student is responsible for producing a report and defend his/her work to the jury.

On top of the bathymetric survey, the students are asked to perform levelling of tide markers and geodetic positioning of geodetic points and remote landmarks (Fig. 14).

One major practical work during this Cat. B hydrographic curriculum is a two-week field project, called RADEC. It consists in a campaign of oceanographic measurements in the roadstead of Brest on *Albert Lucas* launch (Fig. 15). The students are asked to prepare the campaign, plan the data acquisition, perform the survey on board a small vessel, study the water samples in the chemistry lab, post-process the CTD measurements, interpret the results, provide an overview of the hydrological dynamics in the Brest roadstead. A report and an oral presentation of the results are provided and assessed.

As far as the Cat. B cartographic course is concerned, the objective of the final year project is to produce a complete nautical chart, applying the Shom procedure and provide to future cartographers a »leading line« for the first charts they will have to produce in their future positions. The final cartographic is performed over a time period of twelve weeks.

Fig. 14: Shom levelling exercises

All the Shom production means can be operated by trainees during this project. The main available tools and systems are Shom databases and archived data, computing and drawing tools and software, available nautical documentation.

The project evaluation is based on produced documents (preparation file, survey sheets and produced chart) in terms of rigor, completeness and accuracy, regulation, standards and procedure application and quality.

Part 3: Educational collaboration and interaction

Existing partnerships between ENSTA Bretagne, Cnam/Intechmer and Shom/UBO

The three French institutions are involved in the »Training in Hydrography – Hydro3 level« of the Francophone Association of Hydrography (AFHy). The »Hydro3 level« means the surveyor is able to perform independently a hydrographic survey by following a standard methodology. This four-weeks teaching is designed to increase knowledge about current measurements, positioning, echo sounders and practical multibeam survey. At the end, the trainees get a »Hydro3 level« certificate from AFHy.

Last years, part of graduates from ENSTA hydrography have come from »bridges« with other French education programmes. One can mention the students from Ecole Nationale des Sciences Géographiques (ENSG) who have the opportunity to gain a double degree ENSTA/ENSG by spending two years in each school. Also, after graduate from Shom or Intechmer, scholars can apply to ENSTA MSc.

Not only the students, but also the teaching staff, is shared between institutes. For example, the engineering degree of ENSTA Bretagne in Hydrography, and especially the double diplomas ENSTA/UBO MSc (Fig. 1) involves both teachers from ENSTA Bretagne and Shom.

Hydrographic equipment being costly, some agreements have been signed for sharing platforms and sensors. For example, Shom is lending a multibeam echo sounder to ENSTA Bretagne for 2016. ENSTA got also some depreciated equipment from Shom. By contrast, ENSTA Bretagne can provide its survey vessel for some Shom courses or experiments. Regional funds ensure the maintenance and sustainability of the systems (CPER).

ENSTA and IUEM/UBO are involved in ISBlue project: a 10-year project promoting common research and education programmes. Both Hydrography courses in Earth Sciences BSc and MSc are partly supported by this project, mainly for practi-

Fig. 15: RADEC oceanographic survey

cal aspects. All these institutions having close research and operational interests, students have opportunities to apply for summer internship or PhD.

International collaborations

From 2012 to 2014, ENSTA Bretagne co-organised a European Union Erasmus Intensive Programme in Hydrography and Geomatics with Ghent University (Belgium), HCU University (Germany) and the CIDCO (Canada). Students were in charge of surveying the lake of Vassivière (France) during two weeks, both with topographic and bathymetric sensors. The Erasmus funds made three annual sessions possible. This international collaboration was a success but has not been reconducted due to the consequential administrative workload induced. However, it shows that such international training camps are possible.

To renew such educational project at an international scale, two major issues are raised. Firstly, there is the question of funds. Some facilities exist like Erasmus or ISBlue, but it brings the critical question of time. Indeed, almost full-time equivalent persons are required to manage such a huge upstream workload. Today, ENSTA Bretagne has some experience with its CMFP but the organisation is kept quite simple with only a single host, the few external students coming as guests.

For its part, the Cnam Intechmer BSc OP is co-leaded with Belgian partners, thus it provides a relevant abroad experience in the course itself in order to enhance international employability after the diploma.

Finally, the Shom school annually welcomes international students. Most of them are admitted either as part of the French cooperation programme or through bilateral partnerships with foreign hydrographic services. Other trainees are also admitted to follow tailor-made courses, requested by their home organisation.

Prospects

These last years, the French educational facilities have been working on how to fit the teaching of hydrography with the new reality of the job. Indeed, unmanned vehicles are now a reality and the transition to autonomous operations is in process. Moreover, the amount of data, often heterogeneous both in terms of type and quality, is exponentially growing. All of these ongoing and future changes are considering in the trainings.

Firstly, changes have been made on the substance of the lectures. Now students have to master new knowledge such as marine robotics basics, big data or deep learning methods which are well suited for data processing tasks. These new expertises entail a strengthening of collaboration between teaching teams by demanding interconnected specialists.

Secondly, changes have been made on the form of the courses. For example, the Shom school has undertaken to develop distance learning in order to facilitate access to its training courses for external students, but also for its own personnel, within the framework of continuing professional training; thus, the Shom's on-board hydrographers, who are not very available to attend face-to-face courses, could benefit from this development. To this end, the Shom is recruiting an educational engineer and is going to equip itself with a Learning Management System that can be interoperable with the platforms of its partners, like ENSTA Bretagne.

Thus, the Shom school wants to engage in a digital transformation of its training apparatus, in order to offer hybrid training programmes. The AFHy Hydro3 training cycle, intended for staff members of AFHy, is one of the training courses to be adapted to this training method.

To achieve these goals, synergies are being sought between partners for sharing material resources and developing common educational teaching. //

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