



The Standards of Competence for Hydrographic Surveyors and Nautical Cartographers

Keith Miller, IBSC Board Member

Apologies from Adam Greenland, IBSC Chair



The Board

The Board maintains the standards and considers programs for recognition against the standards.

- 10 members (4 FIG, 4 IHO and 2 ICA), from government, education and industry;
- Members from New Zealand, Australia (2), Brazil, Greece, USA, UK, France, Indonesia and Trinidad and Tobago





The Standards



New standards:

- S-5A Standards of Competence for Category "A" Hydrographic Surveyors
- S-8A Standards of Competence for Category "A" Nautical Cartographers
- S-5B Standards of Competence for Category "B" Hydrographic Surveyors
- S-8B Standards of Competence for Category "B" Nautical Cartographers

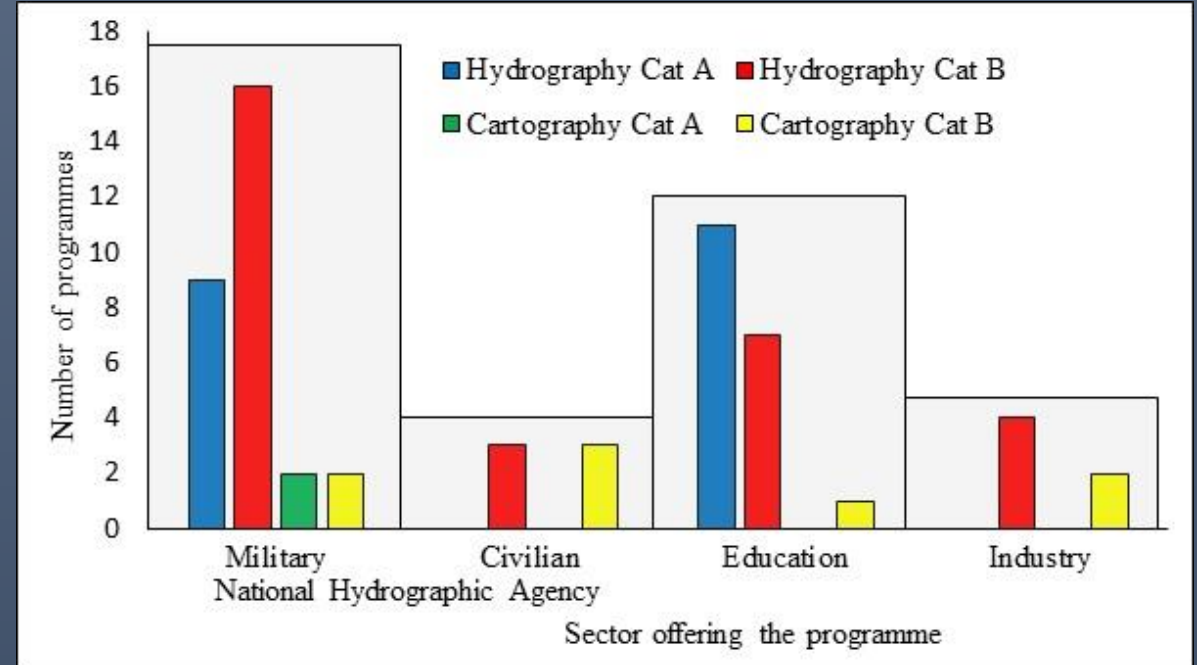
Replace S-5 and S-8.

Educational programs found to be compliant with the standards are awarded recognition for a period of 6 years.



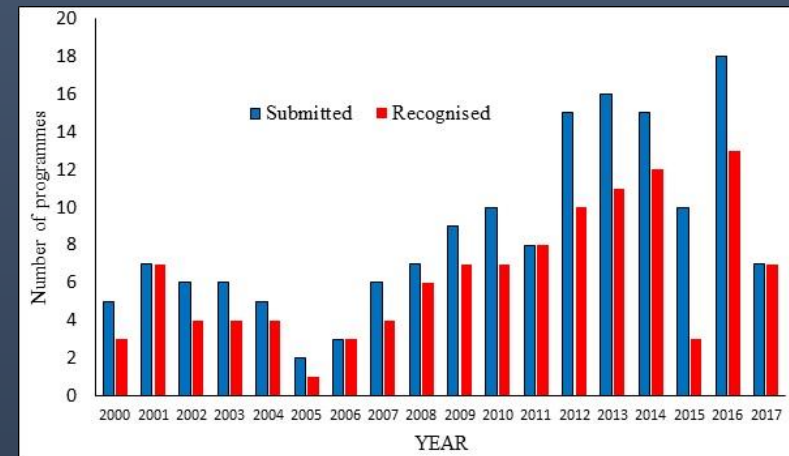
Sectors offering programs

- National agencies –for management of territorial waters;
- Education – Institutions offering degrees at Bachelors and Masters as well as diplomas.
- Industry – programs delivered commercially or internally for staff development.



Wide range of applications, many programs have a broad scope.

Standards must be flexible in meeting the demands while ensuring coverage of key competencies.





Subjects in the Standards



S-5A Subjects	S-5B Subjects
B1 Mathematics, statistics, theory of observations	B1 Mathematics, Statistics, Theory of Errors
B2 Information and Communication Technology	B2 Information and Communication Technology
B3 Physics	B3 Physics
B4 Nautical science	B4 Earth Sciences
B5 Meteorology	B5 Nautical science
F1 Earth Models	B6 Meteorology
F2 Oceanography	E1 Underwater Acoustics
F3 Geology and geophysics	E2 Remote Sensing
H1 Positioning	E3 Water Levels And Flow
H2 Underwater Sensors and Data Processing	E4 Positioning
H3 LiDAR and Remote Sensing	E5 Hydrographic Practice
H4 Survey Operations and Applications	E6 Hydrographic Data Management
H5 Water Levels and Flow	E7 Environment
H6 Hydrographic Data Acquisition and Processing	COMPREHENSIVE FINAL FIELD PROJECT
H7 Management of Hydrographic Data	
H8 Legal Aspects	
COMPLEX MULTIDISCIPLINARY FIELD PROJECT	

S-8A Subjects	S-8B Subjects
B1 Mathematics, Statistics, Theory of Errors	B1: Mathematics, Statistics, Theory of Errors
B2 Information and Communication Technology	B2: Information and Communication Technology
B3 Earth Sciences	B3: Earth Sciences
F1 General Geodesy	E1: General Geodesy
F2 Hydrography and Nautical Products	E2: General Cartography
F3 Photogrammetry and Remote Sensing	E3: Hydrography and Nautical Products
C1 General Cartography	E4: Data for Nautical and Special Purpose Charting
C2 Data for Nautical and Special Purpose Charting	E5: Photogrammetry and Remote Sensing
C3 Geospatial Information and Processing	E6: Geospatial Information and Processing
C4 Nautical Cartography	E7: Nautical Cartography
C5 Legal aspects (Relating to nautical cartography)	E8: Legal aspects (Relating to nautical cartography)
C6 Special Purpose Charting	E9: Special Purpose Charting
C7 Map/Chart Reproduction	E10: Map/Chart Reproduction
COMPREHENSIVE FINAL CARTOGRAPHIC PROJECT	COMPREHENSIVE CARTOGRAPHIC PROJECT

- Basic subjects cover general background principles and skills;
 - Foundation subjects cover specialized subjects that have a scope beyond the standards.
 - Essential subjects (Cat B) and specialist subjects (Cat A) relate directly to the discipline.
- Students may be exempted from Basic and Foundation subjects on the basis of prior learning.



Expressing competencies



H4: Survey Operations and Applications		
Topic/Element	Content	Learning outcomes
H4.1 Hydrographic survey projects		
H4.1a Hydrographic survey requirements (A)	(i) IHO S-44 and other survey quality standards. (ii) Underkeel clearance (iii) Procedures and installations required to conduct hydrographic surveys of specific types, for example: <ul style="list-style-type: none"> • Nautical charting survey • Boundary delimitation survey • Ports, harbor and waterways surveys. • Engineering works and dredging surveys • Coastal engineering surveys • Inland surveys • Erosion and land-sea interface monitoring • Oceanographic surveys • Deep sea and ROVs /AUVs surveys • Seismic, gravity and geomagnetic surveys • Pipeline route, pipeline installation, inspection and cable laying surveys • Wreck and debris surveys. 	Establish procedures required to achieve quality standards in hydrographic surveys. Specify the type of survey system and equipment needs together with associated parameters and procedures for various components of the overall survey operation. Evaluate the impact of local physical and environmental factors on survey results.

Competencies are now specified in the standard format used in education as generic learning outcomes.

Verbs such as ‘specify’, ‘analyse’, ‘specify’, ‘apply’, ‘select’ and ‘identify’ indicate the depth of knowledge through a competency.

Content is given to provide a context for the learning outcome.



Bloom's taxonomy



Used in education to express depth of learning.

- **Remembering** – Define, describe, identify, list,
- **Understanding** – Classify, report, discuss, demonstrate,
- **Applying** – Apply, prepare, produce, implement,
- **Analyzing** – Analyze, classify, compare, examine,
- **Evaluating** – Assess, evaluate, justify, select,
- **Creating** – Compose, design, develop, plan,

There is some overlap, '*produce*' could be an application or a creation, '*select*' could be considered as an application or at the depth of evaluation.



Guidance on level



An indication of the expected level is provided within the element, which is described as Advanced (*A*), Intermediate (*I*), or Basic (*B*).

H1.4 Subsea positioning		
H1.4a Acoustic positioning principles <i>(A)</i>	(i) Long base line (ii) Short baseline (iii) Ultra-short baseline (iv) Doppler velocity log (v) Transponders (vi) Acoustic modems (vii) Subsea INS	Describe the signal structure and observables of mobile and fixed acoustic positioning devices. Relate observables and platform orientation to relative positions through observation equations.
H1.4b Acoustic positioning systems <i>(A)</i>	(viii) Water column structure (ix) Acoustic ray multipath (x) Time synchronization	Explain how acoustic positioning observables, orientation and surface positioning data are used to achieve subsea rover spatial referencing. Specify the deployment and calibration methods for fixed and mobile acoustic positioning systems.

C4 Nautical Cartography		
C4.1 The Nautical Chart		
Element	Content	Learning outcomes
C4.1a Evolution of nautical charts <i>(I)</i>	(i) Paper (national and INT) (ii) ENC (ECDIS) (iii) ECS.	Outline the evolution of nautical charts and chart systems.
C4.1b Nautical charts <i>(I)</i>	(i) Planning/scheming (ii) The use of charts in navigation (iii) Types of charts (iv) Chart reading.	Identify and classify various types of nautical charts and their content according to their primary purpose.

While ‘describe’ and ‘relate’ used H1.4a are remembering and applying, but the principles on which they are based are advanced.

Similarly in elements C4.1a the verb ‘outline’ alone implies remembering, but to achieve this in context of the content the level is considered as intermediate.



Number of outcomes

Subject type	S-5B	S-5A	S-8B	S-8A
Basic	49	62	34	38
Foundation	-	49	-	35
Essential	118	-	191	-
Cartographic Science	-	-	-	164
Hydrographic Science	-	169	-	-
TOTAL	167	280	225	237

A typical Masters program at a University might contain 70 learning outcomes, these are all academic.

Competencies cover both academic knowledge and practical skills, many of the skills based learning outcomes in the standards require short delivery time and may be integrated within practical learning tasks.



Types of outcomes



Example skills based learning outcomes from S-5A:

- B4.9 - *Specify procedures for deployment and recovery of oceanographic and hydrographic equipment.* Students must be involved in equipment deployment and mobilization, this should not be done by technical support staff.
- F1.3e - *Relate historical surveys to legacy positioning systems.* Awareness that GNSS has not always existed, that historical data will not have the same accuracy that is available today.
- H2.1e - *Use the sound speed profile to compute the path of sound ray through the water column.* A detailed task that each student must perform.
- H2.4b - *Tune acoustic parameters on-line for depth and backscatter.* Can only be achieved through hands on practical work.

Competencies cover academic requirements and include core skills that a Category A surveyor must have demonstrated, these typically form an integral part of practical work, hence more learning outcomes exist than expected of an academic program.



Program duration



Guidelines that accompany the Standards specify:

- **Maximum** - The time frame over which an individual studies towards a recognized program cannot be more than five (5) years for a Category "B" Program and no more than six (6) years for a Category "A" Program.
- **Minimum** - In the experience of the Board, for a program (without exemptions sought) delivered full-time in a continuous manner an expected minimum time frame is.
 - At Category "B", twenty four (24) weeks including the final project.
 - At Category "A", forty (40) weeks, including the final project.
- Students are expected to be engaged for 50 to 60 hours per week over this duration to include lectures, practical work and guided study.



Final project



All standards require a comprehensive final project of at least 4 weeks in duration. Students must be involved in:

- Planning
- Preparation and Mobilisation
- Data acquisition
- Data Processing
- Compilation of products and reporting.

The project should be specified to incorporate a variety of equipment. Use of multibeam in hydrography and multibeam data in cartography are requirements.



Program submissions



Submitting organizations must fully document program structure, content and assessment strategy for both practical and theoretical components. Elements considered by the Board include:

- Level of assessment against expectations of specified learning outcomes.
- Content of lectures, practical tasks and other exercises that underpin the knowledge base to achieve the learning outcomes.
- Resources available for program delivery and assessment.
- Specifications and assessment criteria for assignment tasks and for the final field project.



Guidelines for submission



Comprehensive guidelines are available to submitting organisations, these are continually being updated.

<i>Ex (subject)</i>						
<i>Ex.y (topic)</i>						
Topic/ Element	Content	Learning outcomes	Hours			Module and content
			T	P	SG	
<u>Ex.y<c1></u>	i. Content 1 ii. Content 2 iii. Content 3 iv. Content 4	Learning outcome <u>Ex.y<c1></u>	5	3	3	GEOM302 Lecture 1 HYDRO304 Practical 3 Total
<u>Ex.y<c2></u>	v. Content 5 vi. Content 6	Learning outcome <u>Ex.y<c2></u>	8	4		HYDRO501 Assignment 1 Total
			8	4		

A pro-forma cross reference table is provided that duplicates the standards with space for institutions to add modules and teaching hours associated with delivery and assessment. This must accompany detailed information on the program.



Evidence of learning



The Board needs reassurance that student learning is taking place at the required level, this is evidenced by:

- Past examination papers, even for new programs specimen papers are required.
- Specifications for practical tasks and assignments together with assessment criteria.
- Specifications for the final project with assessment criteria and previous student project reports where available. It is expected that there will be more than one form of assessment and that students will be assessed individually as well as in their group performance.



Quality assurance



Evidence is required that internal quality assurance mechanisms are in place that maintain currency of content in practice and theory and address problems associated with logistics of delivery:

- Student progression criteria and remedial measures must be in place.
- Programs should be reviewed every 5 years, more frequently for new programs with feedback from staff, stakeholders and students being considered.
- Student exit surveys must be undertaken each year with a formal mechanism in place to immediately deal with reported problems that need urgent attention.



Submissions



Must demonstrate that:

- Entry requirements are appropriate.
- A structured program exists with a plan for progression.
- Learning is taking place at the level specified in the standards.
- Scope of the intended learning outcomes is covered.
- Adequate time is given to theory and practice.
- Requirements given in the guidelines are met.

It is up to the submitting organization to provide **documentary EVIDENCE**.

Representatives are encouraged to attend the Board meeting to answer questions.



Thanks from the IBSC



On behalf of the Board, I thank you for providing this opportunity to present the new standards.

The Board acknowledges support from stakeholders in the region in providing feedback on drafts of the standards prior to their ratification.

The Board looks forward to receiving further submissions for recognition from organizations offering education in hydrographic surveying and nautical cartography within the region.

I will be at the SEPRHC until Wednesday evening and will be pleased to discuss proposals for submissions further with individuals.