

International Hydrographic Organisation (IHO)
Hydrographic Services and Standards Committee (HSSC)

Project Team on Standards for Hydrographic Surveys (HSPT)
S-44 Questionnaire Analysis 2018

Questionnaire August – December 2017

**IHO HSSC PROJECT TEAM ON STANDARDS FOR HYDROGRAPHIC SURVEYS (HSPT)
S-44 QUESTIONNAIRE ANALYSIS**

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**IHO HSSC PROJECT TEAM ON STANDARDS FOR HYDROGRAPHIC SURVEYS (HSPT)
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1. OVERVIEW

As part of the review of S-44, members of the international hydrographic community were asked for their views in a questionnaire covering a wide range of topics related to hydrographic survey standards. Designed by the HSPT and administrated by IFHS, the questionnaire was disseminated by IFHS, IHO, FIG and HSPT members from mid-August to the end of November 2017. 500 replies were received, with 114 respondents replying in the last week following Hydro17 conference see Figure 1.2 and Table 1.1 for more detail. Responses were received from all over the world with the highest concentration from Europe and Eastern USA see Figure 1.1for the distribution.



Figure 1.1: Global Distribution of S-44 Questionnaire Respondents.

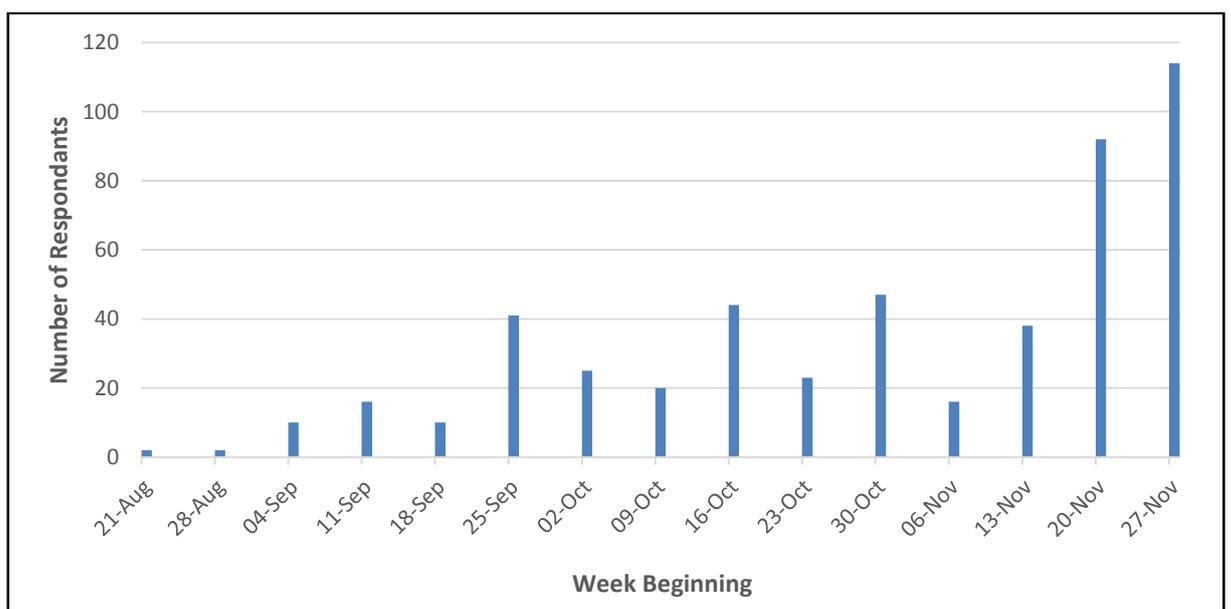


Figure 1.2: Weekly Respondent Response S-44 Questionnaire

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Table 1.1: Monthly Response Distribution S-44 Questionnaire Respondents

Month	Number of Responses
August	3
September	75
October	141
November	281

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2. ANALYSIS SUMMARY

Between August and November 2017, 500 responses were received by HSPT.

- Only 11% of respondents have been involved in hydrography, or an allied industry or profession less than 5 years. It is therefore safe to assume that the questionnaire responses are based on considered professional opinion.
- Respondents identified their principal industry sectors as Navigation and Charting for Safety.
- Respondents identified their principal role as Surveyor although a significant number of other disciplines are represented including dredging, geophysical and pipeline/cable.
- 45.2% of respondents identified as IHO Certified Hydrographers or Cartographers (Cat. A/Cat. B)
- Nearshore and coastal vessel are the most commonly used platforms (71.6%) and use of autonomous vehicles is considered significant (Surface: 22.6%, Underwater: 24.6%, Aerial: 15.8%).
- Multibeam Echosounder is the main sensor used by respondents.
- A large majority of the surveys undertaken by respondents are based on a documented standard (81.3%). Of those 70% use S-44, 29% use a standard more restrictive based on S-44 and 8% use a standard less restrictive based on S44.
- IHO recognised survey criteria would benefit 86.1% of the respondents and 83.5% consider S-44 Edition 5 is relevant to them. 61% use criteria additional to S-44 (most mentioned criteria - client specifications, in-house standards, LINZ, USACE, NOAA specs.).
- Furthermore, regarding the exclusive purpose of safety of navigation, the majority consider S-44 as sufficiently strict (53.5%).
- 48.4% of respondents understand the differentiation between S-44 standards and CATZOC, and 55.2% consider it important to have a clearer connection between both.
- A majority (60.8%) consider S-44 should be extended for other purposes and includes 43.6% who think the S-44 focus must be safety of navigation (most mentioned activities – offshore construction, marine science, coastal zone management, ports and harbours, all aspects of hydrography). Less than 50% want other types of measurements in S-44 than those already included.
- More than $\frac{3}{4}$ of respondents want guidelines included for survey verification and verification of survey system capabilities as meeting S-44 expectations. More than $\frac{3}{4}$ would also like guidelines for other activities (backscatter, water column data).
- Regarding the IHO Manual on Hydrography (C-13), 73% know this document and 20.1% use it. 92% consider it is important to update it (and keep it updated).
- 46.4% of respondents will consider using crowdsourced bathymetric data in the future
- 58% are moving from point measurement to bathymetric surfaces, and 30.4% considering it in the future.

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3. SECTION 1: About You (Compulsory Section)

Q1. To the nearest whole year, how long have you been involved in hydrography, or an allied industry or profession?

- 17% of the respondents have been involved in hydrography or an allied industry or profession for 6-10 years.
- 15% for 11-15 years.
- 12.8% for 16 -20 years

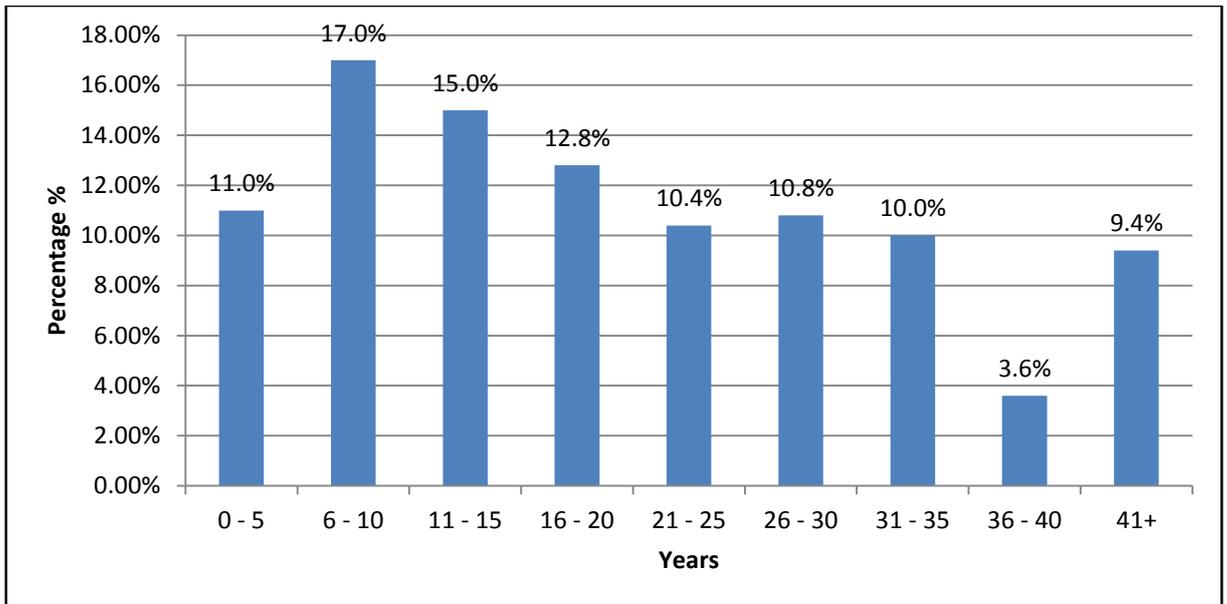


Figure 3.1: Q1 Questionnaire Respondents Years of Hydrography or Allied Experience.

Q2. In which industry sectors(s) are you currently working and/or have you previously worked?

- Navigation & Charting are the main industry sectors (61%), but other sectors are significant (Geophysical =33.4%, Oil & Gas = 32.6%, Dredging = 29%, Military = 26%)

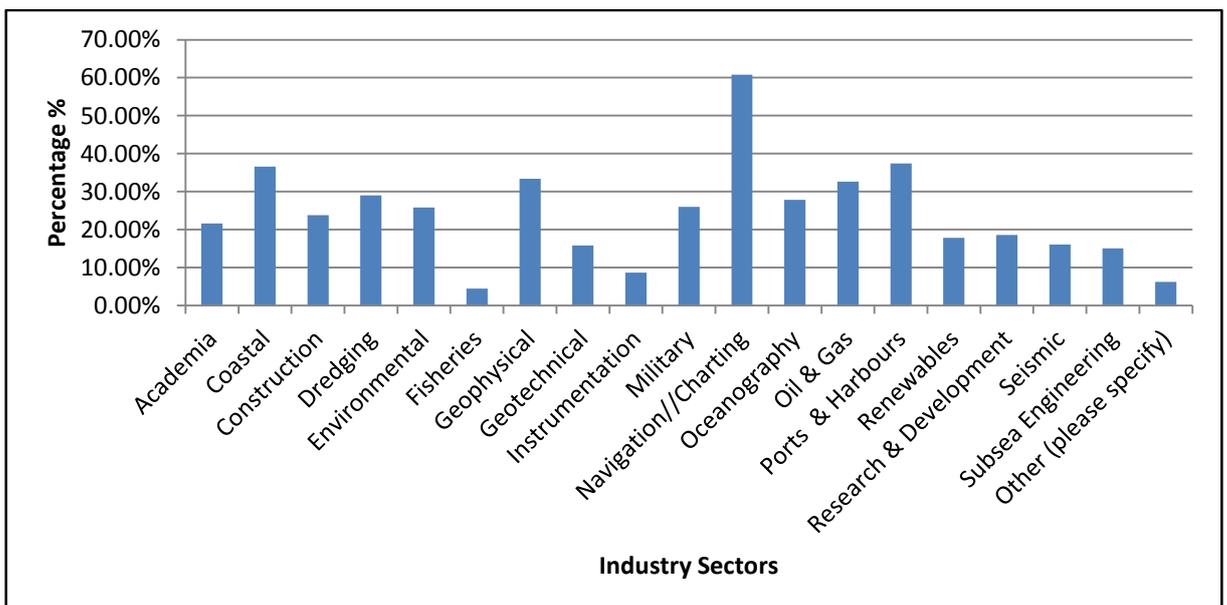


Figure 3.2: Q2 Industry Sectors where Questionnaire Respondents are or have Previously Worked.

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Q3. Which best represents your current role?

- Surveyor is the main role (44.8%), 27.40% Survey Verification, 25.2% Survey Planner, 20.80% Project Managers, 17.8% Technicians and 14.4% Consultants.
- Other (8.4 %) includes: Data Processor, Survey Manager, Expert witness, Retired, Harbour Master, PhD Student, Master Mariner, Researcher, Chief Hydrographer, Tender Manager, and Spatial Data Manager.

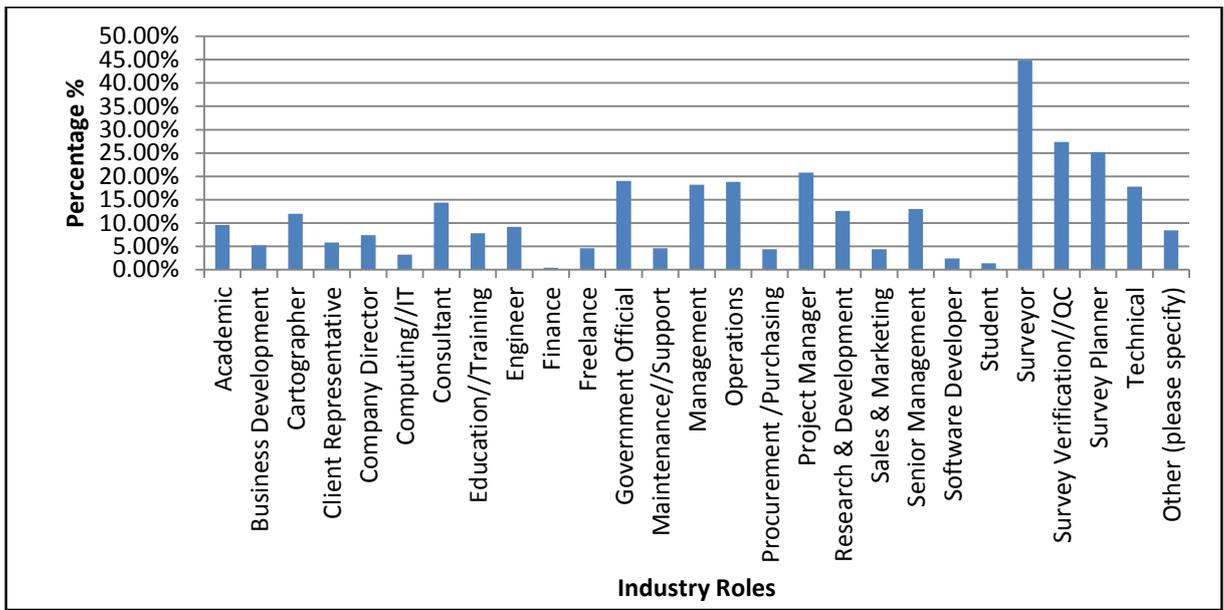


Figure 3.3: Q3 Current Industry Roles of Questionnaire Respondents

Q4. Please give details of your relevant educational qualifications:

- 51.6% have a Bachelor’s degree, 44.2% a Master’s Degree. 23.8% received their qualification through Occupational Training and 23.2% via Military Service.

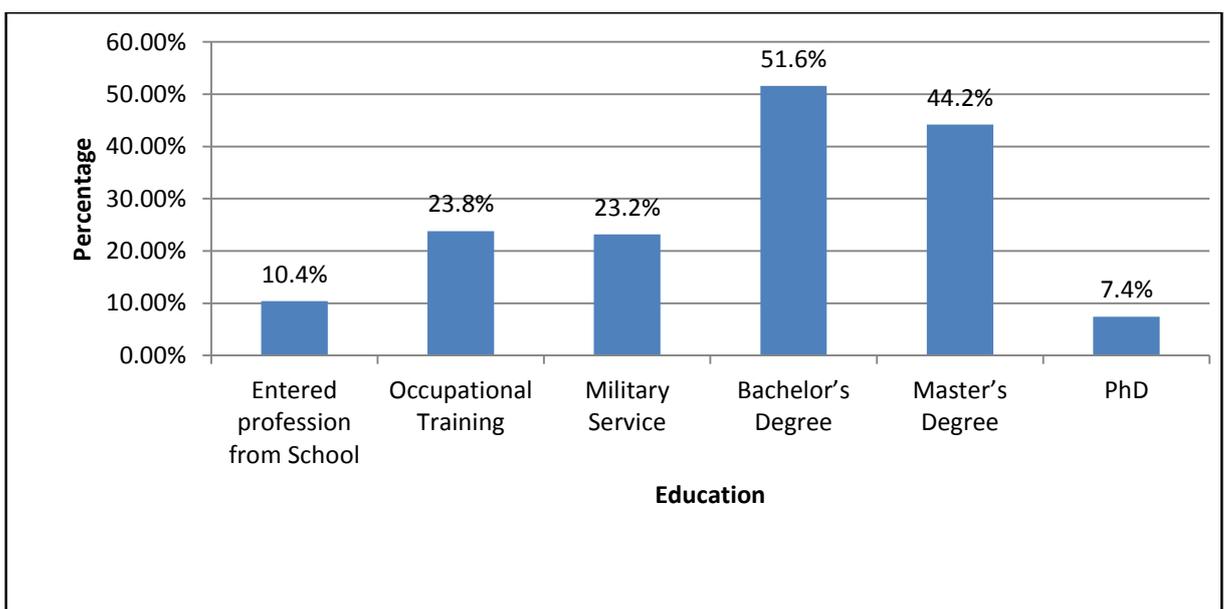


Figure 3.4: Q4 Education and Training of Questionnaire Respondents

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Q5. Have you attended a programme which has been recognised as meeting the requirements of the FIG/IHO/ICA S-5/S-8 Standards of Competence for Category 'A'/'B' Hydrographic Surveyors/Nautical Cartographers?

- 45.2% of respondents are IHO certified. 33.4% have Cat. A qualification and 16.6% Cat. B, 7.2% are Cartographers (Cat A & B).

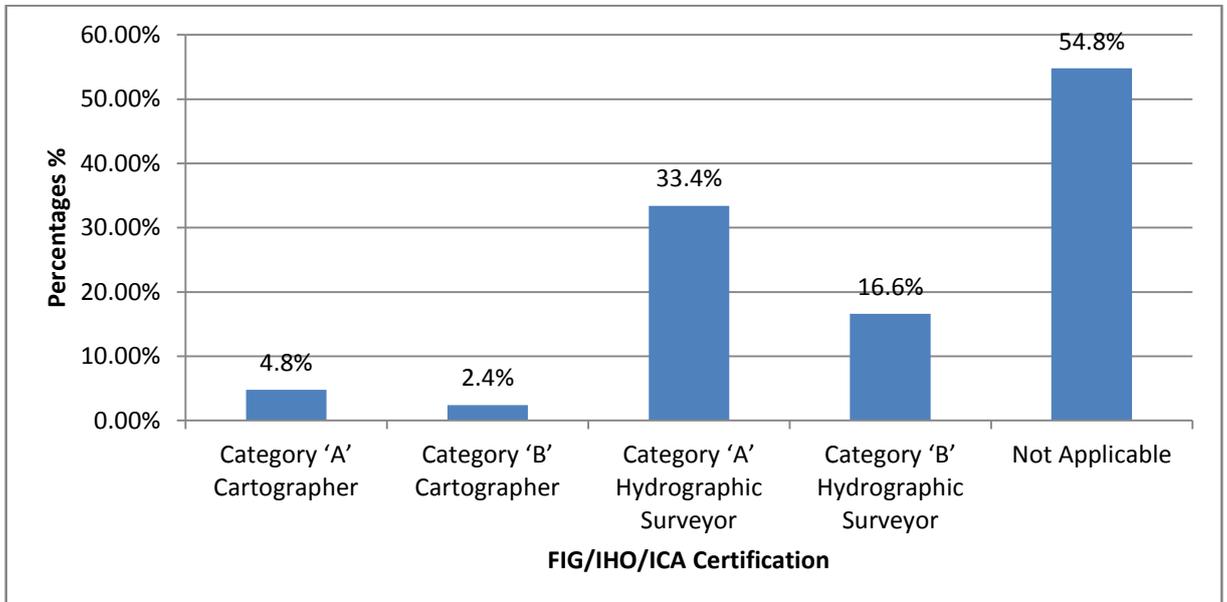


Figure 3.5: Q5 Percentages of FIG/IHO/ICA Certified Respondents

Q6. Are you responding as an individual or representing the wider views of a company, organization or member state?

- 72.6% of the respondents replied as an individual. 22.6% responded on behalf of company/organization and 4.8% responded on behalf of an IHO Member State (India, Brazil, Finland, Denmark, Thailand, Oman, South Korea, Italy, Portugal, Sweden, Indonesia and France).

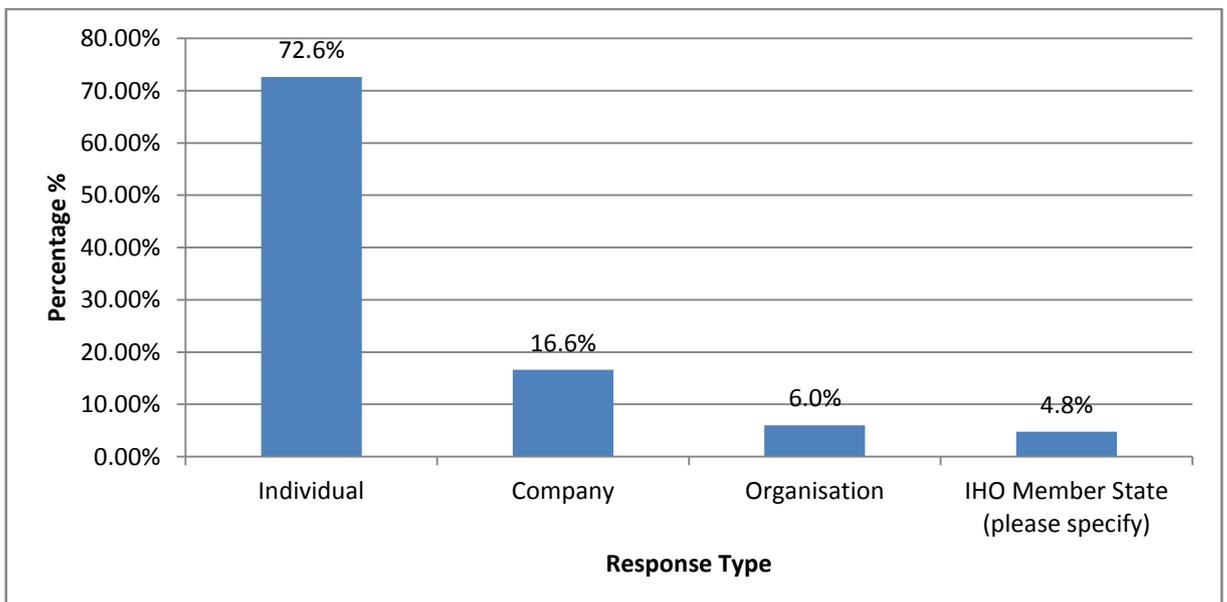


Figure 3.6: Q6 S-44 Questionnaire Response Type

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Q7. Which activities best describes your company/organization? (Tick all that apply)

- Hydrographic Surveying and Hydrography best describe the majority of companies (62.4 and 49.4% respectively). Other significant areas of activity are: Navigation and Positioning (31.8%), Data Processing (36.8%), GIS & Mapping (34.6%), Government (27.4%), Port & Harbours (24.8%), Oceanography (20.8%), Survey Contractor (18.0%), Coastal Management (16.4%). Note: 27.4% work for Government.
- Other (6%) Includes: Autonomous surface vehicles, Law of the Sea/Maritime boundary delimitation, Inspection Repair and Maintenance, Nautical Charting, Cable Lay, Mining and Tidal Analysis.

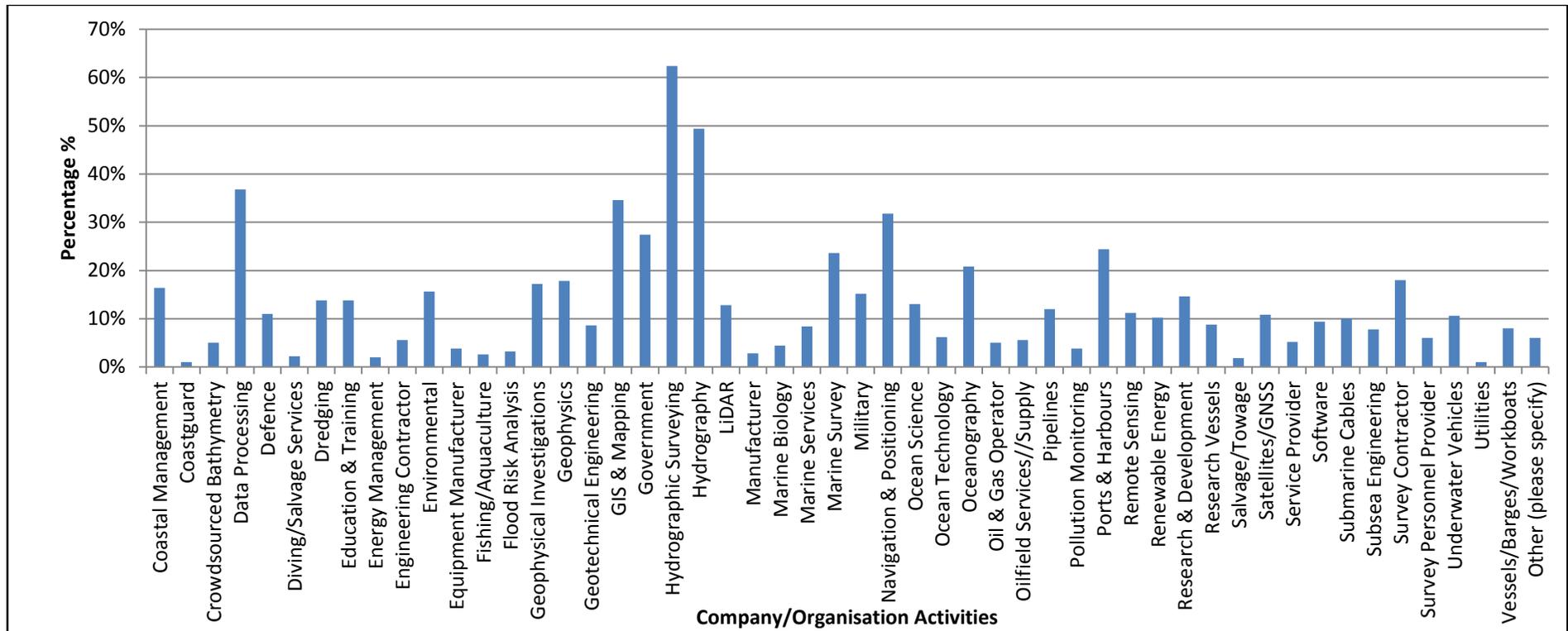


Figure 3.7 Q7 Company/Organisation Activities

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Q8. What is the primary purpose of the surveys in which you are involved? (Tick all that apply)

- 53.8% Safety of Navigation, 42% Ports & Harbours, 30.8% Dredging, 27.8% Geophysical surveys and 25% for Pipeline/Cable surveys.

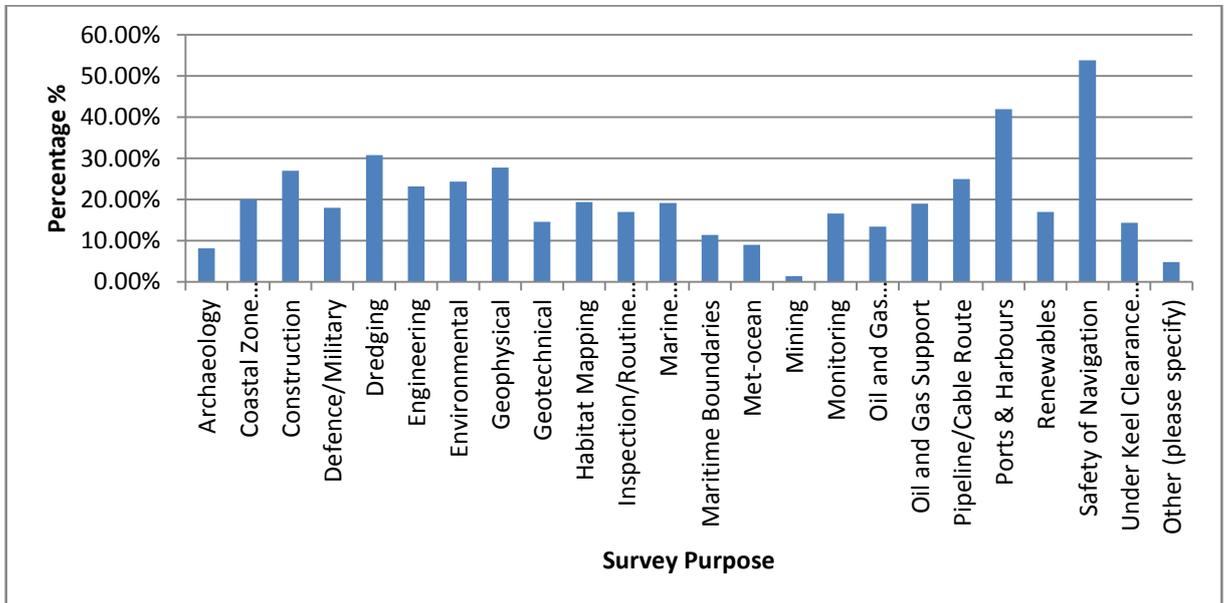


Figure 3.8: Q8 Respondents Primary Purpose of Surveys

Q9. What survey platforms do you or your organization use? (Tick all that apply)

- Nearshore vessel and Coastal vessel are the most used platform (71.6% and 69.4% respectively), while offshore vessel represents 58.4%. Note: Autonomous Surface Vehicle platforms comprise 22.6%, Autonomous Underwater Vehicles 24.60%, and Aerial Drone and Aircraft 15.8% and 16.0% respectively.

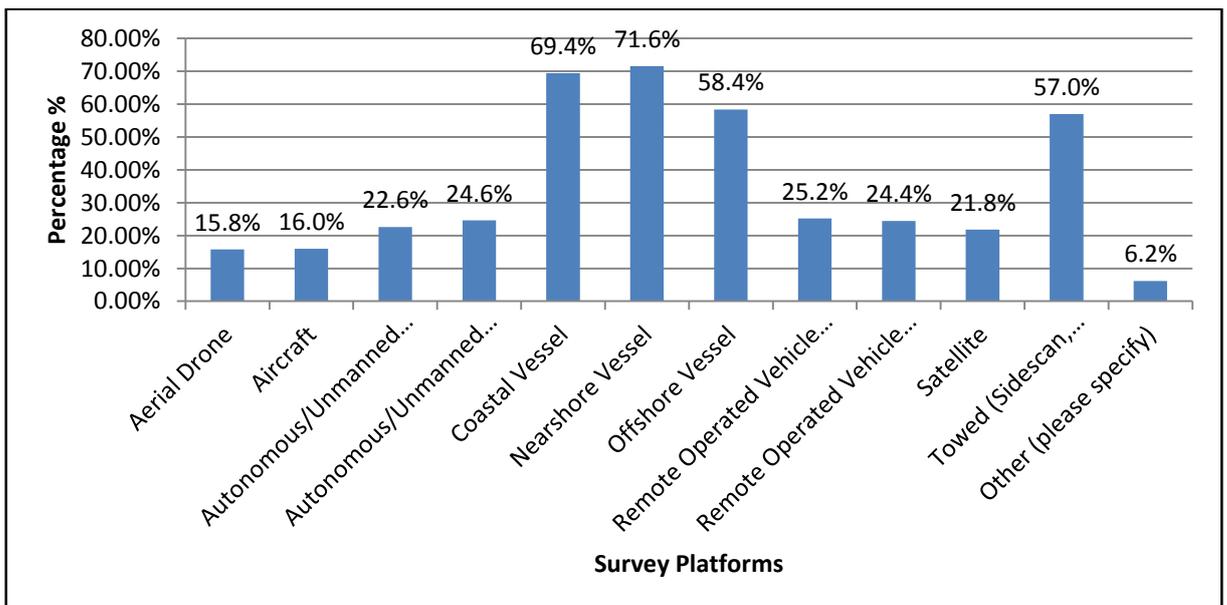


Figure 3.9: Q9 Survey Platforms Utilised

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Q10. What survey sensors do you or your organisation use? (Tick all that apply)

- Multibeam Echosounder is the main sensor used (88%). Other Hydrographic or Object Detection systems are: Sidescan Sonar (79.4%), Singlebeam Echosounder (76.8%), Satellite (39.0%), Interferometric Systems (32.4%), Laser Scanner (31.8%), LIDAR (29.2%). Note: Tide gauges are used by 72.0% of the respondents and Speed of Sound Profiler by 72.8% (meaning that 37.2% don't use sound velocity profiles?). Sub Bottom Profilers are used by 54.2% of the respondents.

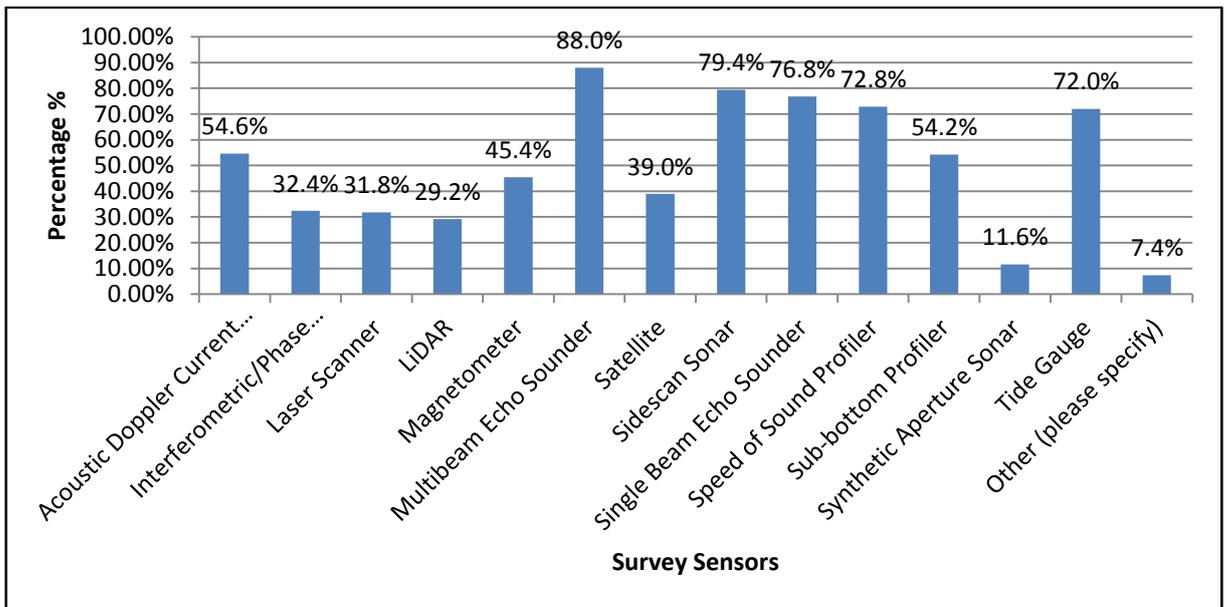


Figure 3.10 Q10 Survey Sensors Utilised.

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4. SECTION 2: Use of Standard

Q11. Do you or your organisation survey to a documented Standard?

- 497 Answered, 3 Skipped
- 83% of respondent's survey to a documented standard.

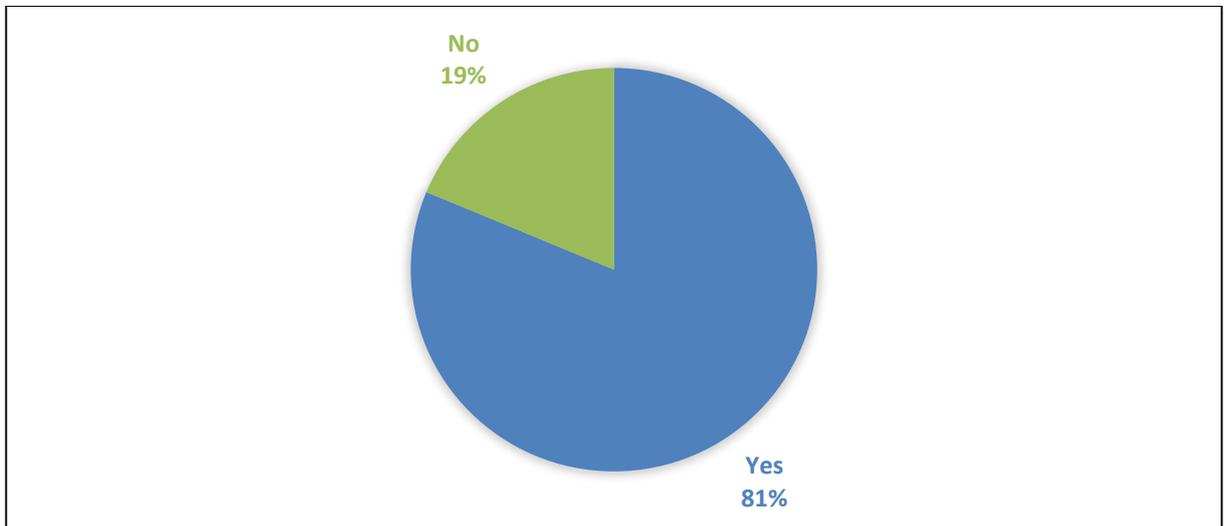


Figure 4.1: Q 11 Surveying to a Documented Standard.

Q12. If 'Yes', to Q11 what Standard do you use?

- 487 Answered 13 Skipped
- 54% use S-44, 23% use a standard more restrictive based on S-44, 7% use a standard less restrictive based on S44.
- Other 15% (Please specify) Included: Client specifications, in-house standards, LINZ, USACE and NOAA specifications were most common. Also, national development and extension of S-44: Canadian Hydrographic Service, Indonesian National Standard, SHOM, UKHO, Dutch, Swedish, Finnish Implementation of S-44.
- In addition, DNV, IMCA Shell Technical Specs, HQAI (NP145) -UK Royal Navy

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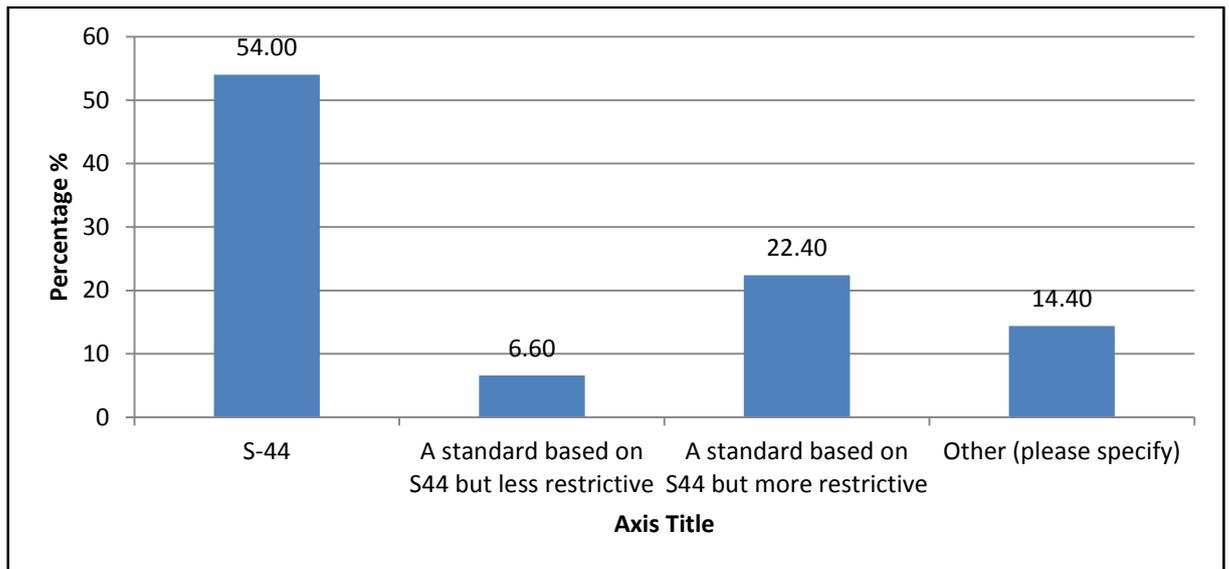


Figure 4.2: Q12 What Standard Do You Use?

Q13. If you use a standard less or more restrictive than S-44, please specify on what parts it differs: (horizontal positioning, depth accuracy, etc.)

Answered 140 Skipped 360, Comments 140

Comments Analysis

- 72% of commenters utilise more restrictive survey criteria than S-44. With only 1% of commenters specifying criteria less restrictive
- 11 % of comments specify depth accuracy, 6 % of comments specify horizontal 25 % of commenters specify both vertical and horizontal uncertainty - more strict than special order.
- Use of S-44 as a standard irrespective of the water depth (Special order positional and horizontal uncertainties used in deep water)
- Reduced uncertainty values less allowable uncertainty
- Feature detection/Object detection criteria detectable feature size (detect smaller targets than S-44 0.5m)
- Target detection - along track and across track number of pings on a target
- Adjustment of depth dependent and independent allowable error contributors.
- Increased coverage redundancy (200%)
- Sounding Density and specific Bin sizes determined
- Mud density
- Mechanical wire sweep

Q14. Does your field of surveying require IHO recognised survey criteria?

Answered 455, Skipped 45

69.9% of respondents require IHO recognized survey criteria.

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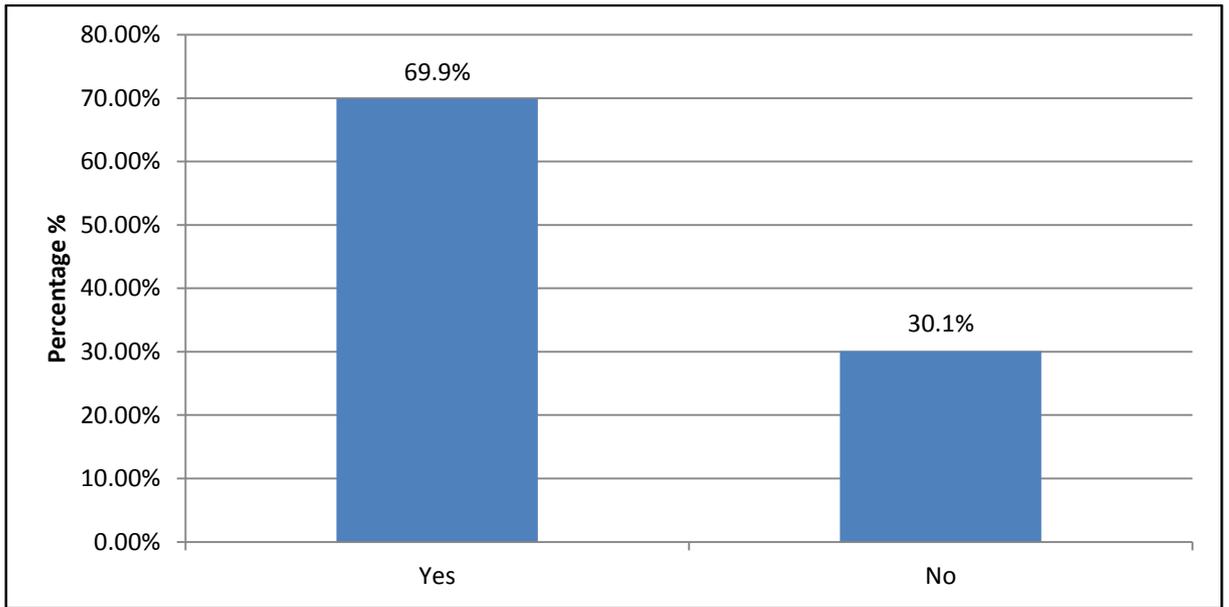


Figure 4.3: Q14 Require IHO Recognised Survey Criteria.

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Q15. Would your field of surveying benefit from having IHO recognised survey criteria?

- Answered 433, Skipped 67, Comments 76
- 86.1% of respondents consider that IHO recognized survey criteria is beneficial.

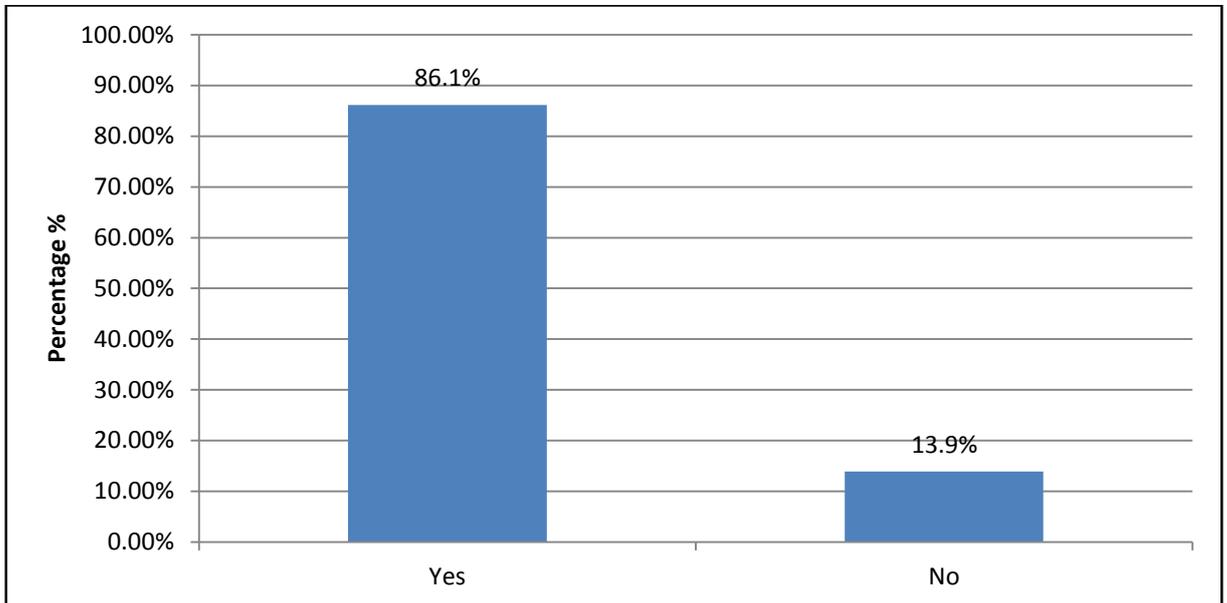


Figure 4.4: Surveys Benefit from IHO Survey Criteria

Comments Analysis

- **Additional analysis of comments required**
- Qualifications linked to the standard as accredited sign off on the data?
- add a section or sections in the next revision of S44, that address the stringent requirements of offshore engineering surveys.
- Acceptance criteria for Satellite Derived Bathymetry
- The usage or popularity of the IHO criteria outside HO's is due to the lack of a better documented criteria. The IHO criteria will not suit most survey requirements.
- HV cables, pipelines, platform/turbine installation sites where a safe depth is less important than the topography of the site and the vertical datum is most likely to be MSL
- Yes - Marine archaeology relative precise data
- Yes - Offshore renewables subsea cable route surveys
- Survey criteria used to communicate confidence in dataset
- S-44 is too multi interpretable
- Surveying for non-navigational use would benefit
- Easier to understand from an end users point of view
- International Best practice
- Guidelines Precision and systematic error formulas for each different project areas/requirements so values for dredging, coastal construction etc
- Order Metadata minimum standards?
- IMCA and RICS guidelines mentioned
- Inclusion of habitat and marine geology
- River environments internal waterways rivers and canals?

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Q16. Does the S-44 Standard drive the procurement/development of new equipment, capabilities or procedures within your organisation?

- Answered 442 Skipped 58;
- S-44 drives the procurement of new equipment, capabilities or procedure for 60.2% of respondents.

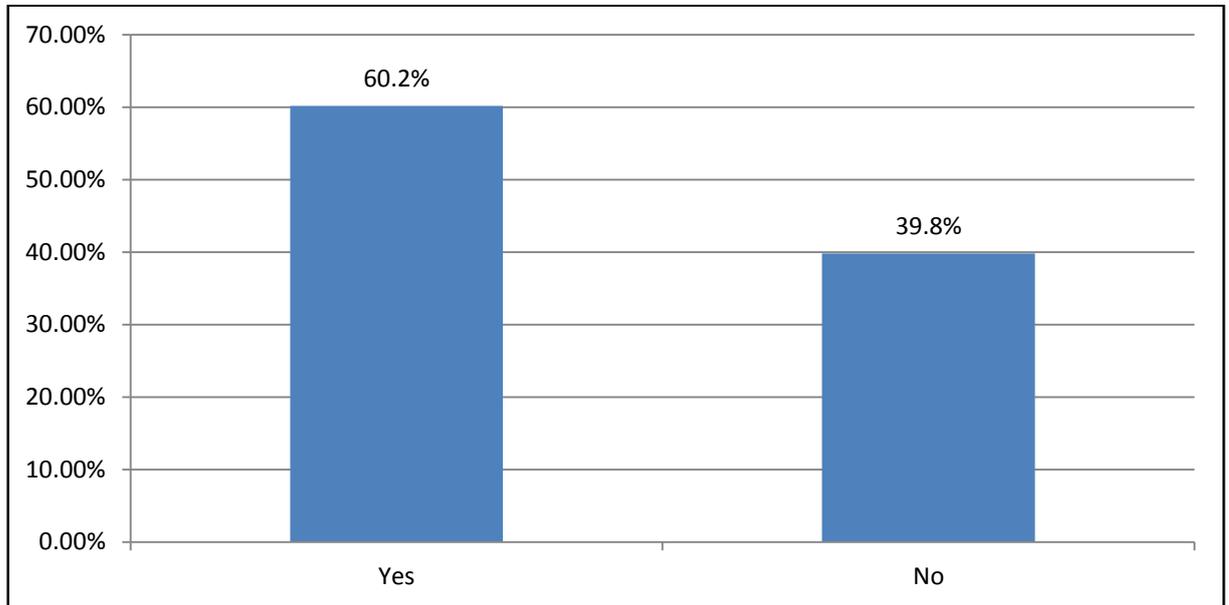


Figure 4.5: Q16 S-44 Standard Drive Procurement/Development of new Equipment?

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5. SECTION 3: Current S-44 Standard (5th Edition, 2008)

Q17. Is the current edition of S-44 relevant in your field of activities?

- Answered 395 Skipped ,105; Comments 81;
- 83.5% consider S-44 to be relevant.

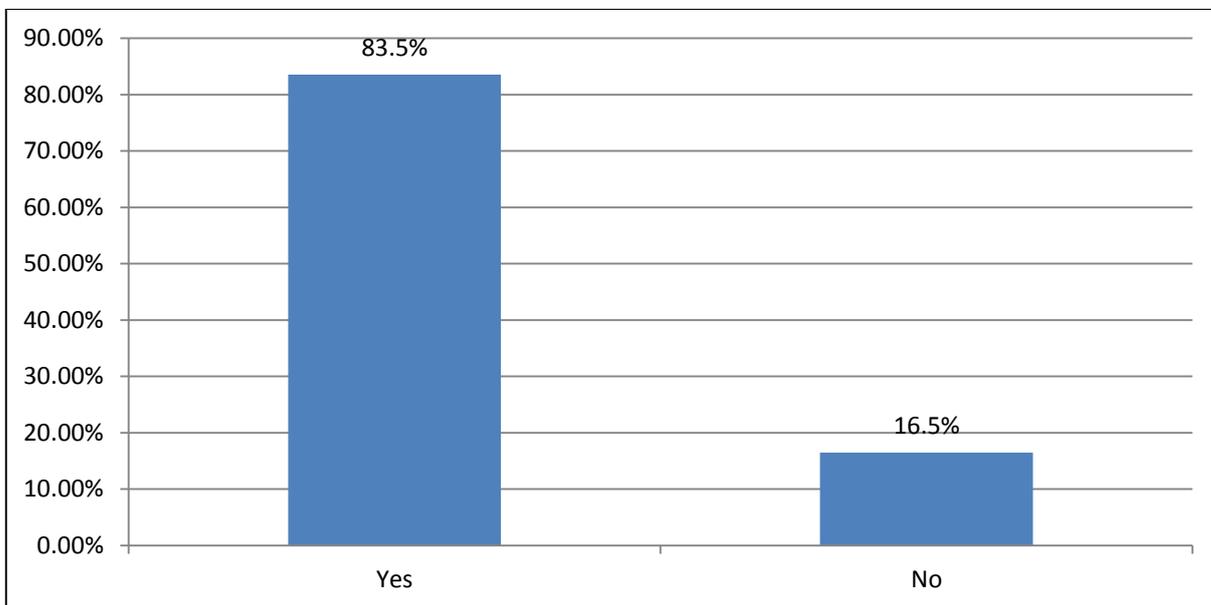


Figure 5.1: Q17 Is Current Edition of S-44 relevant?

Comments Analysis

- **Additional analysis of comments required**
- Good as a minimum baseline standard (x6)
- Relevant for Safety of navigation but doesn't cover all circumstances (x5)
- Not for Engineering Construction Dredging (x3)
- Not for Subsea (x3)
- Satellite derived Bathymetry remains a problem (x2)
- No well adapted for Lidar (x2)
- Accuracy values are too low compared to the equipment used (x3)
- Education regarding the standard is lacking and often quoted by clients who do not understand (x2)
- Too focussed on charting (x2)
- Not stringent enough for Port and Harbours/UKC environments. (x2)
- Not relevant as often superseded by more stringent client spec (x2)
- Not precise or accurate enough (x1)
- S-44 (When considering all aspects, the entire standard is too stringent) (x1)
- Special Order does not reflect what is possible or needed (x1)
- Only as minimum standard on large area bathymetry surveys (x1)
- Not a hydrography standard but a bathymetry Standard (x1)
- It provides a standard that allows the survey data to be accepted for charting but is not tight enough for much of the high-resolution work done for engineering (x1)
- Its relevant but needs to acknowledge the need for additional criteria for different measurements (x1)
- More detailed object detection would be useful (x1)

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- Greater detail for Interferometric sensors (x1)
- It is relevant but needs to be modified to keep pace with current equipment technology (x1).
- Outdated and well over due for revision (x1)
- Relevant to multibeam surveys, not to single beam surveys used in soft bottom areas (x1)

Q18. Does your Company, Organisation or State include additional criteria above and beyond the IHO S-44 Standard when commissioning hydrographic survey activity?

- Answered 381 Skipped 119, Comments 93
- More than 61% of respondents use criteria additional to S-44.

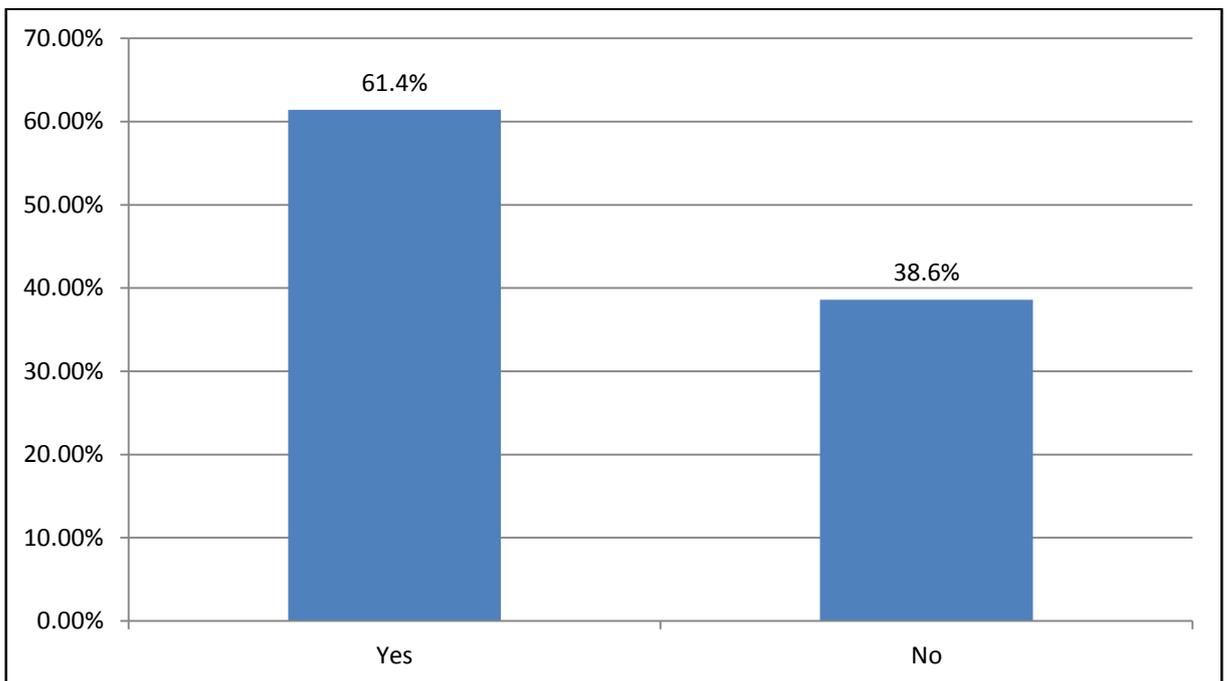


Figure 5.2: Additional Criteria above and beyond IHO S-44

Comments Analysis

- **Additional analysis of comments required**
- Feature/object Detection (x5)
- Sounding Density Minimum Points/soundings per grid cell/ gridding (x5)
- Linz Standard (x3)
- Stricter vertical and horizontal tolerances (x3)
- More stringent accuracies x2
- Sign off by specified level of qualification (Level 1 certified professional through the Australasian Hydrographic Surveyors Certification Panel for example) (x2)
- Coverage (x2)
- Not stringent enough for subsea lidar/laser technologies (x1)
- Feature size rules (CUBE and cartographic horizontal uncertainty in terms of Cube Node spacing) (x1)
- Depth precision in line with Under Keel Clearance requirements (x1)
- Higher than 95 % confidence level (x1)
- More stringent TVU for deeper water (x1)

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- Overlap (x1)
- Minimum Equipment Accuracy/Uncertainty (x1)
- S-44 'Exclusive Order' (Swedish, Finnish and Canadian adaptation) (x1)
- Additional Measurements/criteria (x1)
- More |Stringent Quality Control (Method for meeting the standard) (x1)
- Additional criteria added for engineering construction surveys (x1)
- Route surveys uncertainty allowances mad tighter x1 (x1)
- Detailed error budget must be provided (x1)
- Tighter tolerance for Deeper water surveys (x1)
- An order 3 defined for Satellite Derived Bathymetry? (x1)
- FSIS44 (x1)
- Backscatter x(x1)
- Water Column (x1)
- Positioning (x1)
- ERS Grids (x1)
- Designated soundings (x1)
- Resolution Guidelines (x1)
- Tighter Horizontal Positioning (x1)
- NOAA HSSD (x1)
- Value for money (x1)
- Frequency of areas resurvey defined (x1)
- Full seafloor search is mandatory with MBES 100% overlap (x1)
- TVU limits are linked to sediment mobility and depth of burial of cables (x1)
- SHOM Documentation used (x1)
- IMCA Guidelines used (x1)
- NL norma a and b (x1)
- Scanning of the shore and further (x1)
- Maximum Swath Widths and Frequency to be used. (x1)
- Overlap 2005 plus Cross/check lines (x1)
- Recommended equipment (x1)

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Q19. With regard to the exclusive purpose of maintaining navigational safety:

□ Answered 386, Skipped 114.

a. Is S-44 Sufficiently Strict?

□ 53.5% think S-44 is sufficiently strict, 18.47% think it's not strict enough and 28% don't know

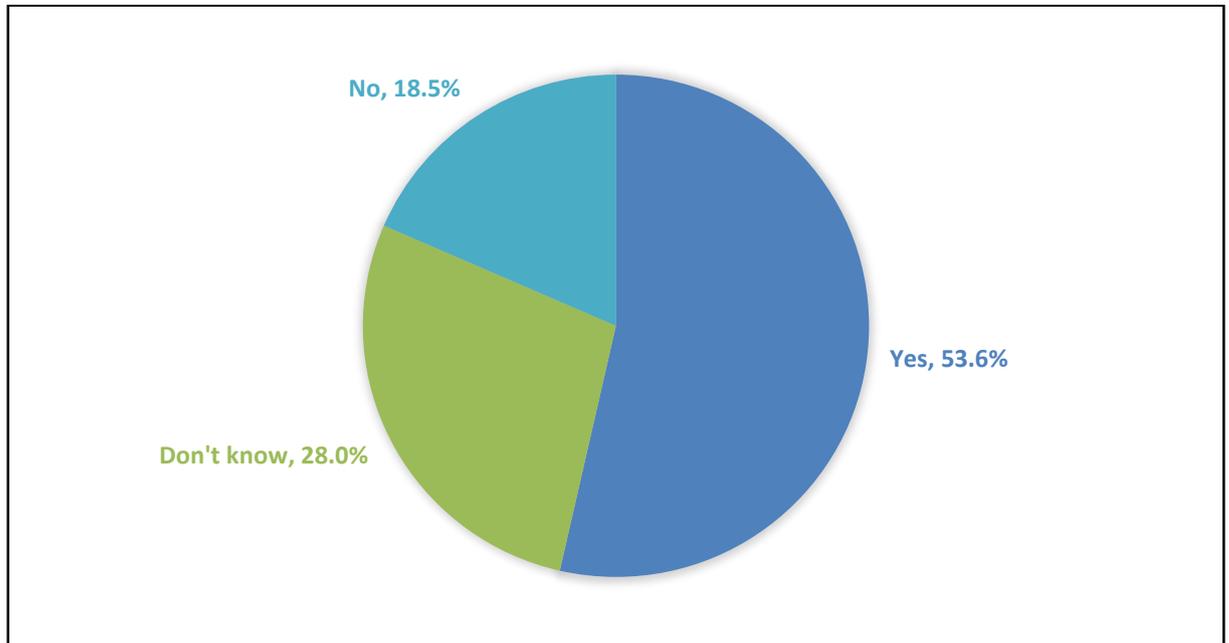


Figure 5.3: IS S-44 Sufficiently Strict

b. Should S-44 be Stricter

□ 32.5% think S-44 should be stricter, 28.15% don't think S-44 should be stricter and 39.3% don't know. Therefore, with respect to the exclusive purpose of safety of navigation, the majority consider S-44 as sufficiently strict.

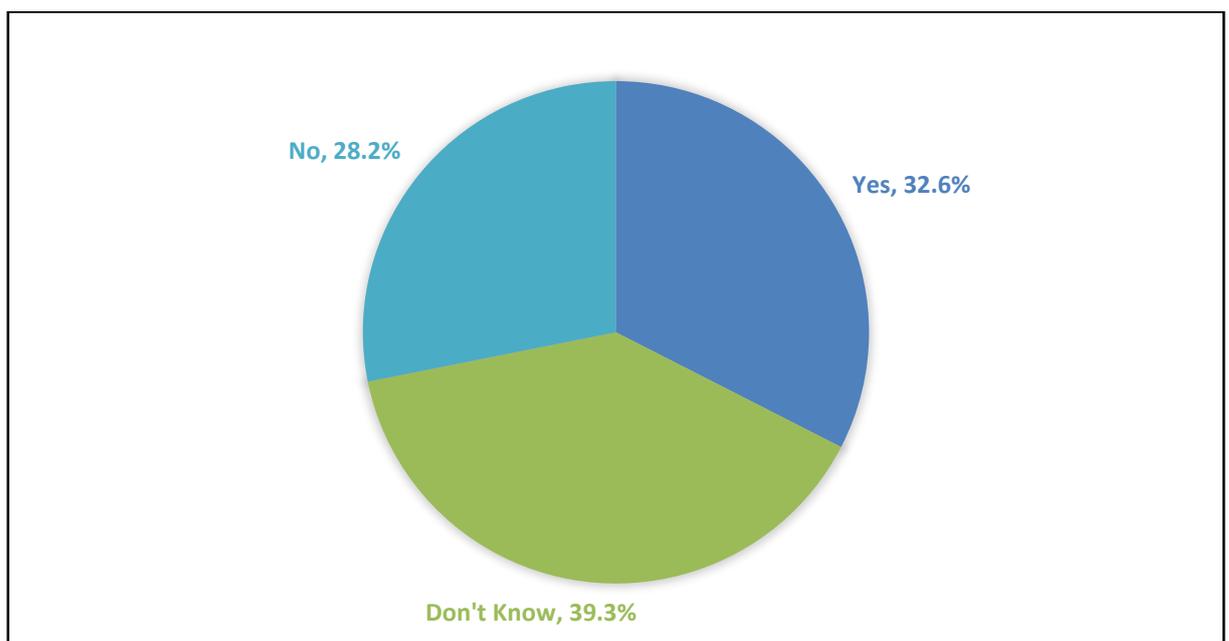


Figure 5.4: Should S-44 be Stricter?

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Q20. Which part(s) of S-44 do you find most useful?

- Answered 215, Skipped 285, Comments 251

Comments Analysis

- **Additional analysis of comments required**
- Table 1 x59
- Chapter 1 (Classification of Survey) x18
- TVU x14
- Depth and Position Accuracies x14
- Chapter 3 x13
- All (Whole document) x13
- Chapter 2 x10
- THU x8
- TPU x7
- Definitions x4
- Object Detection x4
- Chapter 5 x4
- Special Order x3
- Chapter 6 X3
- Sounding Density Object detection x3
- Full seafloor Search x3
- Feature Detection x3
- Error Budgets x3
- Annexes x2
- Coverage Definitions x2
- Glossary x2
- TPE x2
- How to design Specs x1
- Depths. For use in Under-keel Clearance Systems. X1
- Data Quality Control x1
- Elimination of doubtful Data x1
- SBES accuracy Formulae x1?
- Tides x1
- Survey Accuracies
- Depth Accuracy x1
- Definitions – Vertical Uncertainty x1
- Depth Criteria x1
- CATZOC x1
- Page 5 x1
- Accuracy and confidence level guidelines x1

IHO HSSC PROJECT TEAM ON STANDARDS FOR HYDROGRAPHIC SURVEYS (HSPT)
S-44 QUESTIONNAIRE ANALYSIS

Q21. Which part(s) of S-44 do you find least useful?

□ Answered 166, Skipped 344, Comments 166

Comments Analysis

- **Additional analysis of comments required**
- Tides and currents disproportionate x1
- Guidelines for Data Processing x1
- Chapter 4 x2
- Chapter 6 x3
- Annex A x2
- Annex B (Guides for data Processing) x4
- Table 2 x1
- Chapter 5 x1
- Chapter 7 x1
- Seabed search and Object detection criteria
- Search criteria are too mathematical
- SBES
- Being too specific towards bathymetry surveys for hazards to nav
- Repeated terminology
- Conflict's between bottom coverage, survey resolution, horizontal and vertical accuracy
- Tidal Section
- Surface positioning
- Annexes x3
- Accuracy
- Chapter 4
- Horizontal and vertical precision
- Lone spacing Guidelines
- Other measurements
- Horizontal uncertainty
- Positional accuracy is often mis quoted as navigational accuracy – needs addressing in the text.
- Crosslines (not economically viable when running pipeline surveys)
- Main text poorly written
- Other survey orders x1
- TPU modelling. This is poorly understood by the community. People treat this as the silver bullet but forget that a low uncertainty does not validate a correct sounding. For example, false sounding may have a lower TPU but would you credit them more? A dataset with artefacts may have a low TPU but is it acceptable for the purpose of the survey? Repetitive mapping is a far better way to validate a survey.

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S-44 QUESTIONNAIRE ANALYSIS

Q22. Which part(s) of S-44 do you find most problematic?

□ Answered 183, Skipped 317, Comments 183

Comments Analysis

- **Additional analysis of comments required**
- Tides not dealt with in enough detail x2
- Object detection criteria and how to meet it x2
- QC guidelines x1
- Sounding Uncertainty Definition x1
- Seafloor coverage definitions x1
- Seafloor coverage achievement x1
- The use of Orders x2
- Is it based on a- priori or posteriori (predicted system vs actual observed)
- Error Estimates
- Only deals with surface vessel-based sensors x1
- Relating depth and position requirements to acoustic positioning and ROVs x1
- Application of the standards when they are not relevant
- Referenced by clients who don't understand the whole document
- Along track and across track density
- Lack of guidance statistical editing of dense point clouds
- Further guidance on recommended sound densities
- Accuracies of Modelled Bathymetry TINS / interpolated surfaces
- Irregularities between 1.0 m feature detection and bin size
- TPU calculation for whole survey
- Chapter 6 requires further clarification
- Chapter 5, Chapter 7
- Object detection x5
- Minimum depth and feature detection
- No mention of roll pitch heading and heave
- Still focussed on acoustic-based technology insonification
- Orders constrained by depth 40m cutoff? X1
- Table 1 – too limited in its scope x1
- object sizes need to be in the same order of magnitude as the vertical uncertainties.
- Chapter 1 should include other classes of surveys for purposes other than safety of navigation. X1
- Connection of chart and land survey vertical datum's
- Hits on target
- TVU for Order 1b surveys exceeds the depth accuracy specified for ZOC A1 at depths greater than ~120m
- Lack of unity between CATZOC and S-44
- Criteria to deal with dynamic seabed's (Sand waves)
- Elimination of doubtful data could be better defined based on qualitative methods
- Ancillary sensors such as sound speed are not sufficiently covered x1

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S-44 QUESTIONNAIRE ANALYSIS

Q23. Do you, your organisation or customers understand the differentiation between S-44 standards and CATZOC?

- Answered 386, Skipped 114.
- 48.4% of the respondents understand the differentiation between CATZOC and S-44

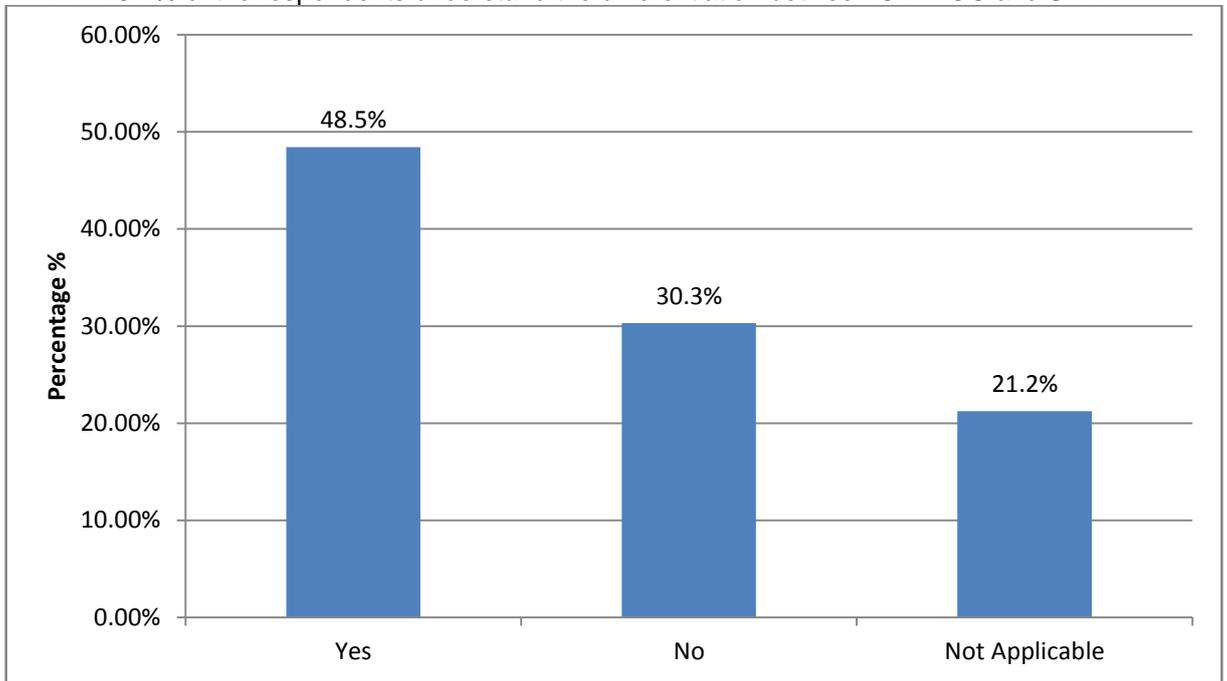


Figure 5.5: Understanding the differentiation between S-44 and CATZOC

Q24. Do you consider it important to have a clearer connection between S-44 and CATZOC??

- Answered 382, Skipped 118.
- 55.2% consider it's important to have a clearer connection between both, 10% consider it is not important and 34.5% consider it. not applicable to their work. Hence, a majority of the respondents want a clearer connection between S-44 and CATZOC.

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S-44 QUESTIONNAIRE ANALYSIS

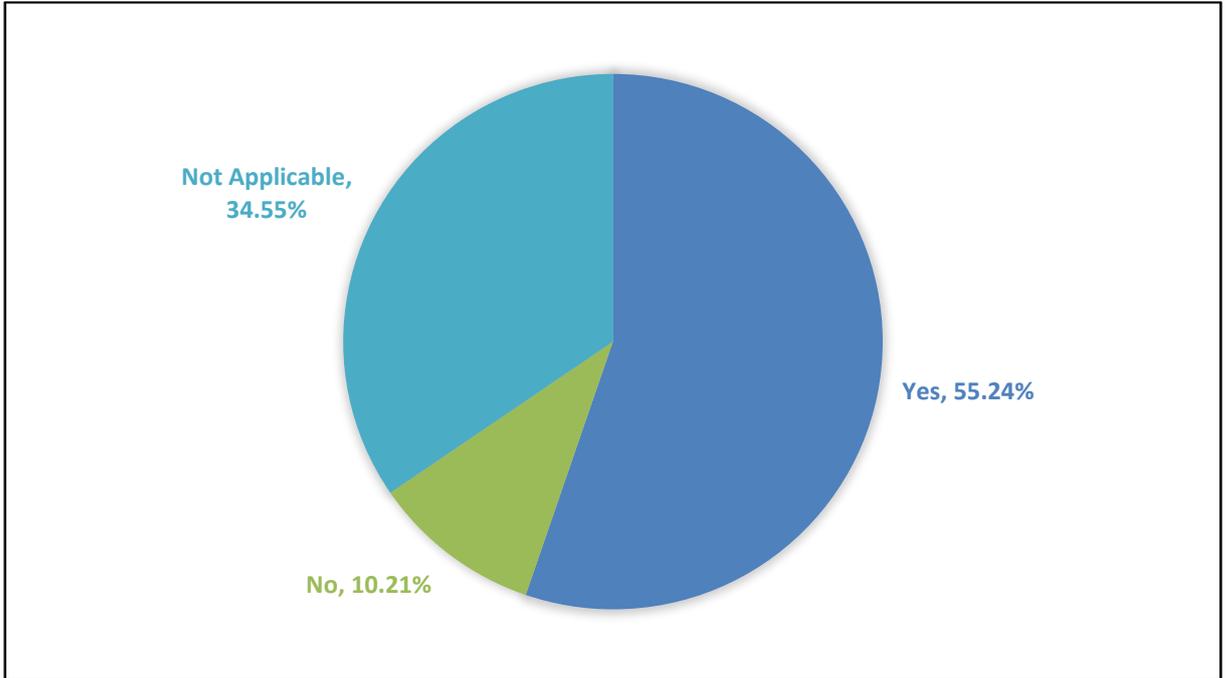


Figure 5.6: Q24 Clearer Connection Between S-44 and CATZOC

6. SECTION 4: Evolution of S-44

Q25. Do you consider that S-44 should be extended for purposes other than for the Safety of Navigation?

- Answered 339, Skipped 161.
- 60.8% consider S44 should be extended for other purposes, other than safety of navigation and 43.66% consider that the main focus S-44 should be safety of navigation.

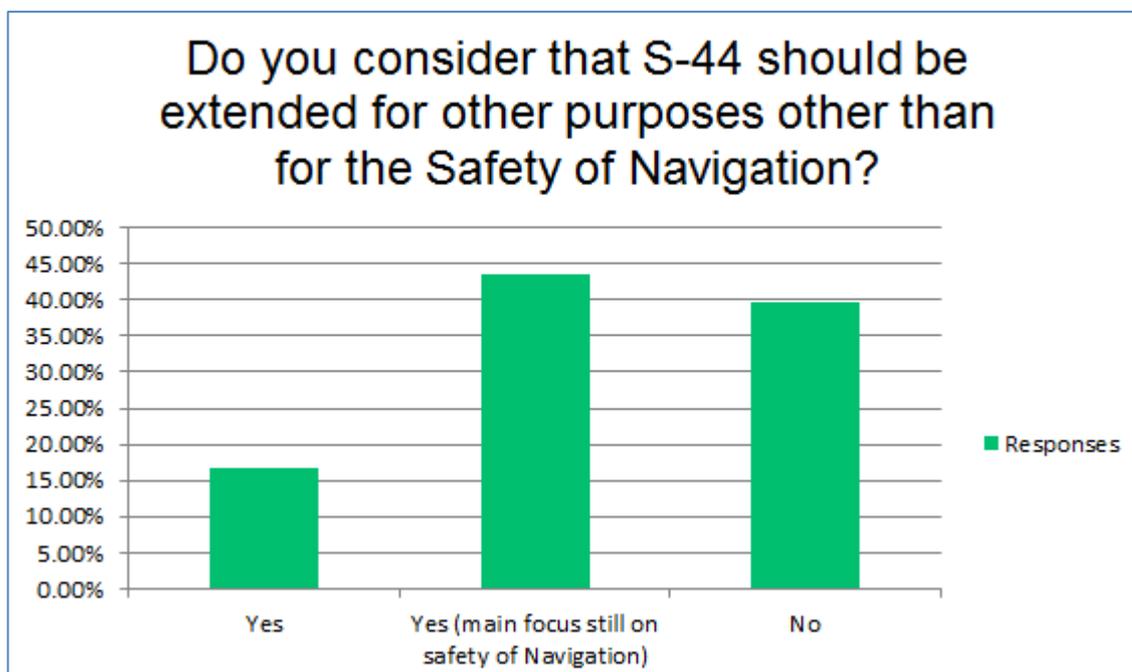


Figure 6.1: Q25 Extension of S-44

Q26. If 'Yes', in the question above which one(s)?

- Q26 Answered 137, Skipped 363, Comments 137

Comments Analysis

- **Additional analysis of comments required**
 - Construction/ Offshore Developments (x19)
 - Dredging (x15)
 - Engineering surveys (x8)
 - Habitat Mapping (x8)
 - Renewables (x6)
 - Subsea Engineering (x5)
 - Pipeline/Cable route surveys (x5)
 - Coastal Engineering (x5)
 - Backscatter (x5)
 - ROV/ASV/AUV surveys (x5)
 - Oil and Gas Exploration (x4)
 - Offshore Positioning Surface and Subsea (x4)
 - Science/Research/Academic Data Collection (x4)
 - Coastal Zone Management (x4)
 - Condition surveys/Inspection maintenance as found/as built (x3)

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- Under Keel Clearance Surveys (x3)
- Disaster Management (x3)
- Satellite Derived Bathymetry (x3)
- Crowd Sourced Bathymetry (x3)
- Tides – Tidal streams height prediction and currents (x2)
- Fisheries and Aquaculture (Benthic and Pelagic) (x2)
- Seabed Classification /characteristics (x2)
- Environmental Monitoring (x2)
- Met-Ocean Observations (x2)
- Reconnaissance/Rapid environmental Assessment (x2)
- UNCLOS (x2)
- Water Column
- Gravity
- Geotechnical
- Geophysical Site Survey
- Marine Geology
- Mining
- Routine Resurvey Requirements
- Seabed Evolution - Survey Data how long is it valid
- Modern techniques for removal of doubtful data
- Searching for recently lost Aircraft / ships
- Subsea Acoustic Positioning system uncertainty ROV/AUV
- GNSS Derived Tides
- Better Doubtful Data definitions
- Non- hazard search criteria
- Relative positioning such as Archelogy
- Unexploded Ordinance
- High Accuracy surveys outside of navigation areas.
- Sub bottom Profilers
- Sidescan Sonars
- Competency Hydrography career paths
- IMCA

Q27. For which purpose(s)?

- Q27 Answered 115, Skipped 385, Comments 115
- The comment responses are linked to Q26, and the responses are far too spread to analyse in this context and may require additional analysis.

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Q28. Should S-44 consider other types of measurements not already present in Edition 5?

- Answered 309, Skipped 191.

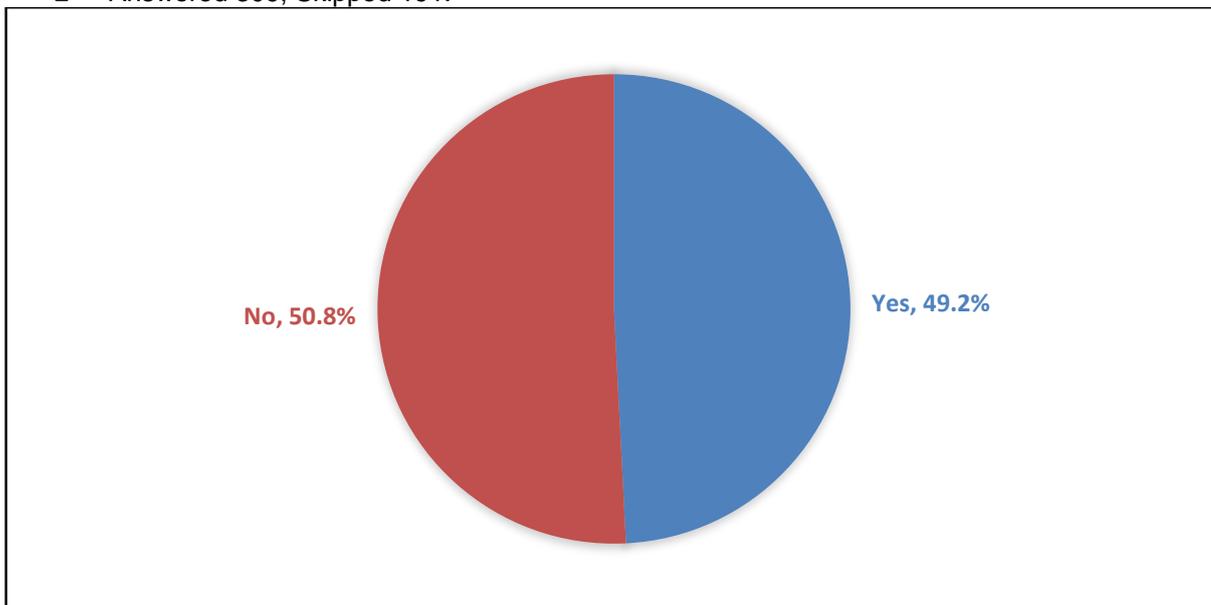


Figure 6.2: Should S-44 Consider other Measurements

Q29. If 'Yes', in the question above which one(s)?

- Q29 Answered 131, Skipped 369, Comments 131

Comments Analysis

- **Additional analysis of comments may be required**
- Lidar (no division between Bathy/Topo) (x17)
- Satellite Derived Bathymetry x14
- Backscatter (x12)
- Laser Scanning (Subsea and terrestrial) (x8)
- Crowd Sourced Bathymetry (x6)
- Tides, Co-tides and Current (x4)
- Water Column (x5)
- Subsea vehicles ROV/AUV (x4)
- GNSS Tides x3
- Satellites (x3)
- Multibeam (x3)
- Object detection - number of beams on object x3
- Geophysical sensors (Sidescan, magnetometer, Sub Bottom Profiler Pinger, Boomer) (x3)
- Sound Speed x3
- Remote Sensing x2
- X band Radar
- Remote Sensing (x2)
- Earth Observation x2
- Photogrammetry (x2)
- Interferometric Multi-Phase Echosounder. X2
- Interferometry (x2)
- USBL Positioning x2

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- LBL Positioning x2
- Magnetics x2
- Depth Sensor Accuracies /Pressure to Depth Calculations (x2)
- Aerial Drone x2
- VORF or similar (x2)
- Acoustic Scanning
- Gravitational
- ADCP
- Synthetic Aperture Sonar
- Tidal Streams
- Reflectivity Data (Lidar)
- Magnetometer
- Density of fluid Mud
- GNSS Horizontal Datum Transformations
- Equipment Certification
- Airborne Hyperspectral Bathymetry
- Land Heights
- UAV surveys
- Sensor Calibrations
- Seabed Classification
- MBES Multi Ping, Multi Freq
- Oceanographic Measurements

Q30. For which purpose?

- Q30 Answered 99, Skipped 401, Comments 99
- 49.2% think S-44 should consider other types of measurements not already present in Edition 5. Hence, not really a majority want other types of measurements.
- See Q29 (131 comments) and Q30 (99 comments) for which other type of measurements and purposes should be considered

Q31. Should guidelines be established and included in S-44 that would enable survey systems to be verified as having the capability of meeting the requirements of S-44?

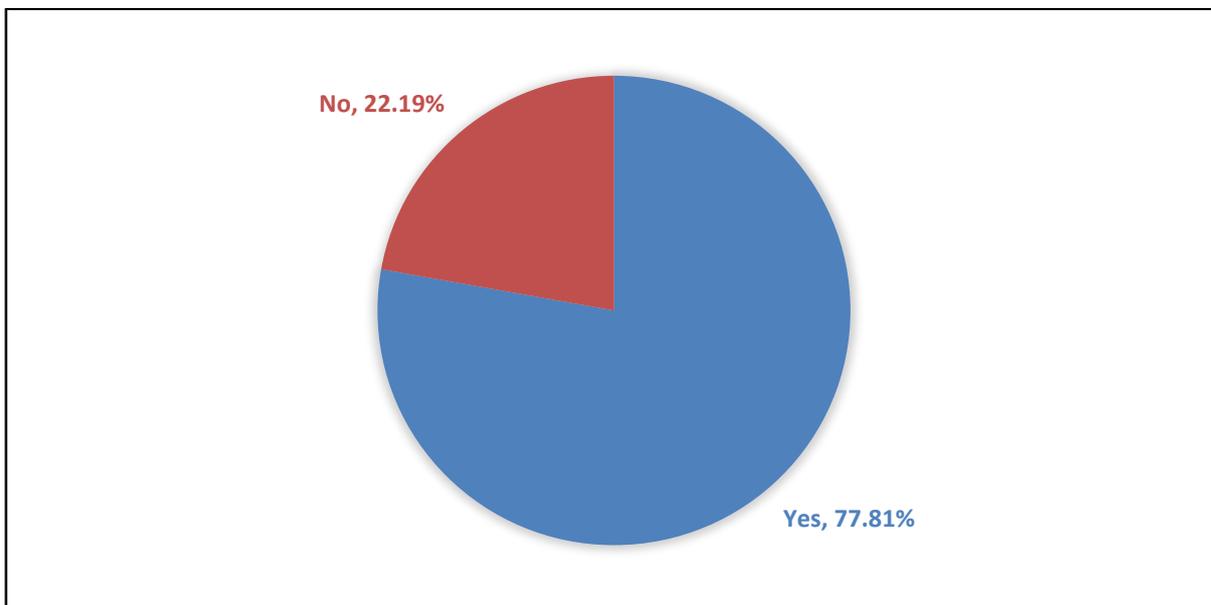


Figure 6.3: Q31 Survey System Verification Guidelines in S-44?

Analysis

Whilst 78% of the 320 respondents to this question want survey system verification guidelines included in the 6th Edition, comments from the 22% who don't are well considered and identify the potential pitfalls of this proposal.

Compilation of the guidelines will not be an easy task. They will need to satisfy competing objectives by addressing (among others) rigor, system component breadth, interoperability and flexibility. It is important that IHO's credibility is preserved. Guidelines should not be overly prescriptive and IHO needs to ensure that system verification does not lead to the sort of difficulties found with obtaining ECDIS Type Approval. The guidelines must be accepted by the Member States and there will need to be clear verification pathways.

The guidelines would also need to cover airborne passive optical systems (hyperspectral) and satellite (multispectral) systems, be equipment agnostic and able to deal with new technologies as they come into use. Updating them will be both a necessity and a challenge.

The role of the Surveyor must not be minimized or undermined by the guidelines. Ultimately, she/he is responsible for the quality of the hydrographic data collected. Competent judgment in the field based on knowledge and experience is still the key component in ensuring safety of navigation through accurate charting.

Should verification guidelines be more usefully included in Member State HO specifications rather than S-44?

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Q32. Should guidelines be established and included in S-44 that would enable surveys to be assessed and validated as meeting the requirements of S-44?

□ Q32 Answered 317, Skipped 183.

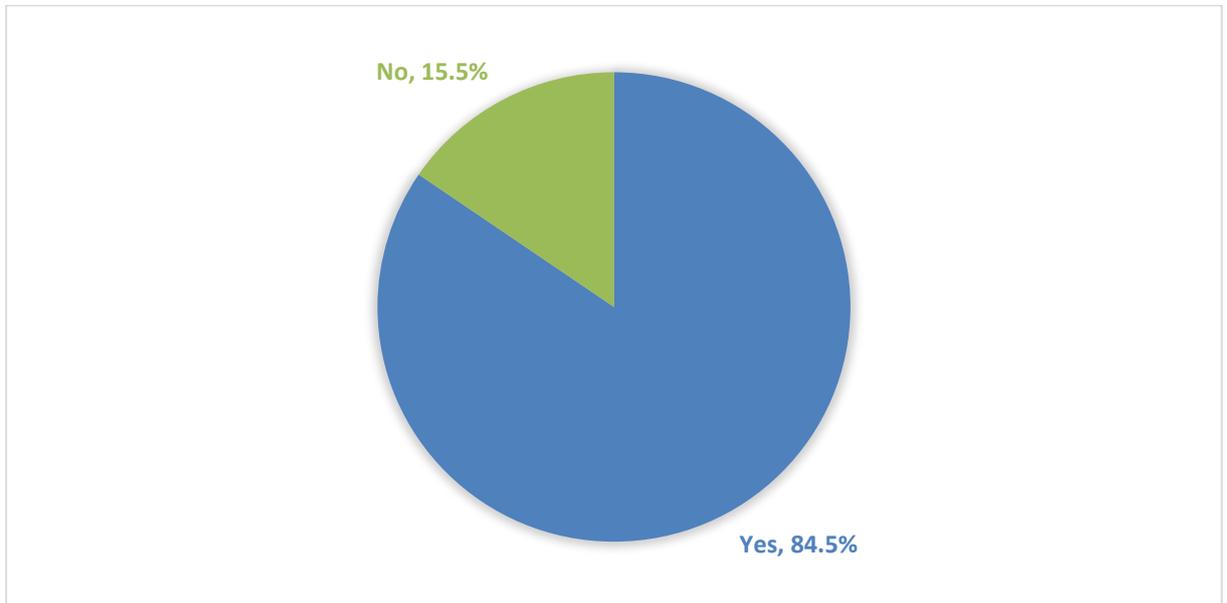


Figure 6.4: Q32 Guidelines for validating surveys against S-44 to be included in the standard.

Analysis

A large majority (84.5%) of the 318 respondents to this question would like guidelines dedicated to survey validation with respect to S-44 standard.

There is no real opposition to assessment and validation guidelines, which are largely positive. Suggestions include satellite derived bathymetry (SDB) and systems where accuracy is hard to determine (interferometric or CAATI sonar) with an indication of data sources. Should these guidelines be included in S-44 or Member State HO specifications?

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S-44 QUESTIONNAIRE ANALYSIS

Q33. Should S-44 include additional guidelines/standards for other activities such as backscatter, water column data?



Figure 6.5: Should S-44 Include Additional Guidelines for other Activities

Analysis

More than three quarters (78%) of the 318 respondents think S-44 should include additional guidelines for other activities. These include:

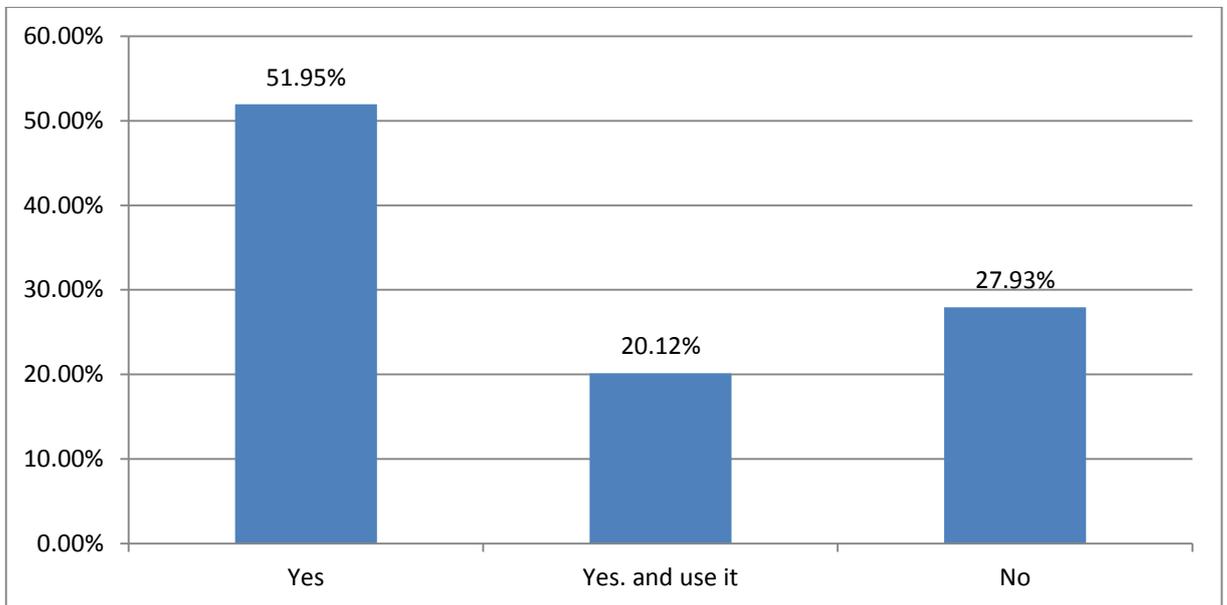
- Backscatter
- Water column data
- Guidelines for calibrated sea bottom reflectance (from LiDAR, multispectral and hyperspectral systems)
- Minimum requirements for SVP dips
- Reflectivity/intensity plots
- ADCP

They should be equipment agnostic and respondents are evenly divided between wanting guidelines or a standard, with many suggesting C-13 may be a more appropriate place for them.

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S-44 QUESTIONNAIRE ANALYSIS**

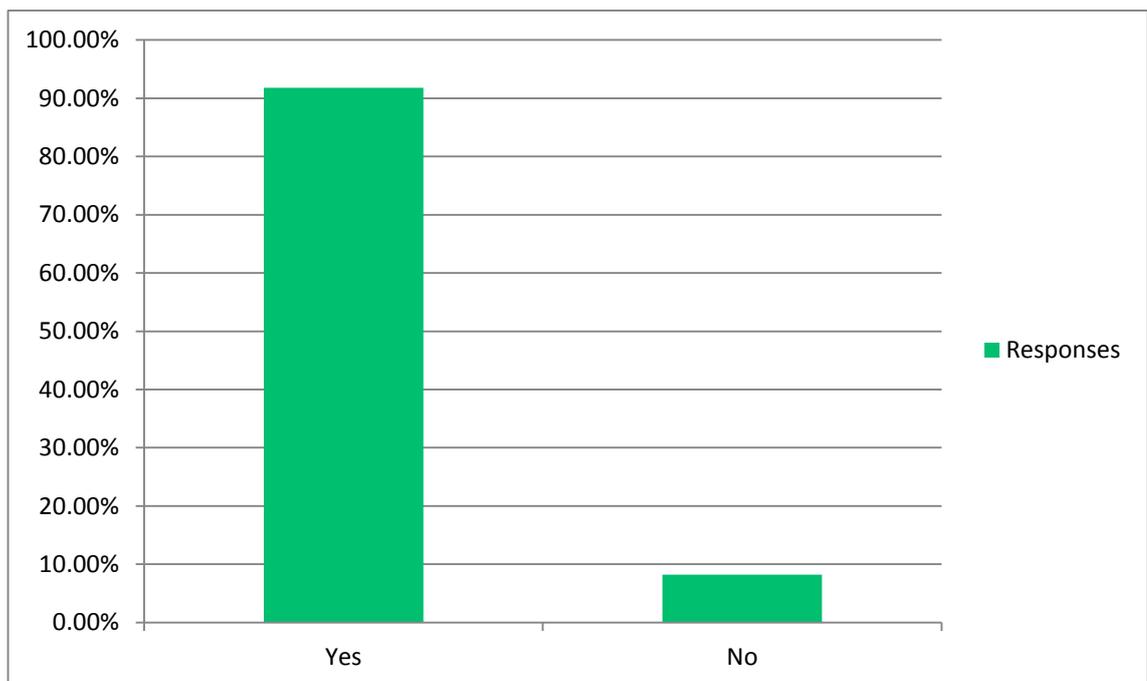
Q34. Are you aware of the IHO Publication C-13 'Manual on Hydrography'?

- Q30 Answered 333, Skipped 167, Comments 99
- 72% of 333 respondents are aware of the C-13 'Manual on Hydrography' and 20% use it. This is a poor uptake rate and promotional work by IHO is needed in this area.



Q35. Q35. With regard to C-13 'Manual on Hydrography' Do you think it will be relevant, in the future, to update this publication?

- Q35 Answered 281, Skipped 219
- 91.81% of the 281 respondents think it will be relevant to update C-13



Do you use another similar manual, but not from IHO? If yes which one?

Non IHO manuals used in order of popularity

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S-44 QUESTIONNAIRE ANALYSIS

- USACE (14)
- NOAA (11)
- Admiralty Manual (8)
- IMCA (7)
- LINZ HYSPEC (6)
- Handbook of Offshore Surveying/Skill Trade Tutorials
- Various Member State HO specifications (5)
- In house specifications (5)
- Comparison with Q12 – What Standard do you use?
- Standards based on S-44 (28)
- Clients specifications (21)
- In house specifications (10)
- USACE (6)
- S-44 (4)

In terms of Q34B, although respondents were asked to identify non-IHO manuals, both the NOAA Hydrographic Surveys Specifications and Deliverables and LINZ HYSPEC are based on S-44. Standards based on S-44 are therefore the most widely used by respondents to both Q12 & Q34B. USACE specifications are widely used but have not been updated for some time. However, their continued use indicates a lack of other definitive standards for inland waterway surveys.

Based on the survey responses, there is a case for updating C-13 as it currently stands but also for broadening its scope. C-13 focuses primarily on nautical charting and there is clearly an appetite for broadening C-13 as a definitive hydrographic manual covering all hydrographic disciplines including coastal zone management, industrial offshore surveying (UKOOA, IMCA, oil & gas industry specifications) surveys for scientific and oceanographic research and inland waterways (USACE). This will be a major undertaking. However there is a clear need and, although not a priority for the HSPT, IHO would be well placed to lead this project in cooperation with others. See also Q38 comments below.

Q36. Are you or your organisation considering using crowdsourced bathymetry data in your products in the future?

Analysis

46.4% consider using crowdsourced in the future. Although a minority of the respondents to this survey, there are sufficient numbers now considering using crowdsourced data that S-44 needs to address how to control its use and the minimum standards that would apply; particularly calibration, data quality, accuracy and liability.

Q37. Is your organisation moving its focus from point measurements to bathymetric surfaces?

Analysis

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S-44 QUESTIONNAIRE ANALYSIS

58% are considering use of bathymetric surfaces and 30.4% are considering it as possibility in the future. Standards need to be formulated for the creation of bathymetric surfaces from point measurements. However the S-100 Working Group is currently working in this area, particularly with respect to S-102, and HSPT doesn't need to duplicate this work.

Q38. Do you have any further comments on possible evolutions of the S-44 not previously addressed by this questionnaire?

Analysis

84 useful comments provided. Underlining the responses is the fundamental assumption that the core role of S-44 remains the definition of standards to be achieved for orders of survey and for the standards to be equipment/process independent. Respondents have made suggestions for enhancement rather than for wholesale changes.

S-44 enhancement

- S-44 to be expanded to cover all hydrographic disciplines (x4)
- S-44 to address data processing standards (is this not covered by S-57, S-58 & S-63 already?) (x2)
- Matrix approach required to enhance Table 1
- S-44 should only focus on safety of navigation (SoN)
- S-44 to consist of 'building blocks'/modular from which to develop survey systems and for future evolution
- S-44 to be output focused
- S-44 to provide standards for use of crowd sourced bathymetry
- S-44 to provide standards for LiDAR, X-band Radar, interferometric sonars and SDB outputs
- S-44 to include standards covering combinations of measurement techniques
- S-44 to address difference between S-44 & CATZOC
- S-44 to include a metadata standard (is this already dealt with by an existing IHO standard?)
- S-44 to cover SDB & Airborne Hyperspectral Bathymetry (AHB) i.e.
 1. Order 3 (new Order less than 2) for SDB
 2. Special, 1 & 2 for AHB restricted as to depth. Minimum depth for each order of survey to be specified or a new equation of TVU adopted for AHB

Keep it simple!

Adaptability/flexibility necessary to deal with technological developments and data requirements

Transparent confidence levels required for the calculation of bin sizes and morphologic influences

S-44 to only address MBES? (No!)

S-44 to include an error budget

S-44 to include sections for acoustic, optic and radar-band surveys

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More emphasis on feature detection is considered essential
S-44 to include a standard for RTK tide

Bathymetric surfaces (BS)/S-100/S-102

Several respondents want S-44 to address bathymetric surfaces. This is part of the work S-100WG is doing and need only be cross referenced by the HSPT.

- BS standards for ports, harbours and approaches and current/future orders
- Correlation between S-44 & S-100 i.e. data acquisition standard/specification for the layers that need physical measurement
- Transform BS uncertainty from two dimensions to one
- Superimpose S-44 compliant layers on ENC's
- Data QC for MBES & LiDAR point clouds, combined surface analysis and data resolution in the case of BS data validation

C-13 Manual on Hydrography/broader IHO policy

- Several comments were better suited for inclusion in an updated C-13 or by wider IHO policy
- Guidance required to address liability with respect to defects in hydrographic data supply chains
- Expand C-13 from safety of navigation to cover all hydrography disciplines
- C-13 to comment on IBSC Category A & B qualifications
- C-13 to include mathematical approach to measurement and calibrations
- How to detect satellite data spoofing/blockage?
- IHO to provide guidance on the impact of surveying/seismic sound sources on marine life – particularly mammals – and mitigation measures
- S-44 & C-13 to be continuously updated
- Guidance on survey campaign planning required
- Guidance to address data integrity & promote best practice