17th TSMAD MEETING
8th to 12th September 2008 (Seattle, USA)

Submitted by:	France (SHOM)
Executive Summary:	IHO recommends the population of useful values of CATZOC. However, some producing nations are reluctant to use ZOC A1 and A2 because of their definition which they consider too restrictive and even subject to legal issues.
	As a priority, it is then recommended to consider a change to the CATZOC definitions for A1 and A2 in order to facilitate their use.
	Besides, it is also proposed to consider the portrayal of M_QUAL and M_SREL information encoded in an ENC
Related Documents:	CHRIS 19-05.1B
	CHRIS 19 – Minutes
	IHO standards for Hydrographic Surveys (S44) 5th edition
Related Projects:	N/A

Version 2.0 – dated 10th June 2008

Introduction / Background

Note: This paper does not intend to review or improve the CATZOC definitions and display for the future (as it may be done by IHO Data Quality WG) but only to consider minor modification to A1 and A2 definitions in order to facilitate, in the very near future, the population of CATZOC in its current format.

IHO consistency recommendation approved by CHRIS 19 states:
"Wherever possible, meaningful and useful values of CATZOC should be used, i.e. values other than CATZOC 6 (data not assessed) for areas of bathymetry (refer S-57 Appendix B.1 – Annex A, clause 2.2.3.1)."
Producers have then been re-examining their policy for encoding CATZOC within the ENC. Due to the current S57 ZOC definitions and their inconsistency with the survey standards in S-44, some producers are very reluctant populating CATZOC with values A1 and A2.

In addition, the use of M_QUAL and M_SREL is an important feature in an ENC as it provides the mariner with important information in regards of age of the survey and bathymetric quality. This information is complementary to CATZOC which currently does not include information about the age of the source data. However, even when the data is encoded, this information is not easily available or displayed on ECDIS systems.

Analysis/Discussion

(Note: Annex A and B contain useful extracts from S57 and S44 standards.)

In order to formulate internal policy regarding the use of CATZOC, an informal survey between some member states has been sent in order to determine if there were common practices with regard to the population of CATZOC.
The questions highlighted a common concern about the use of ZOC A1 and A2.

We also found that member states shared the same concern in regards to the portrayal of the age of surveys within an ENC.

1. ZOC "seafloor coverage" definitions in S-57

a/ There is common concern about the use of ZOC A1 and A2. Indeed, ZOC A1 and A2 are characterized by seafloor coverage in which "<u>All significant</u> seafloor features (are) detected and depths measured." The footnote to this description defines significant seafloor features as "those rising above depicted depths by more than 10% of the depth in depths ranging from 0 to 10 meters, one meter between depths of 10 and 30 meters and 10% of the depth minus 2 meters in depths greater than 30 meters".

It appeared that the inclusion of the term "All" in the above seafloor coverage definition is not compatible with the ability of commonly used survey equipments and methods. Producers are then very reluctant, for legal reasons, populating CATZOC with values A1 and A2 because it is nearly impossible to achieve. Indeed S-44 edition 5 states :
- in Glossary : "Full sea floor search: A systematic method of exploring the sea floor undertaken to <u>detect most of the features</u> specified in Table 1; utilising adequate detection systems, procedures and trained personnel. In practice, <u>it is impossible to achieve 100% ensonification / 100% bathymetric coverage (the use of such terms should be discouraged)</u>."
- in §3.5 Feature detection : "It should be noted that even when surveying with a suitable system <u>100% detection of features can never be guaranteed</u>."

As a consequence, the international use of A1 and A2 classifications for CATZOC may become extremely limited, even in areas where survey standards meet A1 and A2 position and depth accuracy criteria (first two columns).

b/ Besides, inconsistencies between orders of S44 publication (special and 1a) and ZOC in S57 (A1 and A2) makes it difficult to map the survey information to the ENC in the production process. It is not intended to align exactly S57 ZOC and S44 orders, because it may not be necessary, but the <u>important difference in the definition of "significant features"</u> has to be addressed.
It is indeed considered that the A1 and A2 ZOC criteria for feature detection for depths ranging from 0 to 10 meters ("those rising above depicted depths by more than 10% of the depth") is too restrictive compared to the real survey needs. For example, when the surrounding depth of a channel is 5 meters, this would lead to detection of 50 centimetres features (which is twice the current criteria of special order)?

Another issue is that ZOC criteria are stricter than S44 Order 1a criteria. That means that only surveys respecting special order may be qualified with ZOC A1.

The table and the figure below show the current differences in feature detection between S44 and S57:

S44 orders and "feature detection" criteria		S57 ZOC and "significant features" criteria depending of the depth	
special	cubic features > 1 metre	A1	from 0 to 10 metres depths => features >10% depth from 10 to 30 metres depths
1a	- Cubic features > 2 metres, in depths up to 40 metres; - Cubic features > 10% of depth beyond 40 metres	A2	=> features > 1 metre depths beyond 30 metres => features >(10% depth) - 2 metres

Fig. 1 : Current S44 and S57 feature detection criteria
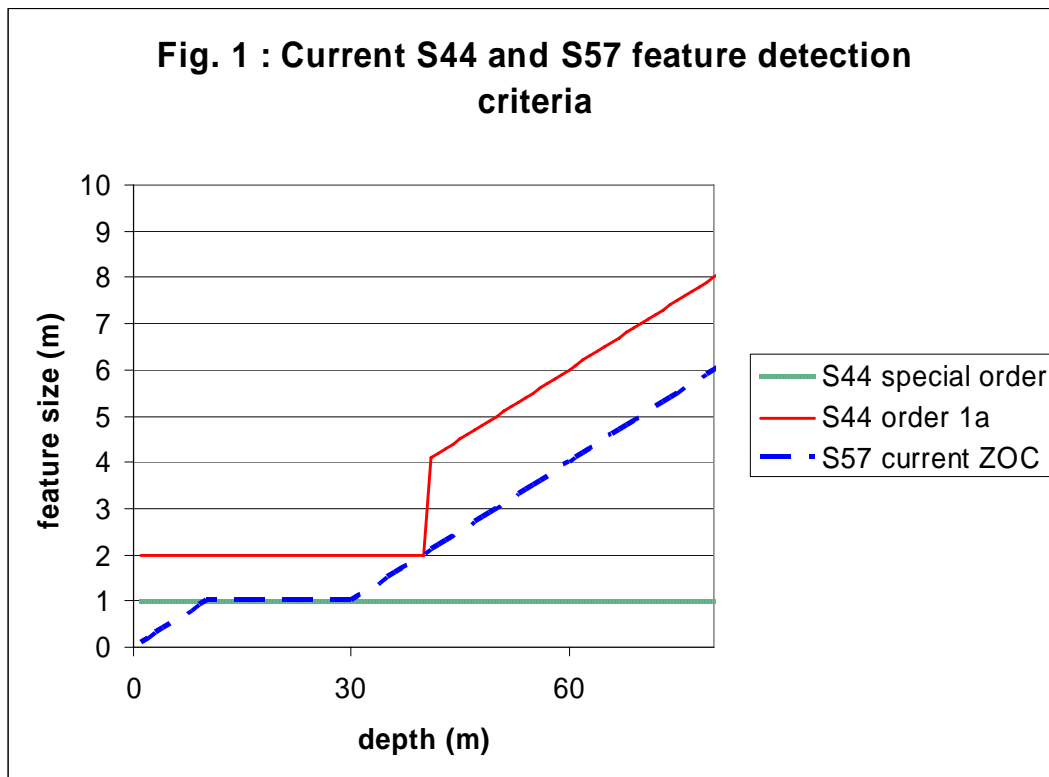
2. Age of surveys

We also mentioned that member states shared the same concern with respect to the portrayal of M_QUAL or M-SREL within an ENC.

Currently there is no display of this information unless the mariner uses the pick report.

A methodology for displaying the age of the survey should be examined by CSMWG in order to easily inform the mariners both the quality and age of the survey at first glance. Even though the mariner may examine the age of the survey via pick report, it has been noted that the lack of uniformity of pick reports may make this information unclear to the mariner.

Recommendations

France proposes the following recommendations to TSMAD and CSMWG:

Recommendation 1:

Modify and clarify the ZOC A1 and A2 "seafloor coverage" definitions in S-57, by changing the wording from "All significant seafloor features detected and depths measured." to "Most significant seafloor features detected and depths measured."

This recommendation may be discussed with or forwarded to the Data Quality Working Group which has been mandated for a review of CATZOC during CHRIS 19.

Note: for all categories of ZOC, S57 correction n°1.Co.34 has already changed the wording in "seafloor coverage" definitions from "Full seafloor ensonification or coverage" to "Full area search", which is considered close enough to the S44 wording recommendation ("Full seafloor search").

Recommendation 2:

Improve alignment between S44 and S57 ZOC criteria for "significant features" detection.
a/ for ZOC A1 :
- for depths from 0 to 30 meters : use special order "feature detection" criteria : Cubic features > 1 m
- for depths beyond 30 metres : slightly modify the CATZOC criterion to read : Cubic features > 10% of depth – 2 meters

b/ for ZOC A2 : use order 1a "feature detection" criteria : cubic features > 2 metres, in depths up to 40 metres; 10% of depth beyond 40 metres

Then, special order surveys will obviously meet ZOC A1 requirements, and order 1a will obviously meet A2 requirements (see figure 2).
However, it will not impede surveyors to look for more accurate data, where needed.

This recommendation may also be discussed with or forwarded to the Data Quality Working Group.

Recommendation 3:

Investigate a change in the portrayal of M_QUAL and M_SREL to include the SUREND symbology. Afterwards, this may also need an encoding bulletin recommending member states to populate associated SUREND (and, optionally, SURSTA).

Note: this is an interim solution, because generally, there is also a need to review the way we convey information about data quality, but this will have to be done within S101 and DQWG.

Justificat**ion and Impacts**

Recommendation 1 outlined above will enable member states to better populate CATZOC with the true value, rather than degrading the information in order to avoid the use of the term "all".

Recommendation 2 will make CATZOC detection criteria more realistic and feasible for depths under 10 metres. It will also ensure more consistency between S44 and S57 data quality definitions and facilitate the assessment of CATZOC for producers (see figure 2).
It is also anticipated that these are the only modifications needed for S44 and S57 in order to harmonize the two standards.

Issuing those clarifications to S-57 is not a significant change and it will not oblige producers to revise the existing data (because the data classified according to the former definitions will also be consistent with the new classification – see figure 2) but it will allow member states to better formulate national policies in regards to the population of A1 and A2 survey data in M_QUAL.

Fig. 2 : Proposed new S57 feature detection criteria
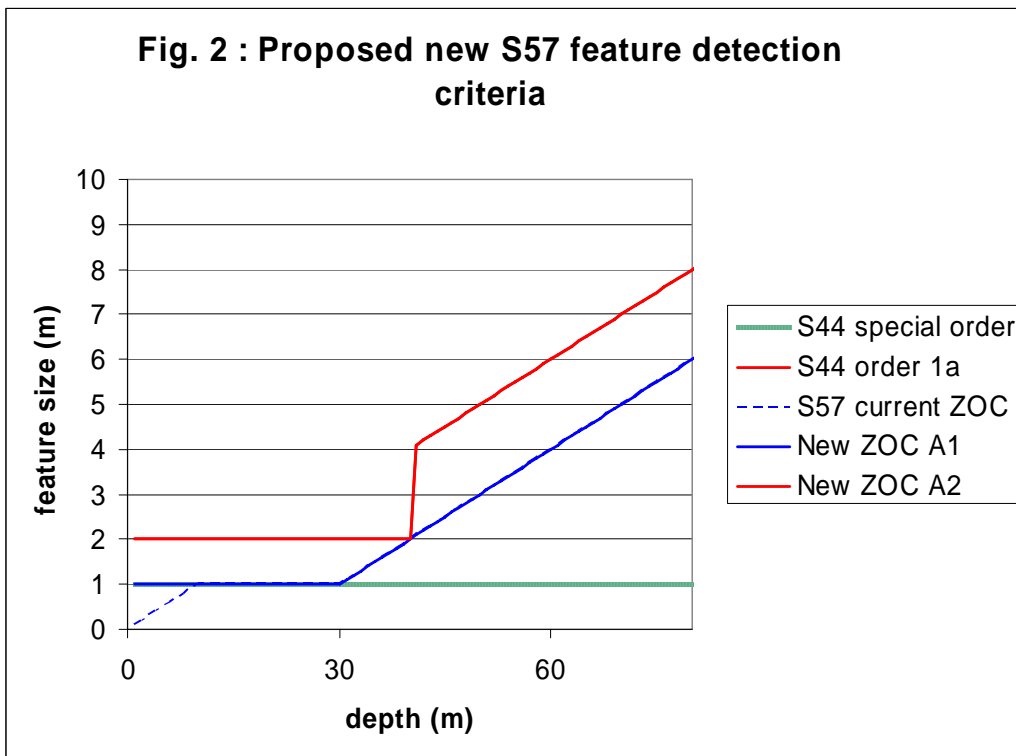
Recommendation 3 will enable the mariner to have easier access to the information conveyed by M_QUAL and M_SREL, and particularly to the age of surveys.

Action Required of TSMAD

A: TSMAD is invited to evaluate the first 2 recommendations for the clarification of S-57 CATZOC A1 and A2.

B: CSMWG is invited to consider the 3rd recommendation, changing portrayal of M_QUAL and M_SREL (SUREND and SURSTA)

ANNEX A: Category of zone of confidence in data as defined in S57 – Appendice A – chapter 2 - Attributes) – As modified by clarification 1.Cl.42 and correction 1.Co.34.

ZOC Table:

1	2	3		4	5
ZOC [1]	Position Accuracy [2]	Depth Accuracy [3]		Seafloor Coverage	Typical Survey Characteristics [5]
A1	± 5 m	=0.50 + 1%d		Full area search undertaken. All significant seafloor features detected [4] and depths measured.	Controlled, systematic survey [6] high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10 30 100 1000	± 0.6 ± 0.8 ± 1.5 ± 10.5		
A2	± 20 m	= 1.00 + 2%d		Full area search undertaken. All significant seafloor features detected [4] and depths measured.	Controlled, systematic survey [6] achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder[7] and a sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10 30 100 1000	± 1.2 ± 1.6 ± 3.0 ± 21.0		
B	± 50 m	= 1.00 + 2%d		Full area search not achieved; uncharted features, hazardous to surface navigation are not expected but may exist.	Controlled, systematic survey achieving similar depth but lesser position accuracies than ZOCA2, using a modern survey echosounder[5], but no sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10 30 100 1000	± 1.2 ± 1.6 ± 3.0 ± 21.0		
C	± 500 m	= 2.00 + 5%d		Full area search not achieved, depth anomalies may be expected.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.
		Depth (m)	Accuracy (m)		
		10 30 100 1000	± 2.5 ± 3.5 ± 7.0 ± 52.0		
D	worse than ZOC C	Worse Than ZOC C		Full area search not achieved, large depth anomalies may be expected.	Poor quality data or data that cannot be quality assessed due to lack of information.
U	Unassessed - The quality of the bathymetric data has yet to be assessed				

(1.Co.34 – replace above table, see also 1.Cl.42) 1.Cl.42 The final report of the IHO Data Quality Working Group was published in November 1997. This has resulted in some minor changes to the wording (but not the values) in the ZOC table for the attribute Category of zone of confidence. (See also 1.Co.34).

Note: The CATZOC attribute definitions are currently the subject of review and the results of this review will be promulgated as soon as possible in the S-57 Corrections Document.

Remarks:

To decide on a ZOC Category, all conditions outlined in columns 2 to 4 of the table must be met.

~~Footnote numbers~~ Explanatory notes quoted in the table ~~have the following meanings~~:

1   The allocation of a ZOC indicates that particular data meets minimum criteria for position and depth accuracy and seafloor coverage defined in this Table. ==ZOC categories reflect a charting standard and not just a hydrographic survey standard. Depth and position accuracies specified for each ZOC category refer to the errors of the final depicted soundings and include not only survey errors but also other errors introduced in the chart production process. (1.Co.34)== Data may be further qualified by Object Class "Quality of Data" (M_QUAL) sub-attributes as follows:

  a)   Positional Accuracy (POSACC) and Sounding Accuracy (SOUACC) may be used to indicate that a higher position or depth accuracy has been achieved than defined in this Table (e.g. a survey where full seafloor coverage was not achieved could not be classified higher that ZOC B; however, if the position accuracy was, for instance, ± 15 metres, the sub-attribute POSACC could be used to indicate this).

  b)   Swept areas where the clearance depth is accurately known but the actual seabed depth is not accurately known may be accorded a "higher" ZOC (i.e. A1 or A2) providing positional and depth accuracies of the swept depth meets the criteria in this Table. In this instance, Depth Range Value 1 (DRVAL1) may be used to specify the swept depth. The position accuracy criteria apply to the boundaries of swept areas.

  c)   SURSTA, SUREND and TECSOU may be used to indicate the start and end dates of the survey and the technique of sounding measurement.

2   Position Accuracy of depicted soundings at 95% CI (2.45 sigma) with respect to the given datum. It is the cumulative error and includes survey, transformation and digitizing errors etc. Position accuracy need not be rigorously computed for ZOCs B, C and D but may be estimated based on type of equipment, calibration regime, historical accuracy etc.

3   Depth accuracy of depicted soundings = a + (b d)/100 at 95% CI (2.00 sigma), where d = depth in metres at the critical depth. Depth accuracy need not be rigorously computed for ZOCs B, C and D but may be estimated based on type of equipment, calibration regime, historical accuracy etc.

4   Significant seafloor features are defined as those rising above depicted depths by more than:

Depth	Significant Feature
a. <10 metres	>0.1 depth,
b. 10 to 30 metres	>1.0 metre,
c. >30 metres	>(0.1 depth) minus 2.0 metres

==Note: Mariners should have due regard to the limitations of sounding equipment when assessing margins of safety to be applied. (1.Co.34)==

5   ==Typical Survey Characteristics - These descriptions should be seen as indicative examples only. (1.Co.34)==

6   Controlled, systematic ~~(high accuracy)~~ survey (ZOC A1, A2 and B) - a survey comprising planned survey lines, on a geodetic datum that can be transformed to WGS 84.

~~Position fixing (ZOC A1) must be strong with at least three high quality Lines of Position (LOP) or Differential GPS.~~

7   Modern survey echosounder - a high precision surveying depth measuring equipment, generally including all survey echosounders designed post 1970. ==(See also 1.Cl.42).==

IHO STANDARDS FOR HYDROGRAPHIC SURVEYS (S-44)
5th Edition February 2008

TABLE 1
Minimum Standards for Hydrographic Surveys
(To be read in conjunction with the full text set out in this document.)

Reference	Order	Special	1a	1b	2
Chapter 1	Description of areas.	Areas where under-keel clearance is critical	Areas shallower than 100 metres where under-keel clearance is less critical but *features* of concern to surface shipping may exist.	Areas shallower than 100 metres where under-keel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas generally deeper than 100 metres where a general description of the sea floor is considered adequate.
Chapter 2	Maximum allowable THU 95% *Confidence level*	2 metres	5 metres + 5% of depth	5 metres + 5% of depth	20 metres + 10% of depth
Para 3.2 and note 1	Maximum allowable TVU 95% *Confidence level*	a = 0.25 metre b = 0.0075	a = 0.5 metre b = 0.013	a = 0.5 metre b = 0.013	a = 1.0 metre b = 0.023
Glossary and note 2	*Full Sea floor Search*	Required	Required	Not required	Not required
Para 2.1 Para 3.4 Para 3.5 and note 3	*Feature Detection*	Cubic *features* > 1 metre	Cubic *features* > 2 metres, in depths up to 40 metres; 10% of depth beyond 40 metres	Not Applicable	Not Applicable
Para 3.6 and note 4	Recommended maximum Line Spacing	Not defined as *full sea floor search* is required	Not defined as *full sea floor search* is required	3 x average depth or 25 metres, whichever is greater For bathymetric lidar a spot spacing of 5 x 5 metres	4 x average depth
Chapter 2 and note 5	Positioning of fixed aids to navigation and topography significant to navigation. (95% *Confidence level*)	2 metres	2 metres	2 metres	5 metres
Chapter 2 and note 5	Positioning of the Coastline and topography less significant to navigation (95% *Confidence level*)	10 metres	20 metres	20 metres	20 metres
Chapter 2 and note 5	Mean position of floating aids to navigation (95% *Confidence level*)	10 metres	10 metres	10 metres	20 metres