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Paper for Consideration by CSPCWG

CATZOC Implementation by UKHO

Submitted by:	UK
Executive Summary:	A briefing of UKHO policy on assessing CATZOC for populating ENC
Related Documents:	S-57 Supplement No 2 (Edition 3.1.2).
Related Projects:	None

Introduction / Background

This paper provides brief details of UKHO policy for populating ENC with CATZOC attributes, for information only. It is derived from an information paper prepared for dissemination within UKHO in September 2009.

Text of paper

General

1. It is important for the ENC to include an indication of the accuracy of the source data, which is encoded within S57 as the CATZOC metadata. This paper describes how UKHO attributes CATZOC and the progress made in providing this metadata within GB ENCs worldwide.
2. In the paper chart world a Source Diagram is provided, which gives the mariner facts about the age and scale of the surveys used to compile the chart, so the navigator can make a sensible decision on the degree of reliance to place on the chart when planning the passage or using the chart for real time navigation.
3. CATZOC (a mandatory attribute within S57) is intended to provide similar quality information within the S57 ENC, so the ECDIS can display this to the mariner. Unlike the paper chart Source Diagram, CATZOCs do not merely state the facts about source data, but require an internal assessment by the authoritative national HO of the reliability and accuracy of the source data included within the ENC. Being a digital information service, the metadata has to be encoded using precise rules. These codes were developed from the IHO's Standards for Hydrographic Surveys (S-44) and provide very specific information on the reliability of surveys at the time they were executed, as assessed by the authoritative national HO.
4. The CATZOC attribute provides information which is different from the paper chart Source Diagram, hence it is not possible to use source diagrams directly to populate the CATZOC. Once a cell has been assessed, the CATZOC value is routinely kept up to date for any new surveys added by new edition to the source chart (for some years now in UKHO the necessary CATZOC values and areas have been captured as part of the appraisal process for each survey).

Progress

5. For the UKHO validated ENC Cells a programme of CATZOC allocation has been devised to produce initial CATZOC allocation for all GB cells world wide by November 2011. All usage band 3 (Coastal), 4 (Approach), 5 (Harbour) and 6 (Berthing) cells covering UK Home Waters and The Gulf have been completed

6. The UKHO CATZOC team are now populating the usage band 2 (General) then 1 (Overview) cells covering the continental shelf around the British Isles and will then populate the usage band 2 and 1 cells covering the rest of the world in geographical blocks driven by the user requirement. The final batch of cells will be the usage band 3, 4, 5 and 6 cells covering other primary charting areas such as The Falkland Islands and areas in the Caribbean and elsewhere which have no Hydrographic Office producing ENC's.

Methodology

7. For new government surveys, it is relatively straightforward to assign a CATZOC, and all the other M_QUAL and M_SREL attributes, based on the information provided in the report of survey. Most of these would be expected to be CATZOC A1 (used by UKHO for fully acceptable swathe surveys) or, occasionally A2 (used by UKHO for fully acceptable 1980 or later single beam echo-sounder with 100% side scan sonar coverage in depths greater than 10 metres). In the ECDIS S52 format A1 areas are displayed with 6 stars, A2 areas with 5 stars. Any areas of modern multi-beam with gaps between the coverage provided by each swath of data and LIDAR areas are normally given CATZOC B. The revised definitions of CATZOCs A1, A2, B, C, D and U are given in the table to accompany this document (S-57 Supplement No 2).
8. In order to provide an accurate CATZOC (which may attract significant product liability) it is essential to study the hydrographic survey data. For UK port authority and other authority surveys, where the source surveys are not appraised by UKHO, the port/other authority should provide a CATZOC assessment (if they are willing to accept the attached liability), otherwise in UK waters a maximum CATZOC assessment of B is assigned. This is also currently used for dredged and maintained depth areas (if UKHO has not officially appraised the post dredge survey) and any areas where 100% sea floor coverage with swathe survey or side scan sonar has not been achieved.
9. Old source data (which forms the source for the majority of the GB world series of paper charts that are the source for the worldwide GB header code ENC) presents a much greater problem. In order to allocate a CATZOC to every item of source data used in the compilation of a particular chart with assurance, it is necessary to examine the original survey and report of survey (if any).

Other Nations

10. Some nations (such as Australia and The Netherlands) adopt similar guidelines to the above, however others (such as Germany) assign all ENC's within a cell the same CATZOC (Germany seems to assign CATZOC B to all ENC) while others (such as USA and France) still assign CATZOC 'U' to all their ENC's. A minor change to the wording of the S57 definitions (of particular relevance to CATZOC A1 and A2) removing the statement '*all significant features*' that has recently taken effect, which will hopefully encourage such nations to start providing meaningful CATZOC assessments akin to UKHO practice. There are also early discussions currently taking place that may, with time, lead to the development of a more meaningful display of CATZOC than the present 'Star' rating. This may, in time, perhaps also allow the automatic display of alarms tailored to the particular vessel characteristics that are envisaged by some to be a key benefit of ECDIS; however this seems some years away as yet.

ZOC Table

Note: Changes from S-57 Edition 3.1 are shown in red.

1	2	3		4	5
ZOC ¹	Position Accuracy ²	Depth Accuracy ³		Seafloor Coverage	Typical Survey Characteristics ⁵
A1	$\pm 5 \text{ m} + 5\% \text{ depth}$	$= 0.50 + 1\%d$		Full area search undertaken. 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	± 0.6		
		30	± 0.8		
		100	± 1.5		
		1000	± 10.5		
A2	$\pm 20 \text{ m}$	$= 1.00 + 2\%d$		Full area search undertaken. 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	± 1.2		
		30	± 1.6		
		100	± 3.0		
		1000	± 21.0		
B	$\pm 50 \text{ m}$	$= 1.00 + 2\%d$		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 ZOC A2, using a modern survey echosounder ⁵ , but no sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10	± 1.2		
		30	± 1.6		
		100	± 3.0		
		1000	± 21.0		
C	$\pm 500 \text{ m}$	$= 2.00 + 5\%d$		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	± 2.5		
		30	± 3.5		
		100	± 7.0		
		1000	± 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				

Remarks:

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

Explanatory notes quoted in the table:

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.** 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 than 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 = $a + (b \cdot d) / 100$ 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.	<40 m	2 m
b.	>40 m	10% depth

A full seafloor search indicates that a systematic survey was conducted using detection systems, depth measurement systems, procedures, and trained personnel designed to detect and measure depths on significant seafloor features. Significant features are included on the chart as scale allows. It is impossible to guarantee that no significant feature could remain undetected, and significant features may have become present in the area since the time of the survey.

⁵ **Typical Survey Characteristics - These descriptions should be seen as indicative examples only.**

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

⁷ **Modern survey echosounder - a high precision single beam depth measuring equipment, generally including all survey echosounders designed post 1970." (See also [1.CI.42](#)).**