

# Conveying Data Quality in ENC's to the Mariner – Work Past, Present and Future of the IHO Data Quality Working Group

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## Outline

- Introduction to the IHO Data Quality Working Group
- The 'Problem'
- Existing methods of representing data quality
- Evidence to suggest change is needed
- Data Quality Working Group studies
- Visualisation- Potential solutions
- Charted depth uncertainty
- Conclusions and future work



## Introduction to the IHO Data Quality Working Group (DQWG)

- Established 2007
- Working group formulated to define data quality policies
- Advisory role
- Forum for debate
- Made up of 15 member states, 1 regional sub committee and invited experts from industry



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## Summary of 'the Problem'

When navigating a ship the sea floor over which you navigate is invisible. The only indication of its characteristics comes from the navigational chart.

Often charts are compiled from partial knowledge and hence the real sea floor differs from that depicted in the chart.

The problem is:

'How do we indicate this uncertainty to the mariner in a way that is meaningful and helps his decision making?'



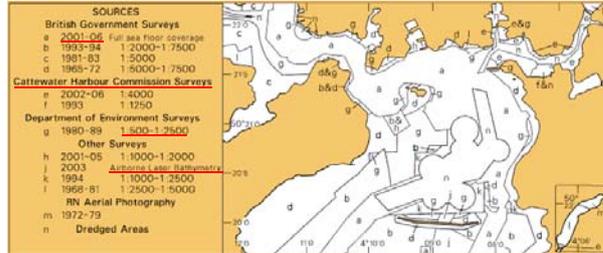
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## Existing Methods of Representing Data Quality

### Paper Charts – Source Diagram (Qualitative)

#### Quality indicators

- Survey Date
- Survey Authority
- Scale
- Acquisition method



Source data diagram for BA chart 1697 Plymouth Sound

What is the difference between a Survey Date Scale 1:5000 and a Survey Authority British Government survey?



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## Existing Methods of Representing Data Quality

### Electronic Navigational Charts (ENCs) – CATZOC (Quantitative)

ZOC	Position Accuracy	Depth Accuracy	Seafloor Coverage
A1	± 5m + 5% depth	0.5m + 1% depth	Full area search undertaken. Significant seafloor features detected and measured.
A2	± 20m	± 1m + 2% depth	Full area search undertaken. Significant seafloor features detected and measured.
B	± 50m	± 1m + 2% depth	Full area search not achieved; uncharted features, hazardous to surface navigation are not expected but may exist.
C	± 500m	2m +5% of depth	Full area search not achieved, depth anomalies may be expected.
D	Worse than ZOC C	Worse than ZOC C	Full area search not achieved, large depth anomalies may be expected.
U	Unassessed – The quality of the bathymetric data has yet to be assessed.		



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## Existing Methods of Representing Data Quality

### Electronic Navigational Charts (ENCs) – CATZOC (Quantitative)

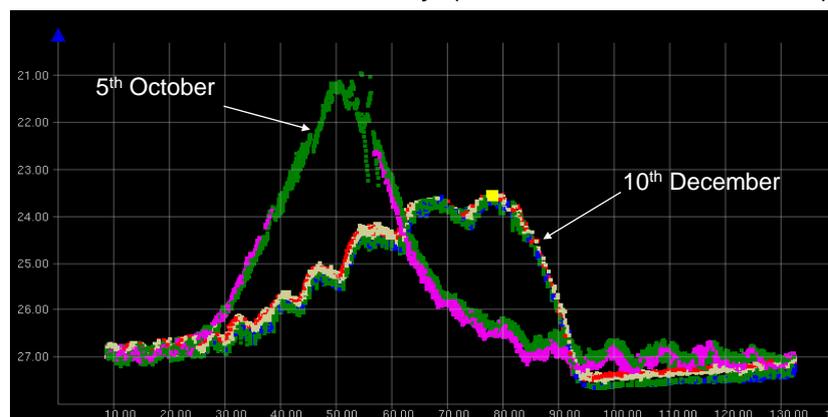
Quantitative but no indication of date of survey. Does the CATZOC refer to when the survey was done or now? In areas of mobile seafloor a survey can be out of date before it is finished ...



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## The relevance of survey date

Survey of sand wave area on England's east coast. Survey took from late September to mid December due to weather. Data was not included on chart until January. (3m vertical / 30m horizontal)



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## Evidence to Suggest that Current Methods are Ineffective

### Grounding of the Octopus – Marine Accident Investigation Board recommendation to the IHO

*“Relevant IHO/IMO working groups should investigate ways of ensuring that ECDIS displays provide a clear warning or indication to the mariner whenever the survey data used to produce the electronic chart in use is of poor quality.”*



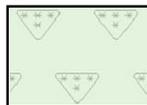
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## Evidence to Suggest that Current Methods are Ineffective

### 2009 NOAA Questionnaire to Mariners

**Question:** If Hydrographic survey quality areas could be portrayed with the Starred Symbol (as shown in A) or the Year of the survey and the Zone of Confidence level (CATZOC) (as shown in B). Which of these would you prefer?

(A)



(B)



**Answer:** 80% of the respondents preferred to see the year of the survey and the zone of confidence displayed, rather than the current portrayal.



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## DQWG Study into the Use of Existing Quality Attributes in S-57

In summer 2010 DQWG sent a questionnaire to all ENC producing IHO member states asking them to indicate what S-57 data quality attributes they currently encode in their ENCs.

The main conclusions from the study were:

- *There is a huge variety of different combinations of data quality attributes that are encoded in ENCs*
- *Although CATZOC is a mandatory attribute, there are a range of differing approaches member states take to populating it*
- *Some member states feel that CATZOC is not comprehensive enough as a primary indicator of data quality*



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## DQWG Study into the Use of Existing Quality Attributes in S-57

Existing S\_57  
Quality Attributes

M\_SREL Qualitative

M\_ACCY Quantitative

M\_QUAL Quantitative

Object Classes	Quality Attributes
M_SREL (Survey reliability)	SURATH (Survey authority)
	SURSTA (Survey start date)
	SUREND (Survey end date)
	TECSOU (Technique of sounding)
M_ACCY (Accuracy)	HORACC (Horizontal accuracy)
	POSACC (Positional accuracy)
	SOUACC (Sounding accuracy)
	VERACC (Vertical accuracy)
M_QUAL (Quality)	CATZOC (Category of zone of Confidence)



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## DQWG Study into the Use of Existing Quality Attributes in S-57

### Distribution of countries populating M\_SREL and M\_ACCY attributes (replies to CL 17/2010)



Countries populating M\_SREL attributes (Qualitative)



Countries populating M\_ACCY attributes (Quantitative)

- This shows that in general member states choose to populate attributes relating to supporting metadata, rather than quantified uncertainty values



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## DQWG Study into the Use of Existing Quality Attributes in S-57

### The Population of CATZOC (replies to CL59/2010)

The study showed that although population of CATZOC is mandatory, it is often populated with 'U', meaning the bathymetric data is unassessed for quality purposes. Reasons given for this include:

- Lack of resources available to assess data
- Difficulty in translating S-44 survey standards to CATZOC
- Difficulty in determining CATZOC for legacy data
- CATZOC does not represent the temporal degradation of survey data quality in areas of high seabed mobility



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## DQWG Study into the CATZOC Classification of Legacy Data

### Reason:

Previous study suggested that assessing legacy data for CATZOC classification is a difficult and costly exercise.

### Objective:

DQWG was keen to learn how different countries approach this task, and learn what criteria are used to designate each CATZOC value. This information could potentially aid the DQWG in defining a standard for classifying legacy data for CATZOC.

### Scope:

All IHO member states were contacted with 25 replying.



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## DQWG Study into the CATZOC Classification of Legacy Data

### Results

The following observations were made:

- Many countries do not formally assess their legacy data. Either making a generic judgement or giving a standard classification of 'U'
- Of the countries that do assess their legacy data for CATZOC, many use S-44 as a guide
- A number of countries feel that their legacy data can only obtain a maximum of CATZOC 'B' because CATZOC does not account for the temporal degradation of bathymetric data
- Some countries are in the process of defining their own standards for assessing legacy data



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## Visualisation- Potential Solutions

### Potential Solutions

Whilst the work of the DQWG is very much ongoing two solutions have been proposed and are being investigated:

MSNFSN – Minimum Standard Necessary for Safe Navigation

And

FITUSE – Fitness for Use



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## Visualisation- Potential Solutions

### MSNFSN – Minimum Standard Needed For Safe Navigation

- Solution that asks the question, “is the underlying data of the minimum standard necessary to allow safe navigation?”
- Attribute populated with either Yes or No
- Takes inputs from existing quality attributes
- It would be up to the responsible Hydrographic Office to make a judgement on whether this is the case



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## Visualisation- Potential Solutions

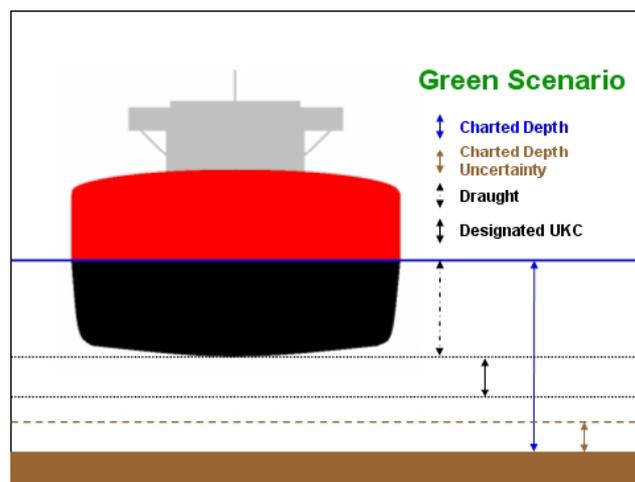
### FITUSE – Fitness for Use

- Solution that asks the question “is the charted data fit for the use that I am intending to make of it?”
- Takes inputs from existing quality attributes, vessel specific parameters **but also needs an estimate of charted depth uncertainty between soundings as well as at soundings**
- This could drive a ‘traffic light’ display on the vessel’s ECDIS, as a colour wash delimiting the specific areas of differing data quality but could also create alarms
- This solution would provide a vessel specific representation of relevant issues relating to the quality of charted bathymetric data



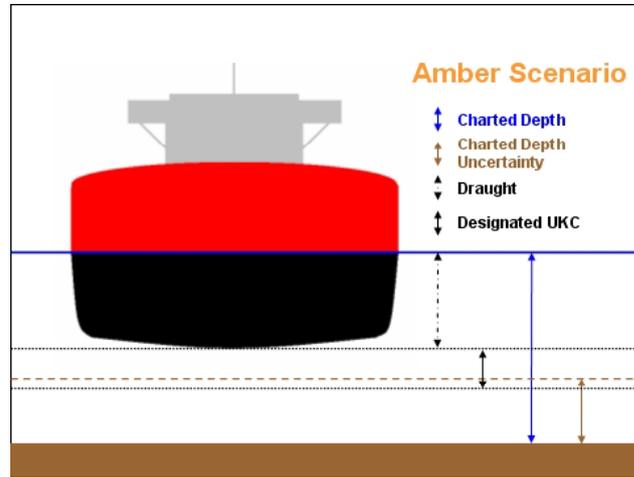
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## Visualisation- Potential Solutions



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## Visualisation- Potential Solutions

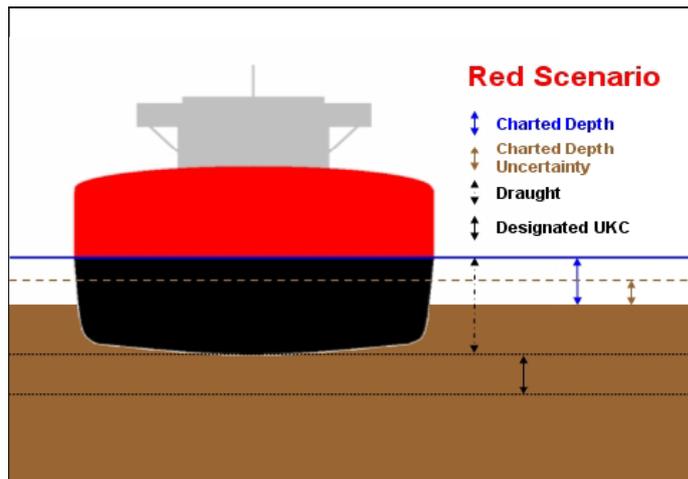


FITUSE – Amber Scenario



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## Visualisation- Potential Solutions



FITUSE – Red Scenario

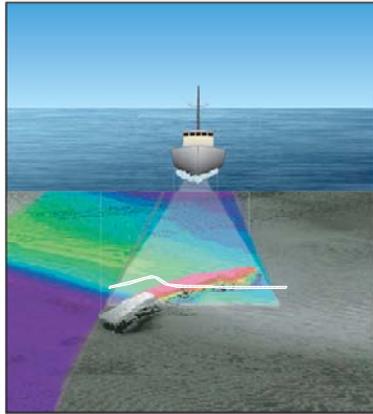


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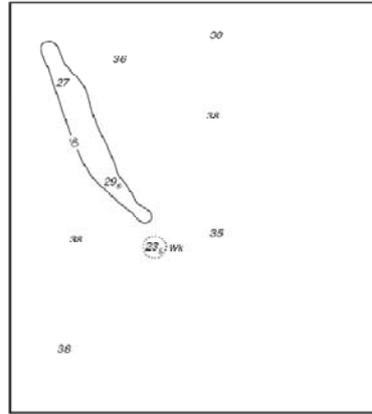


## Charted Depth Uncertainty

Multi-beam or Swathe echo sounders



Multibeam



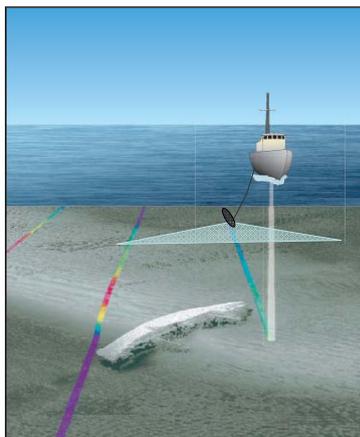
Multibeam sounding selection



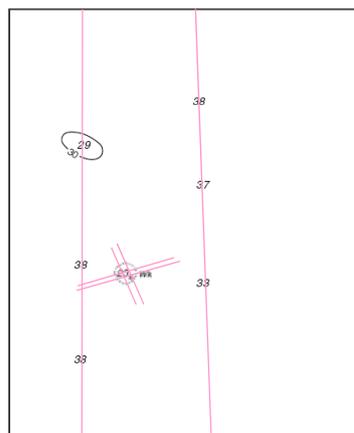
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## Charted Depth Uncertainty

Single Beam Echo Sounder and Side Scan Sonar



Single Beam & Side Scan Sonar



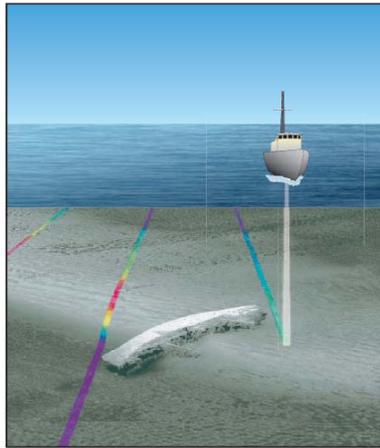
Wreck seen in SSS investigated with Single Beam



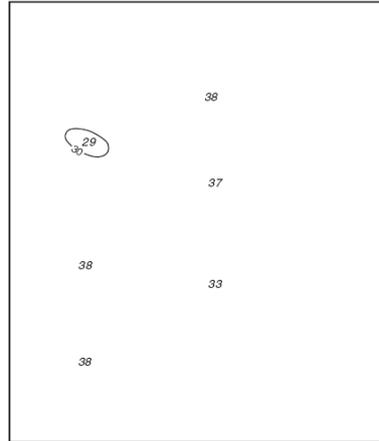
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## Charted Depth Uncertainty

### Single Beam Echo Sounder



Single Beam



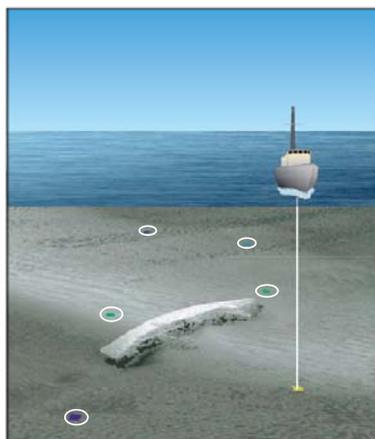
Single Beam sounding selection



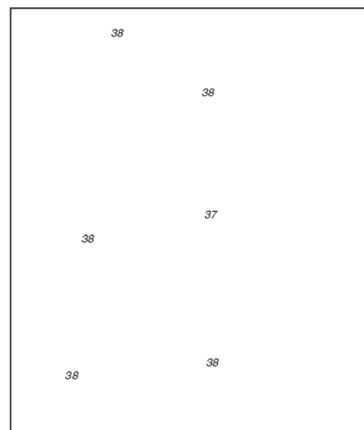
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## Charted Depth Uncertainty

### Lead Line



Lead Line



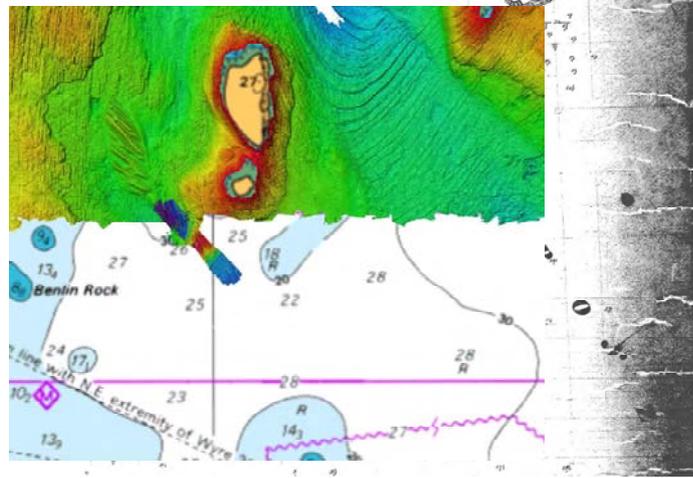
Lead Line sounding selection



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## Charted Depth Uncertainty

1843 lead line survey



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## Charted Depth Uncertainty

**Uncertainty for multibeam is quantifiable**

**Uncertainty for single beam and side scan is quantifiable (sort of!)**

**Is uncertainty for single beam only, lead line or areas of highly mobile sea floor quantifiable?**

**If not, is it any help to the mariner?**



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## Conclusions and Future Work

### Conclusions

- There is a need to standardise the approach that official ENC producing countries take in representing the quality of their source data
- CATZOC does not represent the temporal degradation of survey data
- It would be hugely advantageous to make use of the information already encoded in ENCs in order to minimise the impact on ENC producers' resources



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## Conclusions and Future Work

### Future Work

- Canvas mariners about their perception of the importance of representing data quality in nautical products and on ways that would be useful to them
- Work towards recommending an international standard for the population of CATZOC for legacy data
- Identify the quality attributes necessary to define a meaningful uncertainty value for charted sea floor (for both modern and legacy data) including a study into how this will vary with time for the type of sea bed



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## Conclusions and Future Work

### Future Work (2)

- If needed, define any new data quality attributes that are needed for encoding in S-101
- Develop data quality visualization prototypes for ECDIS and test with mariners



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## Conclusions and Future Work

- If you have any ideas or opinions on what are relevant data quality attributes or on ways to portray them to the mariner please come and talk to me.
- **Also, the DQWG is meeting this Friday at BSH (here in Rostock). All are invited to attend and add your thoughts to these discussions!! Please see me for details.**



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