DQWG 4th Meeting
Helsinki, 14 - 17 June, 2011

Compilation of email discussions

There has been at least following e-mail topics at our GoogleGroup, mainly since the DQWG3 meeting in Rostock:

Oct14 2010	Shep Smith	Risk Management on TJ-One use case
Dec21 2010	Leendert Dorst	Paper Visualization of Data Quality
Mar3 2011	Rob Hare	CATZOC for areas with mobile seafloors
Mar14 2011	Chris Howlett	CATZOC definitions
Mar18 2011	Sam Harper	Feedback from IIC Workshop
Apr01 2011	Leendert Dorst	Various snippets related to data quality and sea floor mobility

There have been some ideas presented also in e-mails which mainly contained questionnaire-related information. Those are added at the end of this document.

Risk Management on TJ-One use case

All,

I thought I would share with you all the standard rules we use on the NOAA Ship Thomas Jefferson for making decisions about where to take the ship.

We are a survey ship, working in coastal areas along the US East and Gulf Coasts. The geology ranges from glacial scoured bedrock to glacial moraines with numerous erratics, to shifting sands to coral reefs.

Our operations are sometimes A-B transits, but more often involve line surveying, bottom samples and casts, maneuvering for boat deployments and pickups, and anchoring in the coastal areas where we work. We draw 15 feet (~5m). My instructions to my bridge teams are to stay outside the 30ft (~10m) curve, and 1/2 mile from any sounding, feature, or contour of 18 ft (~6m) or less. If we need to go closer, we do a more thorough risk analysis (in a planning phase) that might involve looking at the age of the surveys (usually 50+ years old if we are re-surveying), considering alternative routes, tides, and putting ourselves on a higher alert with an enhanced bridge team. In some cases, we will survey an area with our own launches prior to bringing the ship in close (to anchor, for example). Few ships have this luxury.

I looked at using the chart source diagrams as part of my standing orders, but the ones on NOAA charts are not very useful, because they lack precision of area covered, definition of coverage, and age. The source diagram is so small that it is not easy to translate the areas from the diagram to the chart to know, for example, whether the depths on a particular shoal are from the more recent full multibeam survey or the 70 year old leadline survey. The definitions of coverage are too vague ("Full bottom coverage" or "Partial bottom coverage", which do not correspond to a clear notion of feature detection). The ages are given in ranges of years associated with survey technology, but are not helpful to judge age of survey in a particularly changeable area.

I would submit that most areas, and most decisions are much like ours. That is, the decision is less likely to be go/no go on a particular route, and more likely to be "how near can I get" (horizontally) where there is a deeper area available for passage, but a shoaler area is more convenient, or shorter. The areas where there is critical underkeel clearance are typically discrete, limited areas that are well known. In many cases, they are maintained channels.

In the world we working toward, my standing orders would be able to take advantage of data quality information to better refine our operating areas.

For example, I could say the ship cannot go in these areas without a full risk analysis:
-Anything charted shoaler than 18 ft, regardless of age, bottom type, or data quality
-Anything charted shoaler than 24 ft or within 0.1 NM of 18 unless the area is ZOC A1 from the past 5 years and no hurricanes have affected the area in intervening years.
-Anything charted shoaler than 30 ft or within .25 NM of 18 unless the area is ZOC A or B in the past 20 years.
-Anything charted shoaler than 60 ft or within .5 NM of 18 unless the area is ZOC C or bettter in the past 100 years

Ideally, my ECDIS or ECS could simply take these rules supplied by the user (except for the hurricane case) and shade off sections of the chart based on my draft, charted depth areas, and the ZOCs from the ENC.

Best of luck to you at your upcoming meeting.

Cheers,

Shep

Paper Visualization of Data Quality

Dear DQWG members,

recently, I had some correspondence on data quality with prof. Ormeling, former head of the Cartography section at Utrecht University. He recommended an article on this topic by Van der Wel et al, part of the Publication Visualization in Modern Cartography, edited by MacEachren and Fraser Taylor, Vol. 2 in the Series on Modern Cartography, published by Pergamon in 1994.

Although somewhat outdated and containing ideas that are not always relevant for nautical charting, the paper still functions well as a source of inspiration on the visualisation aspects of our Terms of Reference. It is my opinion that we should first agree on the data quality concepts that we want to use (a.iii in the procedure of the ToR & task C of the Work Program), before we discuss the visualisation in detail (a.iv in the procedure of the ToR & task D of the Work Program). In spite of that, I have made the paper available already on my private webspace, at http://members.ziggo.nl/leendertdorst/Vanderweletal1994.pdf (20MB!). This gives those of you that are interested an early opportunity to study and discuss the paper.

I hope the paper helps you in organizing your thoughts on the visualisation on data quality.

All best & best wishes for the holiday season,

Leendert

CATZOC for areas with mobile seafloors

All,

As a bit of light relief from reviewing the DQWG Questionnaire I would be interested in your thoughts on the following:

I have been looking at the use of CATZOC for areas where the seafloor is known to be mobile and personally (not accepted by UKHO yet) I have concluded that CATZOC should be limited to B at best and possibly C in such areas regardless of the quality of survey carried out (this will not stop a lower CATZOC from being attributed if the survey is poor but is only intended to prevent CATZOC A1 and A2 being given).

My view is that CATZOC's only use is to inform the mariner how well the charted seafloor agrees with the actual seafloor. It is not an indication of survey quality in itself. Indeed, I can see no reason why the mariner cares about the quality of the survey, just how well the charted depiction agrees with reality. Hence, in areas of mobile seafloor the charted depiction will differ from reality and hence a lower CATZOC should be provided.

UKHO currently assigns CATZOC A1 or A2 to mobile areas based on survey standard. The area is then also covered by a cautionary note stating 'Changing Depths' or similar and may also have the Sand wave feature (SNDWAV) provided. I consider that these are contradictory to the CATZOC and this combination does little to help the mariner.

So far, having passed my thoughts around UKHO I have received mixed responses – some agree with me others do not! Hence I would be interested in your thoughts as the Data Quality experts. I would also be interested to learn what your particular HO does.

Many thanks for your time and I look forward to seeing your replys

All my very best

Chris

I have thought about this too. During the IIC ENC Workshop in January, Sam and I discussed having, perhaps encoding with the data, some sort of temporal modifier (a model for depth variance expansion with time since survey). In my mind I have an image like that of a semi-variogram, but with the x-axis being time instead of lag distance. One could also imagine a sill distance (or time at which maximum variance is met), especially for sandwave fields. In other instances (e.g. areas of siltation) one might conceive of an increasing depth variance, paired with an extrapolation of gradual depth reduction - i.e. a model for depth changes, with accompanying variance. I hope I have explained this well.

So that means CATZOC continues to be the assessment of the survey as of the date of survey (static), but with some form of temporal modification of the uncertainty encoded into the data (dynamic, temporal). So ECDIS manufacturers would have to read source data quality and the temporal modifier and extend this to depth uncertainty based on SUREND and today's date.

Alternatively, HOs could run this model at regular intervals and when vertical uncertainty exceeds the prescribed value, the CATZOC of a data set is demoted. When this happens, it might trigger a survey planning activity if the requirement for the particular waterway demands that higher CATZOC for navigation safety.

As I said during the ENC workshop, I believe ECDIS has been used to date mostly for Display and less so as an Information System. It could do so much more, but the implication for HOs is much more sophisticated encoding of data quality parameters into our ENC, provided the encoding standards will support this.

CHS, while not performing any rigorous assessment of the ever increasing depth variance, attempts to resurvey our major harbours, channels and approaches on a decadal frequency (and in some key areas annually or even more frequently). As Leendert has pointed out, sometimes this isn't sufficient, and other times it may be overkill. I'd prefer to optimise the process, but for now I'm just thankful when I have the resources to keep the data current in some of our key navigation areas.
Regards,

Rob Hare, P.Eng., C.L.S.

Thanks for your input Rob – your thoughts do seem to agree with mine. However they are more related to changes to how CATZOC is defined (i.e. part of what we are defining as the DQWG). I am trying to get UKHO to alter how it uses the existing CATZOC within current ENCs by reducing the CATZOC to B (or lower) where the seafloor is known to be visibly mobile (and the paper chart carries the legend 'Changing Depths' or has the Sand Wave symbol (ENCs have a cautionary area and maybe the SNDWAV object).

This change could be implemented without altering anything in the existing ENC set up as it would just require an interpretation change by HOs. It would not cure the problem but would, in my mind at least, go some way to alleviating it within the existing constraints of S-57.

Thanks

Chris Howlett CSci CMarSci FIMarEST

As usual, I (personally) agree with you. I think the convention you propose highlights three important principles:

1) CATZOC communicates confidence in the charted information at a particular range in time--the present through the life of the product
2) CATZOC can and should change over time
3) Highly mobile seabeds are a usefully teachable extreme case of the general rule-that confidence estimates should be adjusted for rate of change of the seafloor and time since the last survey.

A similar argument can be made for downgrading CATZOC in areas affected by an extreme event such as a hurricane or earthquake. Such a downgrade may then trigger a resurvey requirement, as Rob suggested, but only if the underkeel clearance margins have been significantly eroded by the change in uncertainty.

While I love Rob's notion of self-degrading quality indicators built into the ENCs, a good first step would be for the HO to apply some simple business rules to the ZOC areas before each publication. Then, as always, it is the mariners' responsibility to interpret that uncertainty in the context of their own operation and planned routes.

Shep

I have been following this discussion with interest, and from a surveyor's point of view, I agree with you both.

A CATZOC is, from my perspective, a cartographic indicator on the confidence of the data for the particular portion of the chart to depict the actual real-world situation. It is not an indicator on 'survey quality' per se. Attainment of the appropriate IHO survey order is. When I was also involved in the survey planning and appraisal process at UKHO certain instances reinforced this opinion:

An incomplete survey might still have all delivered data meeting survey requirements; however if an element could not be recorded fully then the survey was deemed incomplete and flagged accordingly. If all the bathy was good but other elements were missing then it would still degrade the overall appraisal of the survey. The cartographer however might still feel that the bathymetry meets the appropriate CATZOC requirements for that layer of data.

On the other hand a fully compliant Order 1a survey in a known area of significant sediment transport is good from a relative sense but only good temporally in an absolute sense. In other words, it depicted the form of the seabed at the time of the survey only.

So I think there is - correctly - a divorcing element between survey quality and CATZOC rating. Mariners aren't expected to know what IHO Order 1a means, but they should have faith that the CATZOC on/in the chart indicates the confidence they themselves should have in the charted data in any particular area.

R/D
Don Ventura MRICS

In reviewing these discussions with some of my colleagues, we looked at the usefulness to the end user, and Geoff Dean (a hydrographer by trade) made a suggestion I felt was really good. It builds on Rob Hare's proposals, but simplifies it, basically rate the areas for change. So in areas where it is know that the change is frequent and consistent give it a rating as such, and where infrequent events have occurred, like a hurricane, rate the area as such. The proposal is to add

metadata to tell the user about the changing nature of an area and it would supplement CATZOC. In combination the two can give the user a better understanding of the area the user is planning to transit, and he can then make his risk analysis and amend his plans if needed.

Best regards,

Eivind

CATZOC definitions

With the questionnaire to mariners on their understanding of the various data quality issues having now been issued it has led me to think about whether we can devise a better set of rules for the population of CATZOC – still the prime example of data quality used by the mariner when using ENC.

Hence, further to my earlier e-mail about limiting CATZOC to B (or possibly C) where the seafloor is known to be mobile I would like the members of this group to suggest ways that we could encode CATZOC – without changing any of the existing rules (many thanks to all who responded to this). Hence, what I am seeking is a set of rules or guidance to help HOs populate CATZOC in a way that best helps the mariner.

For example:

It is my opinion that to be useful CATZOC must help the mariner. Hence it is a statement of how well the seafloor depicted in the ENC agrees with a real seafloor over which the mariner is, or will be, sailing. Hence cartography with all the imperfections that this imparts comes into play and will, potentially, reduce the CATZOC from what the survey is capable of supporting. The mariner has no interest or concern regarding the quality of the survey that was done in his area. His only concern is how well he can understand the seafloor from the chart/ENC that he is using.

It is from this idea that my thoughts to limit CATZOC to B in areas of known mobile seafloors originates. However, if this idea is taken further then for ENCs created by digitising paper charts (as most of UK's are at present) then with a plottable accuracy of 0.3mm at chart scale, the horizontal accuracies of the various CATZOC criteria are broken fairly quickly:

e.g. A1 5m 0.3mm equates to 5m at a scale of 1:16,666 hence logically a chart at 1:20,000 can not achieve A1 accuracies.

Strictly applying this criterion would result in all small scale planning charts having a blanket C or even D CATZOC regardless of the quality of the surveys that are within them. In some way this would be beneficial since these are not intended for navigation and the poor CATZOC would hint at this. However, when planning passages mariners may want to know where the better surveys are and having a blanket C or D would not assist in this.

Similarly, the vertical accuracy of the chart also deteriorates as the scale of the chart becomes smaller. The Civil engineering community uses a table to define vertical accuracy based on cell size for DTM/DEMs (Flotron and Kölbl: Precision Terrain Models For Civil Engineering, OEEPE Publication, P 32-134, December 2000). This table gives maximum allowable grid spacing to attain a given vertical height accuracy based on flat, rolling or rough terrain:

DEM Height	Required grid distance		
accuracy	flat	rolling	rough
in meter	in meter	in meter	in meter
10	131	82	47
4	66	41	23
2	41	26	15
0.8	20	13	7
0.4	13	8	5
0.2	8	5	3

Now given that the soundings on charts and ENCs are widely spaced – far, far more widely spaced than the largest grid spacing quoted above there will be an error between the picture shown by the soundings and reality. Obviously, the DEM grid is created in a 'dumb' manner whereas the soundings on the chart are placed in their most advantageous locations by the compilers and hence the errors associated with a compiled set of soundings will be less than any arbitrary grid. However given the much greater distances between soundings despite the 'smart' placement there will be vertical errors and these will increase as the spacing becomes wider with smaller scales.

Taken together, and in their most literal way, the above two degradations of accuracy due to the limitations of cartography would limit CATZOC A1s to only the very largest scale charts. I suspect that this would not assist the

mariner so a more pragmatic approach is needed (and this is what HOs do). However, rather than each HO making their own decision based on pragmatism rather than the letter of CATZOC law I think it would be useful if the DQWG could devise a set of rules which the IHB could then recommend for HOs to follow and so obtain a common interpretation of CATZOC in the ENCs.

I welcome your views on the above and as to whether you feel a unified approach is beneficial / desirable (or possible). Also, from those of you who currently passage plan and navigate, is there a way that you would like to see CATZOC being populated which would be most useful to you.

I look forward to hearing from you and, hopefully, starting a debate on this topic while we wait for the main questionnaire to be returned.

All my very best

Chris Howlett CSci CMarSci FIMarEST

I'm not sure I agree with your position on this one. Charts are indeed a depiction of the real world at some instant, but they are based on source data of known or deterministic H and V uncertainty and with some known sampling regime. And it is the sources which define how well we positioned the obstacles to navigation in 3-D and how good a job we did of searching for all the obstacles that must be avoided in order to be safe. So these are the things to which we must associate a ZOC.

So on smaller scales, I admit that the horizontal uncertainty may be degraded if digitization from analogue charts was the route to an ENC, but for route planning, the mariner wishes to know how well surveyed are the areas through which he proposes to guide his ship. How old are they, how well positioned, how sparse or dense were the survey data.

ZOC have the opportunity to one of say several things to the mariner:
we know the precise whereabouts and existance of all hazards in an area, or
we may have missed something, or
there may be something new (since the last time we surveyed), or [strictly speaking, this may be SUREND and not CATZOC]
something may not be exactly as we have portrayed in the ENC (due to age of data or poor positioning or due to undersampling the seabed).
As to your DEM proposal, S-102 should provide the means to present the mariner with both depth and associated uncertainty on a grid. It will be key if we choose to build grids from sparse data, that we get the estimate of grid uncertainty right so the mariner can be warned that depths may be shallower, by an amount that is calculable, than our best estimate of the depth at each grid node. This, in turn, allows statistical shoal biasing of the depth at any chosen confidence interval, should the mariner wish to do so.

So in summary, tell me where the good and the bad data is, for my passage planning, regardless of the scale of the chart that I may be using to design my route. I want to know where to zoom in to get the finer details of the questionable source data, but will not care too much if the data is perfectly fine.

Hope these are helpful comments.
Regards,

Rob Hare, P.Eng., C.L.S.

Thanks for your reply. In effect I think you are basing your reply on the text description within CATZOC rather than the full definition – which is something I agree with (e.g. you are not going to find a surprise here or you may find one or you probably will find one!) The horizontal and vertical accuracies become meaningless at smaller scales and should only have relevance on charts of a scale where navigators may be navigating to those tolerances (e.g. navigators may be navigating to 5m in harbours and would expect charted features to agree).

The above does break the strict rules of CATZOC definition and I think it would be useful if a pragmatic set of rules could be devised to harmonise what different HOs do.

Chris Howlett CSci CMarSci FIMarEST

Feedback from IIC Workshop

Below is some feedback that Rob and I recieved following our talks at the IIC ENC workshop in Vancouver in at the end of Jan.

* There was a general acceptance that things needed to change in terms of the representation data quality.
* Current CATZOC symbology was felt to be unintuitive and clutters the display on an ECDIS
* Traffic-light (go; no-go; use caution) presentation, animated for tides and dynamic draught, met with favourable response. Could be facilitated quite easily with gridded high-resolution bathymetry/uncertainty (e.g. BAG) in S-102. It may also be possible with sparse data using clever gridding techniques.
* Don't change existing uncertainty representation in S-57 in such a way as to punish those HO who have invested considerable resources in fully populating their source metadata. Any changes should be an augmentation and not a full scale modification.
* Any augmentation of S-101 should permit ECDIS manufacturers to take full advantage of the IS in ECDIS, making these systems more than just an ECD.
* HOs will need to make their ENCs uncertainty/information-rich in order to permit ECDIS taking full advantage of the additional information content. The effort required to add this information richness will depend on how S-101 augmentation is implemented.
* General feeling that where available, high resolution bathymetric surfaces can provide an intuitive and useful visual aid to mariners.

Sam

Various snippets related to data quality and sea floor mobility

Having read your contributions of the past month with great interest, I would like to share some snippets with you from a recent email conversation that I had with Chris. (Chris and I will continue our discussion on Ocean Business 2011 in Southampton UK on Thursday, please let us know if you would like to join in.)

I hope you find these snippets interesting. Please also take note of the three questions that are at the end of the email.

Best regards,

Leendert

LD: You make a distinction between "mobile" and "highly mobile" sea floors. Such an approach would be attractive, as the situation near-shore is very different from the situation further off-shore. For instance: migration of rhythmic bedforms of up to 100 m/yr vs up to 10 m/yr; lots of other types of dynamics (shoreface-connected ridges, sediments that come and go near estuaries) vs hardly any other type of dynamics (nonmobile sand banks).

LD: In the paper that I submitted for the NSHC conference in Brest (available at the IHO web site), I made a distinction between migration of rhythmic bedforms and their growth. If a sea floor is dynamic just because of migration, we should not be so alarmed. It would be over the top to adjust a CATZOC assignment: charts are supposed to indicate the shallowest depths in the area by shoal biasing. If nothing happens to these shallowest depths other than a change in position of a few metres per year, this should not worry the mariner. Sand wave growth and other kinds of dynamics should worry the mariner, and consequently should be reflected in the quality indicator.

LD: It is not clear to me what the best approach is for mobile area that recently have been surveyed: first CATZOC A until some expiration date, then CATZOC B, and finally CATZOC C if very mobile? Or immediately CATZOC B/C, even if the survey still reflects the morphology of the sea floor well?

CH: My intention is that the CATZOC is pegged at a B or C regardless of when. However, I am looking at devising a resurvey frequency that will allow a CATZOC of a given value to be achieved. I have not finished thinking about this but I suspect that if, for whatever reason, the survey is not done to schedule then the CATZOC should be dropped.

LD: Sea floor dynamics could be autonomous, or man-made: sand extraction, dumping sites, lost cargo. How would you apply CATZOC to such areas, e.g. areas with very intense shipping (high cargo loss risk!)? And in case of "natural" sediment dynamics, it is not always likely that this happens in some linear way in time. Storms are suspected to cause a large part of the dynamics, and SHOM presented some back-and-forth movements of sand banks in their report to the NSHC meeting. If we apply CATZOC B to areas with high linear natural mobility, I am afraid that we should also follow this approach to areas where nonlinear natural mobility can be expected, or man-made dynamics.

CH: My thoughts really extend only to a partial modification of CATZOC for those areas where the HO has seen fit to place a cautionary area or sand wave area in the ENC. We know these are mobile (hence the notes) so there seems to be no excuse to claim the survey is spot on. As for other areas these are more difficult to quantify.

LD: Besides areas with a static, a mobile, or a highly mobile sea floor, most of the areas on the NLCS have an unknown behaviour of the sea floor. This now starts to change, due to the efforts we made over the last decade on this topic. Changing the application of CATZOC for mobile areas, but not for areas with unknown behaviour would give the mariner a false sense of safety for the second category.

CH: You are right but having a high order CATZOC in areas where we know the seafloor does not now match what the surveyor found also gives the mariner a false sense of security.

LD: The project on Validation of the NLHO Resurvey Policy of Deltares is in its final stage. As part of that project, NLHO has digitised many old fairsheets. We made a very large step forward, as we will have a sea floor mobility map for the majority of the NLCS soon. Some great pictures of very large fields with sand wave migration. This might be the moment to incorporate mobility warnings into our products, as we finally know more about their behaviour. We plan to organize a mini-symposium in June about this, in Amsterdam. More details to follow.

CH: I would be interested in this mini symposium (as should most of the DQWG). I would like to attend if I am allowed.

QUESTION 1 TO DQWG: Who would be interested to receive an invitation for this event?

LD: In Jan/Feb, I spent some time ordering my thoughts about the DQWG in a discussion paper, but did not yet circulate it.

CH: I think you can circulate this now as I would like to generate some discussion on these topics before the meeting. My hope is that the DQWG can develop a set of indicators which are meaningful and then allow ECDIS manufacturers to devise innovative display options rather than us say how this should be displayed.

QUESTION 2 TO DQWG: What are your opinions about the attached discussion paper?

Yesterday, a colleague of mine and I met with Port Metro Vancouver - essentially it was the Harbour Master and his team. They want to make Vancouver into a "Smart Port." To that end, it is their desire to provide various types of value-added navigation information in real-time - such as water levels, air draft under bridges, currents, etc. That got me thinking that there is a third partner, at least in the e-NAV world, to that of data providers (HO) and ECDIS manufacturers. And each has a role to play in contributing to bridge risk management.

As HO, we can indeed provide some statements or metadata to reflect the quality of source/survey data at the time it was collected, and an expiry date (a concept I had not considered before). But my recent experience with pilots is they definitely want to know where they cannot go, but in addition these days, they are wanting to push the limits of where they can safely go. So the somewhat binary nature of the concepts of MSNFSN, FITUSE and GONOGO may not be sufficient for all navigators. Instead, they are tending towards asking us (HO, Ports, ECDIS providers) to provide them with sufficient information about the uncertainty, both in the depth data but also in the value-added e-NAV data and own-ship information such as DUKC system outputs, that they can make their own assessment of the risks associated with loading an additional 1m draft before leaving port. If we provide them with overly cautious estimates of depth and real-time water levels (without any uncertainty information) then they are forced to underload their vessels and or arrive late/leave late, thus losing potentially hundreds of thousands in potential revenues. There certainly appears to be an appetite in today's economy for pushing the boundaries on safe navigation, which sometimes results in groundings. But this appears to be a risk that today’s navigators, quite possibly under pressure from today's shipping companies, are taking.

Regards,

Rob Hare, P.Eng., C.L.S.

Discussion paper on data quality concepts and their visualisation
to be discussed during the next IHO DQWG meeting
Leendert Dorst, Netherlands Hydrographic Office

1. Introduction
In case the questionnaire shows that the concept of CATZOC should no longer be maintained, three other concepts have been proposed by members of the DQWG as an alternative data quality indicator. Each of these have their specific advantages. In this paper, it is explored whether a combination of the proposed concepts results in an attractive solution for the presentation of data uncertainty in nautical charts.

The success of such a solution is just as much dependent on the visualisation as it is on the concept. Therefore, this paper also explores the visualisation of the presented solution, leading to a recommendation to the DQWG on behalf of the NLHO.

2. Data quality concepts

current alternative concepts
Since the activities of the DQWG began, the following concepts have been presented for alternative data quality indicators:
1. minimum standards necessary for safe navigation (MSNFSN)
MSNFSN is a binary indicator whether the data is according to the minimum standards applicable, or not. These standards could include international standards (IHO S44) and national standards (like age of data). Details are given by the Nordic Data Quality Sub Working Group [2009].
2. fit for use (FITUSE)
FITUSE is specifically designed for depth data. Ship parameters are necessary to determine where a ship safely is able to go. Details are given by Harper [2010].
3. no-go area (GONOGO?)
GONOGO equals FITUSE, except for the inclusion of the water level. A ship that cannot go somewhere when the actual water level equals LAT, according to FITUSE, is perhaps able to go there when the water level is higher, according to GONOGO. For instance, some ships travelling through the English Channel/La Manche to the Port of Rotterdam need the incoming tide, and need to navigate through non-FITUSE areas. Details are given by Murakami and Kikuchi [2010].
In this paper, the concept of FITUSE is assumed to also contain the GONOGO concept.

tasks of HO-s versus tasks of third parties
The HO is responsible for providing spatial data to the mariner, independent of the medium (paper or electronic). To this end, it develops its products and it needs to describe the quality of the data presented in them. An HO is not responsible for the operational circumstances of transportation at sea. Care for the determination of ship parameters like draught and required under keel clearance should be left to the mariner.

Adding value to the spatial data of an HO by using a system that combines spatial data with operational data increases safety and should be promoted by the HO. The balance between promotion of operational safety and not accepting responsibilities that an HO cannot manage impacts the decision if FITUSE is acceptable as a concept for the DQWG.

In the vision of the NLHO, the right balance is to enable use of the FITUSE concept in the IHO data standards, and to prescribe the procedure how FITUSE should be given a value. FITUSE cannot be an obligatory concept, it is instead a concept that third parties are encouraged to use in the development of safe navigation solutions on board.

That leaves concept of MSNFSN as the only new concept that could be made mandatory, presented to the DQWG so far. MSNFSN is attractive because it is staightforward and widely applicable. Instead of the meaningless letter/number combinations of CATZOC, it presents itself as a clear yes or no. Instead of the limited applicability of FITUSE to other data than depth values, it can be associated with every kind of data value. (This solves the concern of Mong [2009].)

relevant elements of an indicator

According to Ellmer [2010], there are three elements necessary for a data quality indicator:
1. uncertainty at the time of survey;
2. elapsed time since the survey;
3. dynamics of the observed object (e.g. the sea floor).

CATZOC is an indicator of element 1. Inclusion of the moment of survey, as e.g. suggested by Harper [2010], adds element 2. Element 3 requires advanced modelling, or analysis of a time series of surveys. It can can certainly not be left to the insight of the cartographer, let alone the mariner.

In combination, element 2 and 3 could form a new element, which we term expiry date. Several coastal States have set resurvey frequencies for areas within their responsibility, based on a more or less explicit assessment of dynamics. The expiry date is then calculated as the date of the survey presented in the chart plus the resurvey frequency. If the expiry date has not yet passed, the corresponding indicator is set to safe. If it has past, the indicator is set to unsafe.

This puts the responsibility for setting a resurvey frequency with the coastal State, in a similar way that it has the responsibility to set the required S44 order of each area. (Some thoughts on the side are given in the Annex.) Therefore, we have reduced the necessary elements for a data quality indicator to:
1. uncertainty at the time of survey;
2. expiry date of the survey.

decision scheme

Let us assume that MSNFSN and FITUSE are both implemented as a choice for yes (Y), no (N), or unknown (U), according to the above considerations. A decision scheme for the attribution of values to the indicators would then look like this:

S44 order known? -> no: MSNFSN=U; FITUSE=U.
| yes
v
expiry date of S44 standard known[1]? -> no: MSNFSN=U; FITUSE=U.
| yes
v
maximum ship draught known[2]? -> no: MSNFSN=Y/N; FITUSE=U.
| yes
v
data according to S44 order[3]? -> no: MSNFSN=N; FITUSE=N.
| yes
v
data younger than expiry date? -> no: MSNFSN=N; FITUSE=N.
| yes
v
depth[4]–S44 uncertainty > draught–UKC? -> no: MSNFSN=Y; FITUSE=N.
| yes
v
MSNFSN=Y; FITUSE=Y.

[1] or expiry date assumed at its maximum value due to static/sufficiently deep sea floor
[2] including dynamic draught, pitch/roll-induced draught and temperature/salinity induced draught
[3] either in its current version or in the version valid at the survey date
[4] either with our without water level

potential combinations

Based on the decision scheme, the following combinations could happen (*) and the following combinations could not happen (-):

			MSNFSN		
			U	N	Y
			insufficient quality informationn	quality insufficient	quality sufficient
FITUSE	U	insufficient operational information	*	*	*
	N	too shallow	-	*	*
	Y	sufficiently deep	-	-	*

3. Data quality visualisation

As resulting from the inventarisation of Castren [2010], the DQWG has investigated ways to visualise data quality according to cartographic recommendations. The combination of two indicators require two distinct graphic variables. Literature is not consistent about the best graphic variables to use. Let us apply two very straightforward variables: color and intensity (darkness). Here, this is done just to get an impression. More definite decisions about the applications of graphic variables requires input from a cartographic scientist.

Application of those two graphic variables is hindered by their current use. E.g., areas of comparable depth already are identified using an equal intensity of blue. Areas always covered with water, areas of drying heights, and areas higher than the coastline already are distinguished using the colors blue, green and yellow respectively. Therefore, a color wash of the full area does not seem to be a clear solution. Instead, one could (1) choose to apply color and intensity variations to the line and point elements portrayed in black, or (2) choose to apply color and intensity onto a sparse pattern of symbols.

If the optional FITUSE concept is not used, the graphic variation could be:

MSNFSN		
U	N	Y
insufficient quality informationn	quality insufficient	quality sufficient
pink	purple[5]	black

If all surveys are according to the standards for uncertainty and resurveying, the graphic variation could be:

FITUSE	U	insufficient operational information	black
	N	too shallow	red
	Y	sufficiently deep	green

[5] also called magenta

Based on the table of potential combinations, the full set of graphic variations with color and intensity would be:

			MSNFSN: intensity axis		
			U	N	Y
FITUSE: color axis			insufficient quality informationn	quality insufficient	quality sufficient
	U	insufficient operational information	pink	purple	black
	N	too shallow	-	orange[6]	red
	Y	sufficiently deep	-	-	green

4. Recommendation

The combination of the two concepts of MSNFSN and FITUSE is attractive, where MSNFSN gives the obligatory basic information, and FITUSE the optional advanced information. For visualisation, a combination of the graphic variables color and intensity will work, if applied on lines, points, and/or patterns. NLHO requests that the DQWG proposes alternatives for CATZOC accordingly, in case the questionnaire shows a need for change.

References

Castren, Antti, *ISO Standards and Visualisation*, Finnish Transport Agency, email 21 December 2010.

Ellmer, Wilfried, *Data Quality*, Bundesamt für Seeschifffahrt und Hydrographie, presentation given 5 November 2010.

Harper, Sam, *Conveying Data Quality in ENCs to the Mariner – Work Past, Present and Future of the IHO Data Quality Working Group*, United Kingdom Hydrographic Office, paper presented by Chris Howlett during Hydro2010, 2-5 November 2010.

Murakami, Shuji, and Shinichi Kikuchi, *A Quality Indicator "No-Go Area",* Japanese Hydrographic Association, presentation given 5 November 2010.

Mong, Eivind, *Discussion paper on Data Quality, a Wide Term*, Jeppesen Marine, paper discussed 10-11 May 2009.

Nordic Data Quality Sub Working Group, *Minimum Standards Necessary For Safe Navigation*, Swedish Maritime Administration, 9 April 2009.

Annex: some thoughts on the side about the relation between TPU and survey expiry date

If the expiry date is interpreted as the answer to the question: "When will the S44 TPU requirements for the description of the area no longer be met by the current data set?"[7], the following thoughts are provoked. The smaller the initial TPU is, the longer it takes to expire. A survey of a dynamic sea floor that just meets the S44 requirements expires almost immediately, a survey that leaves a large part of the uncertainty budget unused lasts longer.

In other words, an investment in the accuracy of a MBES survey could be done by reducing swath width. It will take more ship time to complete the survey, which is gained back by the ability to increase resurvey frequency to a longer period. A resurvey stategy is efficient if it finds the optimum between ship time spent on closer survey tracks and ship time spent on resurveying an area. Investments in more accurate equipment are further efficiency boosters.

Accepting the responsibility for setting a resurvey frequency may cause considerable investments. (The NSHC Resurvey WG is making these efforts.) However, for areas that can safely be assumed static or deep enough for all shipping, the resurvey frequency should be set to a maximum. Such a maximum has to be set by agreement within an IHO WG, e.g. the DQWG.

[6] also called amber

[7] Alternatively, a factor times the S44 TPU requirements could be used to reduce necessary efforts.

Miscellaneous

Other:
Go-no-go presentation. There are many similarities to what Peter Kielland and I proposed in the mid-nineties in an article in Contour magazine (distribution of this magazine may have been limited to North America). We proposed a traffic light concept (red - no-go; yellow - extreme caution advised; green - safe to navigate based on own-ship parameters, including ship's position uncertainty, dynamic draft uncertainty, uncertainty of real-time/predicted tides) that used also source reliability, position and depth metadata to determine where safe depths were most likely, including a safety factor. We also proposed to add position buffers (based on confidence levels) to the safety depth contours.

Dynamic seabeds. I thought of the 1993 article by Velberg in Hydrographic Journal. One must distinguish here between migrating sandwave fields, and areas prone to siltation. In one instance, the least depth is not changing, only its location migrates. In the other, the least depth of an area is decreasing with time, at least until a slope failure event, or some dredging occurs.

Regards,

Rob Hare, P.Eng., C.L.S.

Thank you for your input on dynamic seabeds. As you are aware, a lot of work has been done on this topic, in the Netherlands and elsewhere. The article of Bop Velberg is only one example of the series of articles that have been published on this topic. I hope to add this article to the list of articles on www.hydro.nl within a few weeks. Currently, I only have a paper copy - do you happen to have an electronic copy already? As part of my PhD project, I created an overview of all existing literature on data analysis of sea floor dynamics, attached to this message. May be helpful.

It is correct that it is often possible and desirable to distinuish between sand wave migration and sand wave growth/siltation. However, there are also situations in which sand waves migrate into a shipping channel without sand waves. And data quality also includes correct positioning of depth values. Any type of dynamics should impact data quality indicators, whether they affect the least depth or not. It is one of the three pillars on which we have to build, as articulated very well by Wilfried Ellmer.

I hope this helps our discussion.

Best regards,

Leendert

Go-nogo criteria. One signifncant contribution to dynamic draft uncertainty left out of the discussion at this point is salinity. The estuarine salinity change from sea (1035 ppt) to fresh can be a significant contributor to a draft increase, arguably increasing the no-go area significantly. A confirmation of this fact is incorporated into the International Load Lines convention, the Tropical Fresh (TF) "Plimsol Lines" allow a vessel loading significantly deeper than the conventional seasonal loading limits. How to approach this in an automated fashion, by ais/environmental broadcast, or user intervention is up for discussion.

v/r

B. Heap

I would like to commend you on all the hard work that has been put into the questionnaire. I attended the TSMAD meeting last week and the attached paper was discussed. The consensus of TSMAD was that it might be premature to put this concept in S-101, unless we know if the mariner does not want this type of data for small scale ENC's. In a nutshell, we are considering following similar guidelines that are used in paper charts for small scale ENC's and making M_QUAL and CATZOC optional. As such we felt that this type of question should be asked and the DQWG survey is the most appropriate medium.

As an alternative, we also discussed a new attribute for CATZOC for use by HO's at small scales. Essentially – it would be an indicator that at that particular scale the Quality information is generalized and that the larger scale ENC should be used.

Best Regards Julia

Makes me think of image stacks, like one might see in Google Earth. From a long way out, details are not clear - and we have no information about the source or its quality. But as we zoom in more detail becomes apparent, and eventually we see the source or sources of the images. One could consider a similar application for ENCs. Perhaps when passage planning at small scales the poorest CATZOC along the proposed route is identified and the user must zoom to that area for more details, then modify the passage plan accordingly. Iteratively, a passage plan is built such that navigation avoids all the poor ZOC areas.

Regards,

Rob Hare, P.Eng., C.L.S.

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1. Making M_QUAL optional in small scale ENCs both in S-57 and S-101

The motivation for this idea is valid in certain cases, and I feel that the question could well be added to our questionnaire.
On the other hand the implementation of the idea has to be very well defined in order not to give false sense of security, but rather emphasize the fact that quality information is missing or generalized. Rob Hare's and Julia Powell's suggestions (email chain below) address this issue the same ways I have thought.

4. ISO standards and visualisation

I volunteered for Action 3a in the DQWG3 Minutes, but I was too optimistic about my schedule and workload. Therefore just now I only have the possibility to include some links on spatial data visualisation techniques, which were also asked for in the meeting.

Basics with good references:
http://spatial-analyst.net/wiki/index.php?title=Uncertainty_visualization

Very good paper by MacEachren et al:
http://www.personal.psu.edu/users/a/c/acr181/MacEachren_et_al_FINAL.pdf
Read this if have to choose one.

Tesselation presented as means of uncertainty visualisation:
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.165.6539&rep=rep1&type=pdf

Jump to geology:
http://pubs.usgs.gov/of/2002/of02-370/soller1.html

Antti
