IMPLEMENTING MODERN METHODS TO ENSURE ENC QUALITY

A Practical Look at ENC Quality

The term 'quality of an ENC' can be defined in a straightforward way as the suitability of the ENC to provide for safe navigation within its geographical extent. This simple definition implies that electronic chart quality is a complex matter beyond the scope of criteria stipulated by S-58. A chart may successfully pass all the recommended checks but still be inadequate for its main purpose. To guarantee the required result a modern ENC production system must be built as a combination of three elements: tools optimised for a particular operation, proven well defined technology and quality management. This article focuses on a practical implementation of important production steps from the perspective of ensuring the final quality of the ENC.

An electronic navigational chart has been around as a product for about a decade already, since the first S-57 compatible datasets were issued. During this time rich experience in practical data production has been gained but ENC quality remains a restraining factor on the market. If we analyse practical approaches to electronic chart production selected by various data producers we can conclude that ENC is still seen as a side-product coming in the wake of paper charts. Let us analyse a few critical stages of chart production to see how traditional cartographic methods do not always guarantee the quality of the ENC product.

What is ENC quality?

The final quality of an ENC can be seen as a sum of the following aspects:

- quality of source materials used for ENC production (survey data, paper charts, navigational publications, databases, etc.)
- quality of operator's work on the chart
- quality of S-57 implementation in the dataset
- quality of updates which, in turn, involves the quality of source Notices to Mariner and how they are applied to the chart
- user-friendliness for the mariner (seamless coverage, good presentation, reliable operation in ECDIS, etc.).

All these aspects (save S-57 specifics) correspond well to paper chart production; nevertheless, in practice they require specific ENC-oriented tools and technology.

Coverage planning

Good ENC coverage contributes significantly to user-friendliness of the product. Thus to provide high-quality, seamless coverage of ENC data in a region, each cell must be given optimal geographic shape, must be placed at a correct location and must agree with its neighbours in contents. This is natural for paper charts but in the ENC world we face a new requirement: 'coverage' is not a set of charts from one HO but a combination of all cells of different producers within a given usage band. This 'international' coverage is what counts.

ENC coverage quality is impossible to achieve without a specific tool: a catalogue database containing parameters of all cells and paper charts issued by a HO (see Figure 1). This database must not only be regularly maintained but also synchronised with neighbouring HOs. As a result, the entire data coverage will be naturally visualised and any quality problems will be discovered easier and faster. Another aspect of coverage quality is so called 'edge matching', when same features from adjoining cells meet at a cell boundary (an example is a depth contour that must be visually continuous through the cells). This effect is not as important for paper charts because they overlap and, when projections differ, it is practically impossible to check for geometry coincidence between neighbouring charts. With ENC, bad edge matching is very easy to spot in any ECS. Therefore any QC tool employed for coverage analysis must have functionality to load several cells together in one screen (see Figure 2).

Complexity of S-57

An attentive viewer will be able to spot technical errors in a paper chart. In the ENC production process a cartographer cannot thus directly assess the quality of the result because of the complexity of S-57, which cannot be comprehended by an average human being. Therefore an automated data validation tool must be employed. Edition 3.1 finally delivered a set of formal specifications for such validation (now issued as S-58) and this was perhaps the biggest step forward in the whole history of the standard. Now tools are available and everybody who has worked with them in practice knows that the error/warning log they generate cannot be taken as a final verdict. In the first place, programs are not perfect and the word 'bug' has become a standard cartographic term. Secondly, the world is far more complex than any model, even one as advanced as S-57; often what seems to be an error in data is a true reflection of a particular hydrographic situation. For example, a buoy of the 'wrong' shape might be put out simply because there were no more 'correct' buoys left. Thirdly, because the S-

58 standard is not yet a mature specification, software producers may implement some tests according to their own interpretation not necessarily as intended by the inventor of the test. As a result, the validation log should be (a) filtered to ignore known false messages and (b) analysed on a case-by-case basis by a cartographer.

From a practical perspective, the quality of an ENC after automatic QC depends not only upon availability of verification software but just as much on convenience tools accompanying the verifier. How good is the explanation provided for each error message? How easy it is to analyse the problem in the chart? Is it possible to correct the error immediately or not? Is it possible to suppress an individual check? And so on. The most reliable practical configuration can be seen when an automatic data inspector is embedded in the production system and can be invoked at any time during the production process. Such should be able to propose a solution for a problem it discovers and block any erroneous operator action before it takes place (see Figure 3). At the same time, however, and for reasons explained above, it is safer to have two independent data validation tools, one from inside the system and another as an external application from a different vendor - a good example of the classical ‘second eye’ cartographic method implemented on another technical level.

ENC updating

The most important aspect of practical ER generating is neither the S-57 specifics nor technical characteristics of tools in use; it is the technological approach selected.
The situation with updating is similar to electronic chart production five years ago, when digitising paper charts was the only practical method to make an ENC. Up until now the only source for ENC updating has been the Notice to Mariners (NM) booklet. NM is optimised for manual on-board correction of books and paper charts; its application to a cell is not at all trivial. In practical terms, the quality of the product (ER) is limited firstly by insufficient source information and, secondly, by the level of experience and skills of the cartographer who does the work. At sea, the dramatic consequences of this limitation are only too well known. It is obvious that new methods for ENC updating must be found and implemented. For instance, source NM information can be utilised directly instead of digested into the form of a booklet. But even working with traditional Notices, serious improvements in quality provision have been achieved. Practice shows that human mistakes most often occur during the following operations:

a) searching for NMs suitable for the ENC in a booklet
b) transferring the NM text into S-57 constructs
c) handling coordinates of features when they fall outside the cell limits.

Tasks a) and c) must be automated as much as possible. For this a database of NtM is deployed and ENC production environment interfaces this database directly (see Figure 4). Positions are automatically taken from the notice text and used by the cartographic environment with limited human intervention. This will guarantee that shape clipping, coordinate transformation and datum shift will be correct.
Task b) is a more complex case. The only practical solution found so far has again been the ‘second eye’ approach: another cartographer repeats the operation and checks the result. And, of course, traceability in updating is essential; the production system must keep a record of by whom, when and why a file was updated.

Quality management

An electronic navigational chart as a product makes more quality demands than its paper predecessor, first of all because it is used with a very accurate and sophisticated instrument such as ECDIS. Deficiency in data quality may compromise the very idea of computer-aided navigation. As we have seen in practical life, an ISO-9000 certificate is not always a guarantee of the quality of the final EN and ER product, mainly certification concerns not the cartographic technology but the administrative procedure supporting production. Obviously, to meet the ENC challenge a quality management system must be technically integrated with the production system at each stage of chart production and maintenance. This has been well understood by many data producers and we may observe intensive development in this area.

Conclusion

The quality of an ENC is a complex matter. As we have seen, the task of ensuring ENC quality during practical chart production is much wider than direct implementation of S-57 and S-58 requirements. Specific tools must be employed at each step in production in accordance with error-proof technology and the whole process must be controlled via an established quality management system. This is the most practical approach to providing mariners with reliable ENCs of really high quality.