

Quality Electronic Navigation Chart Production

For Hydrographic Offices

Complexity in Hydrographic data and technological advancement challenge
To the
ENC Producing Agencies for Quality output.

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Background

Hydrographic Offices produce navigational charts for safe navigation of vessels in adjoining seas. Hydrographic Offices acquire the data for production of navigational charts by conducting hydrographic surveys on various scales. Hydrographic Offices carry thorough validation processes to ensure the quality and accuracy of data acquired for chart compilation.

Each Hydrographic Office has different production environment and specifications for chart production within International standards for paper Charts, Electronic Navigation Charts, Sailing directions, List of Lights, Notices To Mariners etc. International Hydrographic Organisation sets these standards for hydrography and nautical charts. Member hydrographic offices comply with these standards in generating hydrographic products with consistency for use by mariner in different parts of the sea routes around the world.

International Maritime Organisation is international body, sets the standards for safety of life and material at sea. Safety of Life at Sea Convention of International Maritime

Organisation stipulates the carriage requirements of various equipments, personnel, and navigation systems for safety of life at sea. Nautical chart is carriage requirement of vessels plying in the sea.

Advent of technological innovations in the computers, communication, position fixing methods and other shipboard systems, necessitated use of digital form of navigational charts for carriage requirement. Presently certain class of vessels were approved to have Electronic Navigation Charts in lieu of paper charts as carriage requirement.

Hydrographic Offices are to produce Electronic Navigation Charts of their sea coverage in International Hydrographic Organisation standard “Transfer Standard for Digital Hydrographic Data” Specified in Special publication S-57 (3.1) more popularly known as S-57. Hydrographic Offices have off loaded the production to the industry to accelerate electronic navigation chart coverage. Ensuring the quality of these products by the industry is a challenging task. Complying with S-57 standard for digital chart needs a thorough understanding of nautical chart content, S-57 data model and its relation to a paper charts for producing a quality electronic navigation charts.

A brief overview of the Quality Control procedures to meet stringent standards of Hydrographic Offices in electronic navigation chart production by outside agencies is outlined from the experience gained in handling charts of various Hydrographic Offices.

Input Evaluation

Input evaluation is the key for identifying the tasks and processes involved for each project. This is construed as the first step in quality control mechanism adopted by IIC for Hydrographic Offices.

Each Hydrographic Office provides detailed specifications for production of Electronic Navigation Charts and the relevant input required for the production. The basic input may be of varying nature and these are; Paper Chart, Scanned tiff files of the paper charts as colour/black tiff images, Geotiff images, Digital file of paper chart or Film positives of paper charts and Raster files of various colour films used for paper chart production.

Hydrographic Offices also supply documents related to chart parameters, list of lights extract, coding guidelines for each chart as annotated chart or overlays etc. If the input is fieldsheet data of hydrographic survey either in the form of S-57 digital file or as analogue form, it is to be evaluated for the scanning, and if it is a raster file, clarity of the input for registering the images.

Inconsistencies in the input not compliant to specifications are to be brought to the notice of the client for clarification before production is initiated. This eliminates ambiguities and misinterpretation during production such as geographical limits, registration tolerances and specifications of the client within International Hydrographic Organisation S-57 product specifications.

Pre processing of the input data

Based on input evaluation for each Hydrographic Office the production processes are identified. Each Hydrographic Office input needs preprocessing before the input is used for production. This may involve scanning of hard copies of input, registration of scanned images/conversion of the images to appropriate format for use in production environment. Some of Hydrographic Offices may be supplying input as digital files of proprietary formats such DXF, ASCII, CARIS NTX, Intergraph design files of ESRI shape files and so on.

For importing input data of varying formats in to production environment some tools are developed for use in addition to available tools for any special formats. This also facilitates easy production process flow. Imported data is to be verified for correctness and ensure the original data integrity is preserved when it is brought in to production environment. For ensuring the integrity of conversion from proprietary format, quality check is performed on the imported data before it is used for regular production.

Coding of Charted features

Electronic Navigation Chart dataset creation largely depends on the clear understanding of International Hydrographic Organisation S-57 data model structure and its relation to charted features on a navigational chart. All the charted features present on paper chart may not be necessary for encoding them as S-57 objects and attributes. International Hydrographic Organisation Special Publication S-57 provides guidance in encoding

charted features as S-57 objects in the document 'Use Of Object Catalogue for Electronic Navigation Chart of International Hydrographic Organisation Special publication S-57.

Creating a good Electronic Navigation Chart dataset requires thorough knowledge of charted features and interpreting them to corresponding S57 objects and its attributes. Nautical cartographic knowledge and International Hydrographic Organisation standards are essential for this task. As a first step the production team is required to be trained about the chart content and their relevance to S57 data model. This enables the production turnaround good in terms of quality and time as most of the charted features when captured in the first instance correctly, many of the features can be converted to S57 objects and their attributes automatically.

Many of charted features may not necessarily be convertible to S57 objects attributes automatically due to varying characteristics of their attributes. It is necessary to encode them manually. Such manual encoding procedure will be error prone. All manual encoding procedure needs to be examined and validated before applying these attributes to relevant objects while creating dataset. Developing small routine to assign objects and attributes to charted features would minimise the human errors.

Dataset creation

CARIS software Hydrographic Object Manager is used by IIC for creating International Electronic Navigation Chart. CARIS Hydrographic Object Manager handles most of the processing automatically and has inbuilt validation checks to verify the compliance of the

data to International Hydrographic Organisation S57, Electronic Navigation Chart product specifications. Each validation check is run and errors reported fixed to proceed to next stage. Operator intervention is confined to run the checks sequentially and fix the errors reported. To fix the errors the operator need to have good knowledge of specifications and well conversant with software capabilities. Finally the data is exported as Electronic Navigation Chart exchange dataset.

Third party Validation Tools

Independent software is used to validate the dataset compliance to S-57 standard. This validation will invariably bring out the interpretation ambiguities of production software and any missing features of Electronic Navigation Chart dataset in terms of S-57 standard compliance. Validation software packages are designed to verify the datasets for various aspects of data model defined in S-57 Standard and International Hydrographic Organisation special publication S58- 'Recommended Electronic Navigation Chart validation checks' of the dataset.

Advantage of these validation packages is their ability to have registered image backdrop of original raster files used for data capture for verifying the Electronic Navigation Chart vector data for positional accuracy and content presentation has been correctly performed by production team. These software packages provide error logs for evaluation and fixing the final dataset before it is packed for delivery to the Hydrographic Offices.

Quality Control

Quality management adopted should be multilevel examination and also evaluate and identify the processes required for each client specifications. Here main focus is to address customer requirement and set the workflow to achieve it in the production environment.

Quality Control is performed at each stage of process to ensure that the process is complying with specifications laid down by Hydrographic Office. This process stage validation ensures that data proceeding to next stage is free from critical and gross errors needing revision at later stage. An independent team of Quality team performs the quality control of the product

Production Team:

People with sound knowledge of nautical cartography and S-57 data model concepts are essential in the production teams. Training the operators in data capture and encoding of the charted features in to S-57 objects and attributes is prerequisite for good Electronic Navigation Chart production.

Evaluation of skill levels of operators

Evaluate the skill levels of people who will be assigned in the production and train the team for the specific tasks. Operator skill levels attained after imparting training must be of high quality with 80% marks in the tests conducted on understanding client specifications and production process. Besides work instructions to highlight the requirement of the client are prepared for following implicitly by production teams.

Client interaction

Graphic presentation of features and textual annotation on chart may be easier for presentation on a paper chart. However interpreting and encoding them as S-57 objects brings out the knowledge of nautical cartography and understanding S-57 data model by the producing agencies. Constant interaction with the client will give insight in to the approach of the client production methodologies and the production agencies can follow them implicitly to derive the desired products.

Conclusion

From the experience it is felt constant fine-tuning of skill levels of operators to meet ever demanding requirements of the Hydrographic Offices is a challenging task. The production teams is to be subjected to refresher training regularly in the modern methods, new software tools and changing standards is essential to keep pace with production requirements of Hydrographic Offices.

Organizations such as International Hydrographic Organisation and International Maritime Organisation constantly strive to keep pace with ever increasing technological changes in marine environment for safety of life and material at sea. All these changes must be known to the producing agencies contracted by Hydrographic Offices to provide them qualitative and timely services in quality Electronic Navigation Chart production.

Biography

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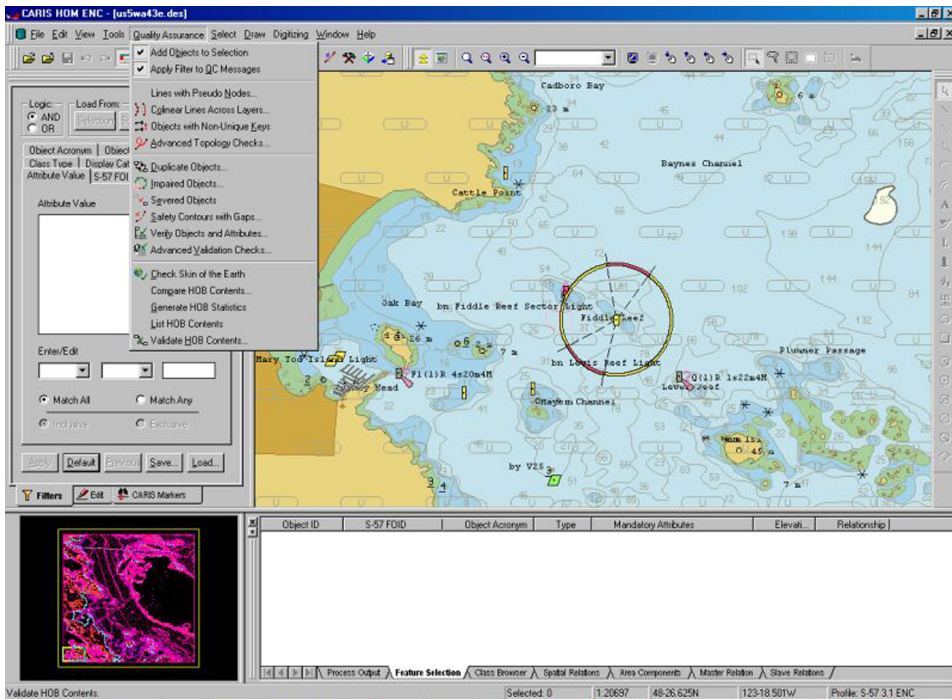


Figure 1

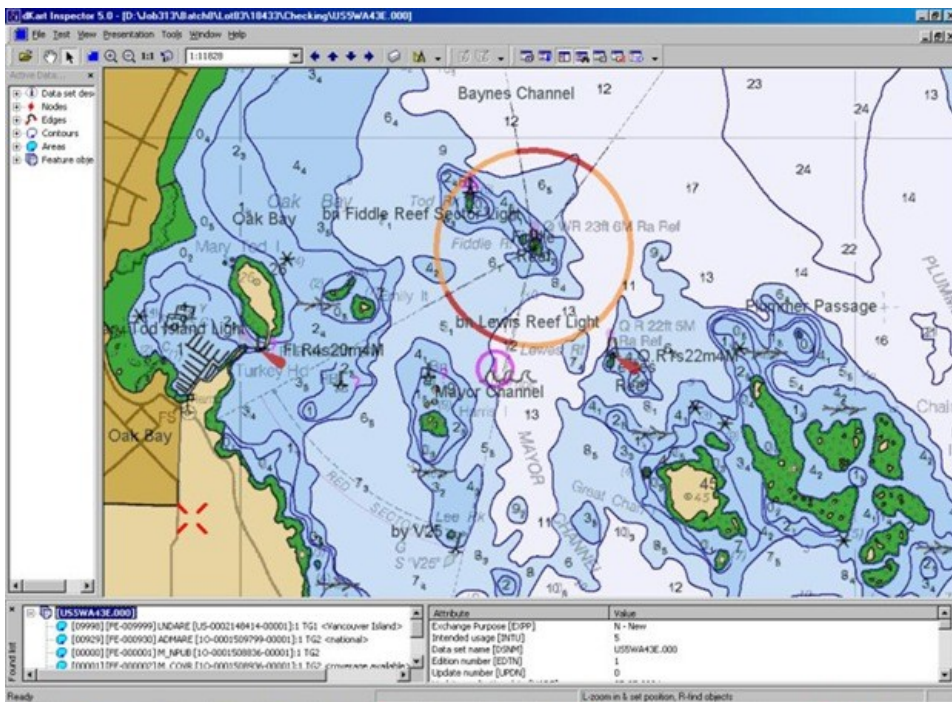


Figure 2



Figure 3