DEVELOPMENT OF INDIAN ELECTRONIC NAVIGATIONAL CHARTS (ENC)

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Introduction

The Basic role of a Hydrographic Office's (HO) is to provide essential hydrographic Services to support safe and efficient navigation and promote national maritime development for the nation. In recent years HOs all over the world are playing leading role in development of Electronic Navigational Charts for marine community so that vessels can navigate safely on their voyage across oceans.

Navigation of ships in and out of the nation's coastal waters and channels could be made safer by improving the Navigational systems by adopting new navigation technologies. In recent years, well-publicized shipping disasters have called into question the safety of life at sea both to the mariners and ocean environment, the effectiveness of navigation technology thus is facing challenges and looking into future for a technology that the Navigation system uses. Presently although Navigational systems for the most part are safe, but could be made more safer with improvements in onboard navigational systems performance by better use of new technologies including improved coordination of vessel traffic and using digital/electronic navigational charts for improved safety.

Innovations in navigation technology hold significant potential for reducing operational risk and improving safety performance, and their introduction should be expedited. Use of Electronic Chart Display and Information Systems (ECDIS) to replace paper charts holds particular promise. When combined with data from Global Positioning System, satellites, electronic charting systems can provide accurate real-time positions, as well as steering guidance, automatic hazard warnings, and a permanent navigation record. However, the full benefits of this and other new technologies are not likely to be gained in the near term unless deliberate measures are taken to promote their introduction. A comprehensive & specific familiarization for use of the ECDIS should be made before implementing this new navigation technology. Such measures must include establishment of technical and operating standards and improvement in charting of water depths

and other hydrographic data. Professional training in the use of these new technologies is essential

The international nature of the shipping and maritime industry is well known therefore in order to improve standards and to recognized the actions required to improve safety in maritime operations would require more efforts at an international level rather than by individual countries acting unilaterally and without co-ordination with others, with this aim it was decided that Electronic Navigational Charting is such a source that would increase safety of navigation and facilitate everyday mariner's work. First electronic charts and related systems had appeared on the market in early 80s. These charts were merely scanned and digitized paper chart reproductions-so called *raster electronic charts.*

The quality and contents of nautical charts is the cornerstone of safety at sea, and is strictly controlled by international agreements. Thus the industrial development of technically elegant solutions is not enough, the products must meet a well-defined standard for international approval of IMO/IHO. As a result an international S-57 standard has been established.

ENC Availability Issues

The lack of comprehensive ENC coverage along major shipping routes has been significant and also there was confusion about policies regulating the use of ENC and paper chart, furthermore, uncertainty was also about using SENC in ECDIS when the original ENC produced by a national HO are available to the user. This ambiguity was resolved in July 2002, when the revised version of SOLAS Chapter V came into force, and the status of ECDIS and ENCs has been clarified, and as a result HOs, if they wish, can support delivery of their ENC data in SENC formats.

With this in mind, the IHO recently conducted a survey to determine from its Member States how many ENCs have already been produced. The findings of this survey are quite revealing, and full details can be found on the IHO website (http://iho.shom.fr/). One of the main conclusions from the survey was the large number of ENCs that are already available, along with a significant amount of ENC data that are either in production or which have been produced but which are not currently available to the mariner (shown in red and blue respectively in the Fig 1).

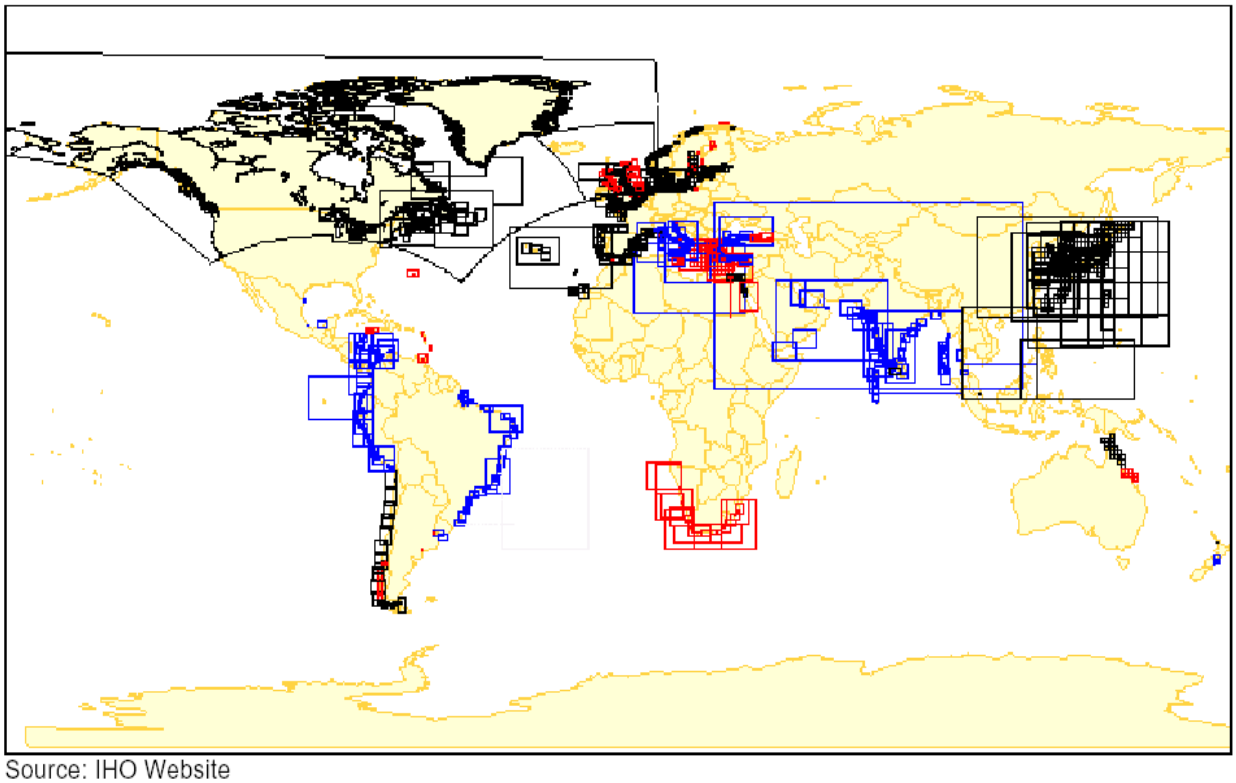
Augmentation of ENCs

Presently the hydrographic community is under a transition phase form old paper chart days to more sophisticated digital chart days ahead The lack of official S-57 data has created lacuna in the navigation market and this lead to the development of non-official data form private data producers (Fig 2). Today both official and non-official data exists in the international marine community and the

mariner is thus bent to take derived products from private vendors although the risk is high. The priority available for using data as envisaged by mariner today is:

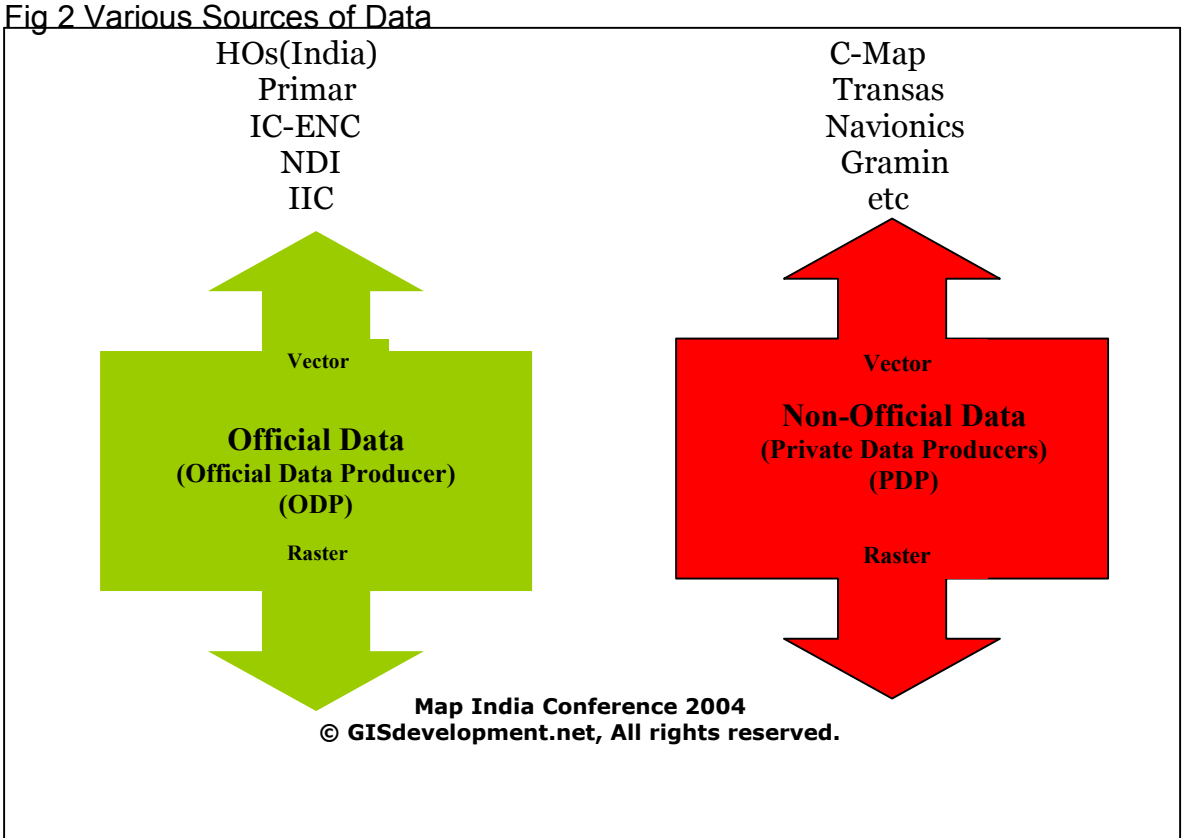
Official ENC Data ⇨ **Official Raster Charts** **Digital Nautical Charts from NIMA** ⇨ **Non-Official Raster Charts** **Private Vector Data**

Figure 1– Status of ENC Production March 2003



Source: IHO Website

Fig 2 Various Sources of Data



ARCS
PSX (USA)
BSB (USA, CANADA)

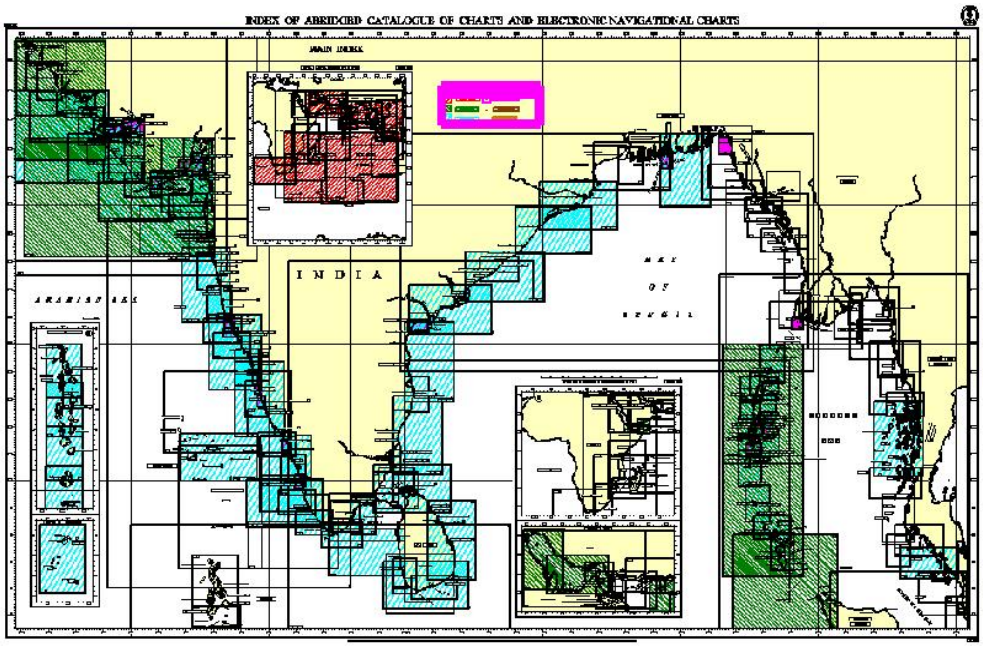
Non-Official Raster

Initial Accomplishments in Indian ENC Programme

The Electronic Navigational Charting programme of India started with a vision to gain a greater appreciation and understanding of the use of electronic charts when operating in its waters. Beside this the purpose was to develop an information system and demonstrate world that India is capable of producing full coverage of its National Chart series digitally and as per the specifications laid down by IHO/IMO.

With a solid core of experienced cartographers and Hydrographer, equipments and the nations most extensive holding of bathymetric and hydrographic data, a quest for development of Electronic navigational Charts started in 1997. For Indian hydrographic Office creating Electronic Navigational Charts for its waters was a very prestigious project. Initial hurdles include source for generating ENCs and populating it with data. The obvious choice for source for its creation was initially paper chart, although limitations of a paper chart is that if it is used for creation of ENC to enrich it, all the limitations corresponding to the scale would be transferred to ENC, but due to financial and other constraints it was decided to digitized the paper chart information for the purpose of creating ENCs rather than going for original source material. Then came the problem of finance and after careful review the task was contracted to an Indian firm who then utilized CARIS™ Suite of Software for implementing S-57 standards of IHO/IMO for obtaining full coverage as per national chart series of India. Stringent QA/QC checks were employed to follow that resultant product i.e. ENCs are fully compliant as per IHO Product specifications and as a result India attained full ENC coverage of its Indian waters in 2002. (Fig 3)

Fig 3. ENC Coverage of Indian Water



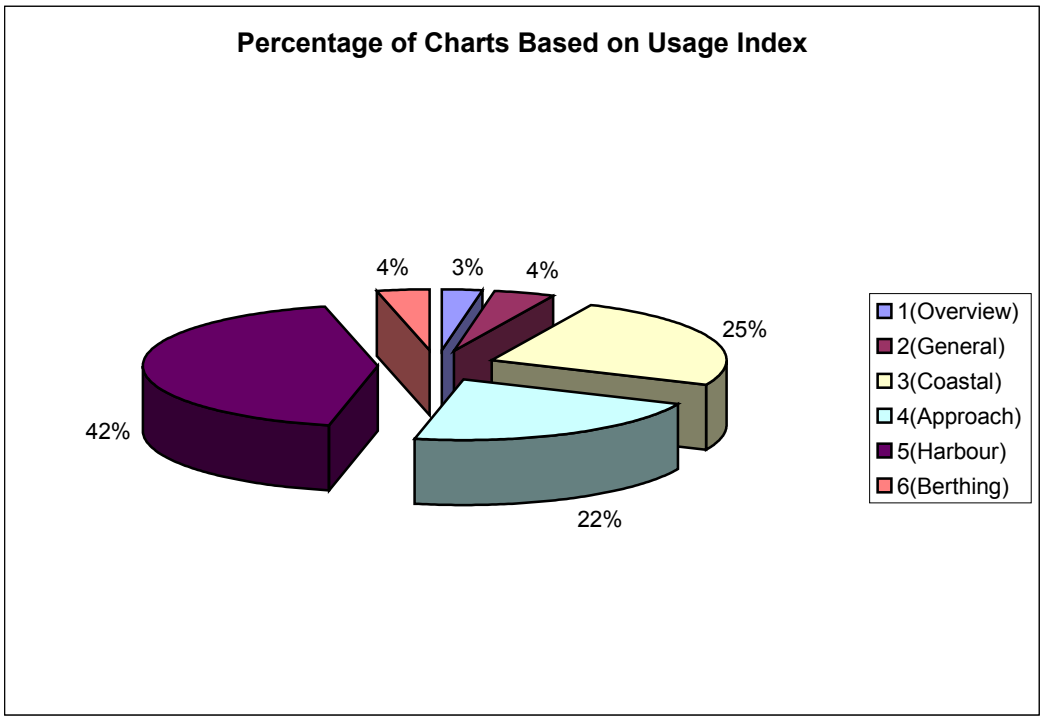
The scale of a ENC is determined by the type of navigation for which it is intended, the nature of the area to be covered and the quantity of information to be shown. Various scale terms are used in the S-57 IHO Product Specifications Appendix B, such as Overview, General, Coastal, Approach, Harbour and Berthing which belongs to Chart series of medium-scale, large-scale, and coastal series. The IHO product specifications for ENCs although mentions navigational purpose of ENCs, but it did not specify the scale range that should be applied to each ENC. The reason behind it is that different HOs have their own scale ranges to meet the navigational purpose. The Indian Hydrographic Office followed INT M4 chart specifications for the simple reason that each ENC cell is roughly equivalent to limits as per paper chart.

As per IHO S-57 Product Specifications Appendix B India produced 253 ENC cell with usage band/scale range as given in the Table 1 below along with Fig 4 showing graphical presentation of percentages of Indian ENCs based on usage index:

Table 1

Code	Scale Range	Navigational Purpose	No of Charts in Usage band
1	1:3.5- smaller	Overview	8
2	1:500,000-1:1.5M	General	10
3	1:150,000-1:300,000	Coastal	62
4	1:37,500-1:100,000	Approach	56
5	1:25,000-1:35,000	Harbour	107
6	1:6000-1:20,000	Berthing	10
		TOTAL	**253**

Fig 4 Indian ENCs ratio based on Usage Band



Current Projects

Validation: -Validation or post-production analysis of the ENC is a process to ensure a supply of high quality consistent data to end-user. As ENC is to be used in ECDIS therefore its NHO commitment to follow and ensure proper QA/QC norms as per IMO SOLAS regulations.

QA/QC is ensured by standard validation softwares, which have, embedded libraries that check ENCs so that they can be displayed in accordance to S-52 standards as defined by IHO and IMO ECDIS performance standards. Today softwares for validating ENCs are available in the market for which IHO S-58 document specifies the checks that, at a minimum, producers of ENC validation tools should include in their validation software. These software used by hydrographic offices ensures that their ENC data are compliant with the ENC Product Specification (Appendix B.1 of S-57). ENC validation software checks that the data are in conformance with the ENC Product Specification. Any violations are categorized as either "errors" or "warnings". **"Errors"** are defined as more serious discrepancies or violations. For example, the data may not conform to one of the mandatory requirements of the ENC Product Specification. **"Warnings"** identify less serious violations or suspicious data. An example would be the apparent location of a building in the sea. The various checks in this document have been categorized with these definitions in mind.
The cheeks includes:-

Checks relating to S-57 Data Structure
Checks relating to ENC Product Specification
Checks relating to ECDIS
Checks relating to Use of the Object Catalogue for ENC

INHO has ensured fully that all its ENCs are error free and in tuned to IHO/IMO standards.

Future Plans

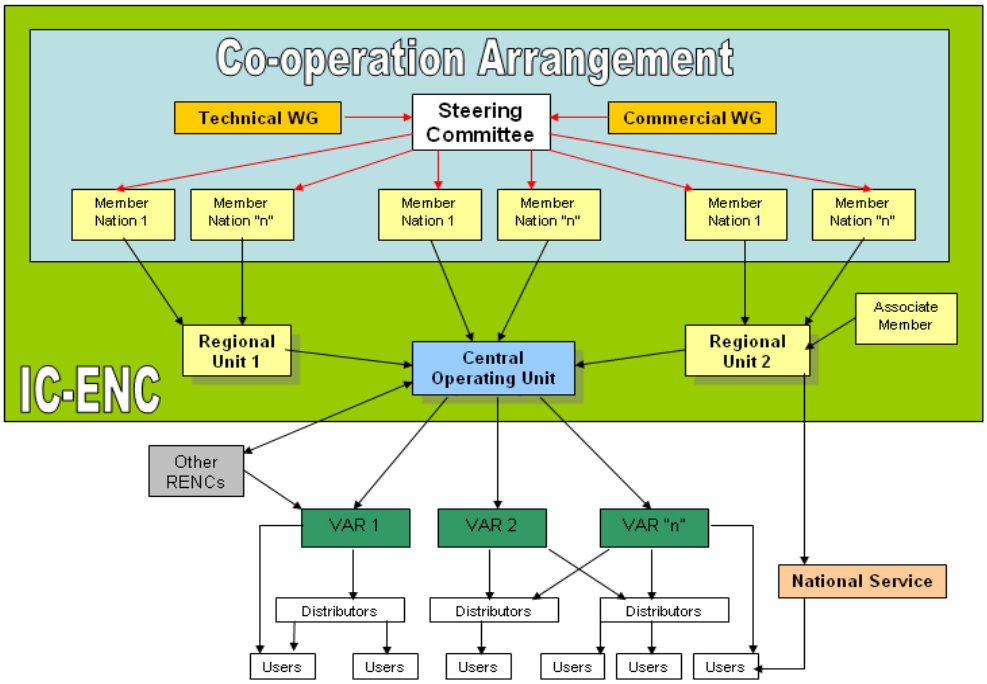
The task of ENC production of ENCs for Indian Hydrographic Office was completed in Feb 2002. The ENCs therefore now required to be validated for providing error free ENC Data before taking up marketing plans for revenue generation. Further the ENCs have to be updated regularly as per N to Ms by on a continuous basis. As Indian Hydrographic office has completely developed portfolio of Electronic Navigational Charts, marketing & distribution has been assigned a primary focus and as a result India signed a bilateral agreement with IC-ENC (International center of ENC) for marketing and distribution of its product to end-users.
***IC-ENC is an association of national hydrographic organizations which are working together to harmonize the production & distribution of high quality official Electronic Charts*.**

IC-ENC does the following basic functions such as:

a) Collation of ENCs from member
b) Validation of ENCs & updates
c) Database Management
d) Exchange set creation

IC-ENC functions are based on the following structure

Fig 5 Functions that are provided by the central IC-ENC operating unit (OU) in Taunton



IC-ENC appoints Value Added Resellers to be specialist distributors who develop their own services based around ENCs, typically including additional complementary electronic products, and provide these tailored services through their own distribution networks. Presently IC-ENC has appointed following VARs

Conclusion

The Indian Hydrographic Office (INHO) through mutual business and technical co-operation with established ENC promotional agencies will have better value for its products in international market. It will also give Indian ENCs advantage of adding its data to international distributors in order to maximize return of its investments. It will also help us play a leading role in the development and operation of Regional ENC (RENC) co-ordination center.