

## **PROBING THE PROBLEMS AND PROSPECTS OF INTERNATIONAL HYDROGRAPHY**

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### **INTRODUCTION**

The International Hydrographic Organization (IHO) is in its 75th Year. The author of this article moves into the last year of his second and last term as a Member of the Directing Committee of the Organization. It is a good time to take stock, to ponder on the problems and to look at the prospects for the future. This article is being published in the same issue as one written by Barbara BOND [1], Deputy Director of the UK Hydrographic Office, one of the three worldwide charting agencies. To some extent it will cover the same areas but seen perhaps from a different perspective.

From time to time Members of the IHB Directing Committee have written similar papers, summing up where they see the Organization stand and where it might go in the future. Published in the next issue, designed to commemorate the 75th Anniversary, will be a history of the Organization over the years from its conception and formation. Reading that paper one is struck on the one hand by a great sense of "déjà vu" and on the other hand of great progress. The two main objectives of coordinating the activities of national Hydrographic Offices and seeking the greatest possible uniformity in nautical charts and documents, have remained the same but the complexity has grown tremendously. During the last thirty years it may be noted that although the number of Directors and Staff of the I.H. Bureau have only increased from 19 to 21 the Member States have increased from 38 to 62. But the need to service the greatly increased number of Member States is just part of the problem. The major increase in complexity has been caused by the acceleration in technological change accompanied by the many new institutions that have developed. There was perhaps a time when hydrographic standards could be developed by simply trying to reach agreement between the Member States but today, particularly in the development of digital data standards, we must ensure that the work coincides with a whole plethora of international and regional standard setting organizations. Another matter to consider is that hydrography has become

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multi-disciplinary and the old surveyor is a fast dying breed. Modern hydrography requires not only surveyors but cartographers, engineers, computer scientists, physical scientists and, taken in its whole range, requires lawyers and financial experts to cover all the matters that must be considered.

To carry out its work the Organization must call on experts from its Member States and to form numerous working groups, committees and commissions. There are at present 34 such bodies (see Fig. 1). In addition to this, the Organization must be represented and participate in many other fora. The IHO decided in the years after the last World War, not to directly associate itself with the United Nations but it has nevertheless strong associations with several UN agencies, notably the International Maritime Organization (IMO), the Intergovernmental Commission (IOC) of UNESCO and the UN Division of the Law of the Sea (DOALOS). It also has strong associations with several non-governmental organizations of which the Fédération Internationale des Géomètres (FIG) is the most predominant.

So much for the increasing complexity of the work of the IHO. Let us now look deeper into its work and contributions to its two major objectives.

## **THE GREATEST POSSIBLE UNIFORMITY OF NAUTICAL CHARTS AND DOCUMENTS**

The author has discussed the progress to date and some of the current concerns in a paper presented at the Royal Institute of Navigation [2]. Historically, the object of introducing uniformity in conventional signs and abbreviations on charts was one of the main reasons why the Organization was formed in the first place. Quite clearly the different units used on charts must have caused concern to the founders and the goal of seeking uniformity in the metric system has been pursued from the beginning, even though it took over 70 years for one of the most important members of the Organization to agree to move from fathoms to metres! During the early Conferences one can read of the proposals and discussions involved in the adoption of various symbols but it was really the decision to combine all the resolutions into the Chart Specifications of the IHO that provided the major drive towards uniformity. This work was taken in hand as a result of a decision made during the XIth I.H. Conference to form a Chart Specifications Committee under the chairmanship of Mr. D.W. NEWSON of the UKHO [3]. The development of this major work provided precise instructions on the design and drafting of charts and of the symbols to be used. Nevertheless, because the IHO is a consultative and not a regulatory body the Member States are not bound to follow these specifications and there remain today some noteworthy differences in the design and colours used on different national charts. So much so that navigators have some strong opinions on what charts they prefer. Whether these differences are significant in terms of navigation safety is perhaps questionable.

Ten years before the formation of the Chart Specifications Committee was formed, in 1967, the French and Netherlands delegations to the IXth I.H. Conference proposed the idea of an international set of charts. The subsequent development has

REGIONAL HYDROGRAPHIC COMMISSIONS	COMMISSIONS	COMMITTEES	WORKING GROUPS	SPECIAL GROUPS & COMMITTEES	FINANCE COMMITTEE
<ul style="list-style-type: none"> <li>- Nordic</li> <li>- North Sea</li> <li>- East Asia</li> <li>- US/Canada</li> <li>- Mediterranean &amp; Black Sea</li> <li>- Baltic</li> <li>- East Atlantic</li> <li>- South East Pacific</li> <li>- South West Pacific</li> <li>- Caribbean Sea &amp; Gulf of Mexico</li> <li>- Southern African and Adjacent Ocean Islands</li> </ul> <p>NOTE: A proposal for establishing a Regional Commission for Antarctica will be put forward at the XVth Conference</p>	<ul style="list-style-type: none"> <li>- Promulgation of Radio Navigation Warnings</li> </ul>	<ul style="list-style-type: none"> <li>- Chart Standardisation</li> <li>- Hydrographic Requirements of Information Systems (previously COE and CEDD)</li> <li>- Technical Assistance Coordination</li> <li>- Legal Advisory</li> <li>- Worldwide Electronic Navigational Chart</li> </ul>	<p>CHRIS - specifications</p> <ul style="list-style-type: none"> <li>- updating</li> <li>- colours and symbols</li> <li>- glossary</li> <li>- data base</li> <li>- quality</li> <li>- transfer standard maintenance</li> </ul> <p>- Tidal</p> <ul style="list-style-type: none"> <li>- Hydrographic Dictionary</li> <li>- Cooperation in Antarctica (Permanent WG) (Its upgrading to Regional Commission will be proposed to the XVth I.H. Conference)</li> <li>- Standards for Hydrographic Surveys (S-44)</li> <li>- Copyright on Charts and Nautical publications</li> <li>- Standardisation of Sailing Directions</li> </ul>	<ul style="list-style-type: none"> <li>- GEBCO Guiding (IHO/IOC)</li> <li>- GEBCO Officers (IHO/IOC)</li> <li>- GEBCO Sub-committee on Undersea Feature Names</li> <li>- GEBCO Sub-committee on Digital Bathymetry</li> <li>- Advisory Board on Law of the Sea (IHO/IAG)</li> <li>- Advisory Board on Standards of Competence for Hydrographic Surveyors (FIG/IHO)</li> <li>- Harmonising Group on ECDIS (IMO/IHO)</li> <li>- LAC Procedural Rules Committee</li> </ul>	<ul style="list-style-type: none"> <li>- Sub-committee on Terms &amp; Conditions of Directors &amp; Staff</li> </ul>

FIG. 1.- IHO Commissions, Committees and Working Groups.

made a significant contribution to the goal of reaching uniformity of charts and has also been a major element of the second objective of the Organization in coordinating the work of Hydrographic Offices. Rear Admiral LANGERAAR, the Netherlands Hydrographer of the day, has explained the thinking behind the development in a paper presented to the XIIIth International Congress of Surveyors in 1968 [4]. He noted the considerable duplication of work by Hydrographic Offices and pointed out examples where certain areas had been charted by at least eight different HOs making different compilations of the same area. It was proposed that a unique scheme of charts be developed covering all the world's oceans and that individual HOs volunteered to make the compilation of specific sheets. These compilations would then be available to whatever HO wished to make a facsimile copy but there would be just one unique version of the chart for every area and scale scheme. As all the charts had to look the same they would have to be compiled and drawn to very precise specifications and this process would lead to the uniformity that was desired. The idea was received by acclaim and work started to produce first the small scale charts at 1:10 million and 1:3.5 million and later to produce charts at medium and large scales. Although the small scale charts were produced with some dispatch, today, over 25 years later, the Organization has unfortunately a long way to go to complete the series, a matter that will be discussed further in the next part of this paper.

Besides its work in trying to achieve uniformity of paper charts various activities have taken place to develop uniformity of other hydrographic publications, such as Sailing Directions and Lists of Lights. Some of this work has been successful and some has moved forward slowly. Language remains a major constraint in all publications that involve substantial text.

It has been the digital revolution that has led the organization into a completely new field of standardization. Computers and digital data processing had been introduced into Hydrographic Offices as early as the 1960s but it was not until 1977 that the Australian delegation at the XIth I.H. Conference raised the need for standardizing the format of digital data that was then being used in the production of paper charts. This resulted in the formation in 1983 of the Committee on the Exchange of Digital Data (CEDD). However, technological development was now moving fast and only three years later a Working Group of the North Sea Hydrographic Commission, chaired by another Netherlands Hydrographer [5], reported on concerns over the development of electronic charts and this led to the formation of the Committee on ECDIS (COE). One of the earlier findings of this committee was that there was a need to revise the digital data exchange standard being developed by CEDD as it did not cover the needs for digital data that would be used in conjunction with electronic charts. This was eventually to lead, in 1992, to the first release of the IHO Transfer Standard for Digital Hydrographic Data, to become known by its publication number of S-57 (DX90). This was not quite the end for this particular development because experience in applying the standard over several years has shown the need for refinement and at the time of publication of this article S-57 will be formally released in its 3rd Edition, with plans to then freeze the standard for four years.

S-57 has not been the only standards or specifications to have been developed as a result of the advent of the electronic chart. For the first time the IHO has found itself working very closely with IMO in developing Performance Standards

for ECDIS. Such standards are used to define every piece of equipment carried aboard a ship, but few are as complex as that required for ECDIS and the work took nine years to complete. Working through its own COE and its various working groups, the IHO has developed a whole array of specifications concerning the hydrographic aspects of ECDIS. These include guidelines on updating and specifications for colours and symbols and specifications for the digital data base and for digital data quality. In retrospect, it is possible to realize that people who participated in these developments were at the start lacking in experience in the development of modern equipment standards and much has been learnt from other organizations about the way to proceed.

In developing these modern standards, particularly those concerning the data, the organization has become aware that it is not alone and that all over the world organizations are working in parallel on the same problems. National standards organizations in the USA, regional organization such as CEN (Centre European Normalization) in Europe and the overall international standards organization the International Standards Organization (ISO) are all struggling with the same issues. This is both a good and a bad thing because experience can be shared but standards once developed are by nature inflexible and there is a reluctance to move from the hard fought ground of one's own standards. Even in the rather narrow field of hydrography there is a breach between the IHO's chosen S-57 standard and that chosen by one of its Member State's HO, the US Defense Mapping Agency, which has chosen to use the Vector Product Format due to its applicability to strategic needs. Hopefully harmonization of these standards that is now going on will allow data in the different standards to be freely exchanged in the future. One very important matter to note is that unlike the earlier graphic specifications digital systems permit absolutely no deviation from the standard and strict adherence is mandatory.

Although the work on developing standards for ECDIS and, in particular, those concerning the digital data, is not over it is to be hoped that a point of some stability has been reached and the IHO can now turn its attention forcibly to its second objective, that of coordinating the activities of national Hydrographic Offices. That will be the subject of the next part of this paper and the main thrust, because therein is the future of the Organization.

## **THE CO-ORDINATION OF THE ACTIVITIES OF NATIONAL HYDROGRAPHIC OFFICES**

The word "co-ordination" has different connotations, which may range from co-operation to control. Consequently, as sovereign entities, individual Hydrographic Offices tend to take different stances over their membership of the IHO. Article II of the IHO Convention states clearly that it shall have a consultative and purely technical nature and this must be taken to mean both outside and inside the Organization. However its success will be affected by just how well individual Member States contribute to what are stated to be the goals of the Organization. Specifications that are not totally followed by all Member States will lead to less uniformity than if total adherence is given but obviously there will be times when

national pressures may exceed the obligations of Member States to the international goals. It has been already stated that some lack of adherence to graphics may be accepted but a lack of adherence to specifications for digital products is unacceptable if the goals are to be reached. It is this fact that caused the IHO to be adamant that only the S-57 exchange standard be permitted under the IMO Performance Standard on ECDIS.

It is not so much in the realm of uniformity but in the coordination of activities that the author now wishes to explore. In its interest to help each other in producing charts the Organization agreed in its earlier years to exchange data and documents. These agreements have been published in Section 3 of the Technical Resolutions. There were several reasons for exchanging data and documents. Adjacent countries wish to ensure that the hydrographic products of their waters match accurately those of their neighbour. It was also useful to examine the technology used by other states and the design and format of their publications. However foremost was the fact that some HOs produced charts covering areas of the oceans outside their sovereign control as a service to their merchant and naval vessels on international voyages. As these exchanges were all seen as contributing to the safety of those at sea the exchanges were generally free, with perhaps only the costs of the materials requested. Such exchanges were particularly useful to those HOs which produced world or regional chart coverage of charts. However, in recent years there has been a hardening of attitude to such free exchanges. Legally the change has been brought about by the Third Conference on the Law of the Sea, now enshrined in the Convention. The responsibility for management of the exclusive economic zone, stretching 200 miles offshore became the responsibility of the coastal state. Financially most western governments were looking to their governments to exercise cost recovery whereas free exchanges, even if these exchanges did lead to greater safety at sea, were no longer favoured. The idea that Hydrographic Offices other than the coastal state could freely make use of data gathered at great expense by the coastal state to produce charts that would be sold to the benefit of another state was being increasingly resisted. Coastal states which might at one time have had limited hydrographic capabilities now felt that they were equally as capable as their previous colonial masters. These developments came to a peak at the XIVth IH Conference when several countries spoke up against the existing resolutions permitting free exchange. The weapon against such invasion was copyright, the solution was bilateral agreement.

The IHO formed a committee to deal with the copyright issue and to develop more acceptable rules for the exchange of data. This has resulted in the present version of Technical Resolution A 3.4. Although most Member States are convinced that charts can be legally copyrighted a minority voice argues that facts cannot be copyrighted and as a chart is a collection of facts it is not possible to control the use of the data by copyright. Perhaps the most contentious matter at present is a clause in the existing technical resolution which states that if bilateral agreements cannot be made, a Hydrographic Office may re-compile the products of other hydrographic offices provided that due acknowledgement is given. This is total anathema to some Member States and can be expected to be strongly contested during the next Conference. At this point it should be noted that the world charting agencies, in particular that of the UK, as pointed out by BOND [6], have worked exceedingly hard to seek bilateral agreements with those countries whose data they use in the production of their charts of foreign waters.

Agreements on the exchange of data is not the only matter that concerns some Member States today. Another matter of considerable concern is the practice of re-compilation of charts of other coastal state's waters. It has been argued by world charting agencies that the scheming of national charts is frequently designed to satisfy the needs for coastal shipping and does not satisfy the needs of international shipping. Such re-compilations become part of an international chart folio and one single set of Notices to Mariners can be used to providing information for updating. It is pointed out that the use of all national charts to produce an international folio of charts would be unnecessarily costly for international shipping. Coastal states argue that Notices to Mariners and charts provided by the coastal state provide much more immediate and correct information than those provided by a distant authority. The matter of language comes into the middle of these discussions because clearly languages used by the coastal state, particularly if they are not in Roman alphabet, may be unreadable by international navigators. It is becoming clear that a groundswell of resistance to chart compilation by countries other than the coastal state is developing but the solution is to be found in a much faster adoption of the INTernational chart by all coastal states. INTernational charts are schemed to satisfy the needs of international shipping. Earlier resistance to their introduction by many Hydrographic Offices was based on the fact that they made free exchange even easier and encouraged the loss of business. However the bilateral agreements that are now required will overcome this problem. Although a change in the cartography is not permitted in the INTernational chart system, a change of language is allowed and the best solution is probably to produce bilingual versions using the language of the coastal state in parallel with English, which is recognized by IMO as the international language of the sea. Notices to Mariners can be provided by the coastal state but may then be combined for convenience in the Notices to Mariners of the regional or worldwide charting organization. The difficulty with introducing these ideas of adopting the INTernational charts more rapidly is that few Hydrographic Offices have the resources to carry out such a programme. One can only encourage coastal states in producing charts of their waters to give more attention to producing them in the agreed INTernational chart scheme and specifications and that those who wish to chart the coasts of other countries will not recompile the national charts but will make use of the INTernational charts produced by the coastal states. Experience shows that international shipping prefers what is sometimes termed "one stop shopping", in which all the charts and the subsequent notices to mariners for a given voyage can be obtained from one source.

The introduction of electronic charts has caused new business practices to be introduced in the sale, maintenance and distribution of nautical charts. Although commercial industry has been involved in producing paper charts for many years, these have been primarily to satisfy the yachting market, which until recently represented a small part of the overall chart market. That situation has now greatly changed. Not only is the yachting market a major part of the chart market but commercial companies have now seriously entered the business of providing digital charts for commercial shipping. The cause of the invasion of this market, previously occupied exclusively by government HOs has been partly due to the slowness with which the HOs have been able to turn their production lines from graphic to digital production. It has also been due to the insistence of the HOs that the digital data standards must be precise and accurate.

The IHO has tackled the international production of charts in two ways. At the IMO it has insisted that if ships are to carry electronic charts in lieu of paper charts they must meet precise standards with respect to both the system and data design and that furthermore the data must be provided under the authority of a national HO. Legally this means that although electronic charts may be produced by a commercial company they must be produced under the authority of an HO and this means that the data quality is ensured. The other element of IHO action has been to develop an organization that will integrate all the digital data produced by its Member States into a series of regional integrated data bases that may be combined to provide a worldwide service. This organization is known as the WEND (Worldwide Electronic Navigational Chart Database). The conceptual model for this has been described in a paper by the author [7]. The model is not significantly different from the ideas of the INTernational chart system, in that the products of all the Member States can be harnessed to provide a single worldwide service. A point to note is that the WEND operates on a list of principles, one of which ensures total ownership and responsibility for the data of the waters under the jurisdiction of a coastal state [8]. A second principle is that through bilateral agreements the HOs receive reimbursement for the data that they provide to the regional coordinating centres.

The Regional Electronic Navigational Chart Coordinating Centres (RENC) are at present in a state of development. Norway, which had originally offered to develop a worldwide data base by itself, took the lead in developing a RENC for Northern Europe (RENC/NE). UK has now joined this enterprise, with all the main HOs in the region agreeing to contribute data. So far, the RENC/NE has perhaps developed more slowly than many would have wished but with substantial investment planned and the fact that the S-57 standard is now firmly in place, it is hoped that progress will increase rapidly. Elsewhere Japan proposes to develop a RENC for East Asia but its thinking at this stage is less of data integration than of sharing technology.

The exact way in which the WEND may develop is unclear at this time but there is great urgency for official vector services, using the S-57 standard and authorized data, to be provided. There is great concern within the IHO that unless these services are provided very soon the commercial companies will capture the market with unauthorized data. It is well recognized that commercial enterprises can move more rapidly and with greater flexibility but the IHO remains insistent that only government HO authorized data is legally acceptable as a replacement for paper charts. It is a time for great cooperation between IHO Member States.

Some of the more obvious questions facing the IHO and its WEND organization at the moment include the speed at which it can offer complete services to various parts of the world, the viability of the WEND concept overall. Can RENCs really function and will all HOs be able to keep up with their promises commitments? A particularly interesting question is whether the integration of data sets from different HOs in one geographic location is the best organizational model. Telecommunications have been developing very rapidly in recent years and distributed or virtual databases are becoming increasingly viable. It is evident that some HOs wish to retain total control of their own data and do not favour the WEND concept of integrating and marketing their data at a single geographical location. It has been proposed that each HO can retain its own data and provide its own updating and that all that is needed is a data network on the lines of INTERNET



through which commercial agents can draw and package data to satisfy the needs of their customers. It is even possible that individual customers can draw out the necessary data and updates for a voyage while they are at sea by addressing their requests to individual HO's providing services along their route. The RENC/NE through a European Commission funded project called ECHO (European Chart Hub Organization) [9] is studying the development of an ENC (Electronic Navigational Chart) Information Network and this may lead to some answers to these questions.

The relationship of the IHO to Industry is rapidly changing and needs careful consideration by the Organization. The IHO itself is an intergovernmental organization but many of its Member States have now developed close relationships with commercial companies and this has an important bearing on the IHO itself. The relationship between HO's and commercial company ranges from straightforward contractual work to actual partnerships. In the matter of developing a worldwide electronic chart data service the organization must decide just where the part of Industry begins and ends. It appears at the moment that unless the IHO develops firm policies on these matters, that are supported by all its Member States, Industry will move into areas of work and business that to date have been considered the domain of the HO's. The basic question is whether HO's should remain responsible for marketing the data that they have collected or having compiled that data into some basic product should they leave its marketing, including the development of value added products, to Industry? It is doubted that if at this time any Member States would agree to such a suggestion but unless they move firmly forward, making bold changes in their priorities towards digital products and agreeing to cooperate internationally, even at the expense of some national interests, the decisions on the part that Industry will play in the future will be made for them.

## References

- [1] BOND B.A. (1996). Strategic Considerations for International Hydrography in the 21st Century. This issue of the *International Hydrographic Review*.
- [2] KERR A.J. (1996). Developing International Specifications for Nautical Charts - Possibilities and Pitfalls. *Journal of Navigation* No. 49 (2), pp. 132-142.
- [3] RITCHIE G.S. (1983). The Work of the International Hydrographic Organization. *Journal of Navigation* No. 36 (1), pp. 116-123.
- [4] LANGERAAR W. (1969). Towards an International Chart. *International Hydrographic Review*, Vol. XLVI (2), pp 7-16.
- [5] NORTH SEA HYDROGRAPHIC COMMISSION (1986). Report of the NSHC Working Group on Electronic Chart Display Systems. (Chairman: Rear Admiral L.H. van OPSTAL), February 1986.
- [6] BOND B.A. (1996). Ibid.
- [7] KERR A.J. (1994). The Conceptual Model of a Regional Integrated Data Base for ECDIS. *International Hydrographic Review*, Vol. LXXX (2), pp. 37-45.
- [8] INTERNATIONAL HYDROGRAPHIC ORGANIZATION (1994). Report of the Special Committee on WEND. Circular Letter 27/1994.
- [9] BUCKLE J.K. and R. SANDVIK (1996). ECHO: Developing an ENC Telematic Information Network. *Proceedings of Canadian Hydrographic Conference*, Halifax, Canada.