

# THE VALUE OF HYDROGRAPHIC INFORMATION AND ITS INFLUENCE

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**Abstract.** The International Hydrographic Organization (IHO) and its objectives of aiming at improving hydrographic capabilities worldwide are introduced in this paper. Hydrographic development contributes to safety of life at sea and the protection of the marine environment, while also contributes to sustainable development. Highlights the importance of capacity building and invites countries in the region to consider joint work with the Meso American and Caribbean Hydrographic Commission, the regional structure of the IHO. The definition of hydrography and nautical chart and nautical publications is provided to fix the scope of the paper, including some economic characteristics of these products. The paper makes to these products and identifies some elements of main value. These elements are also cross-referenced with several other different activities for which such information is required. The influence of hydrographic information has in the decision making process of different activities of national importance is described and some conclusions are offered as invitation for further consideration.

**Key words:** capacity building, cartography, coastal zone management, engineering survey, hydrography, marine cadastre, real estate development, risk management.

## 1 INTRODUCTION

The International Hydrographic Organization is an intergovernmental organization with a consultative and technical character, contributing to safety to navigation and protection of the marine environment through the coordination of the activities of National Hydrographic Services. The organization seeks for the greatest uniformity of nautical charts and complementary publications, as well as the adoption of the safest and most efficient methods of conducting hydrographic surveys and production of nautical charts.

The IHO has a structure that comprises of a Conference – meeting of all member states, today 80; a Secretariat the headquarters of which is in the Principality of Monaco, 15 Regional Hydrographic Commission, including the Meso American and Caribbean Sea Hydrographic Commission at which Costa Rica as well as all Central American countries can participate. Also the IHO has different Working Groups, Committees and Commissions to deal with technical specific topics. One of the Committees is the Capacity Building Committee that looks after the improvement of existing hydrographic capabilities and develop strategies to establish new hydrographic offices where they do not exist, provided that expression of interest are received from interested countries.

The IHO is doing a great effort in raising awareness on the importance of hydrography worldwide and this FIG Regional Conference was identified a an excellent opportunity to flag this matter in a region where hydrography does not look to be developed, despite of the maritime characteristics of the countries in Central America.

For senior hydrographers and hydrographic surveyors this paper does not constitute any surprise, but a reiteration and an opportunity to call for a higher priority to an activity that no doubt contributes to sustainable development for national and regional initiatives of

economic importance. Safety to navigation and protection of the marine environment cannot be achieved without a national hydrographic agency and a coordinated structure. Hydrography needs to be seen as a national objective of strategic importance.

Let us go now to some early definitions that shall help us to get a better understanding of the importance of hydrography.

Understanding that there might be several definitions for Hydrography, I invite you to consider for the purpose of this presentation the definition adopted by the International Hydrographic Organization that says:

“Hydrography is that branch of applied sciences which deals with the measurement and description of the features of the seas and coastal areas for the primary purpose of navigation and all other marine purposes and activities, including –inter alia- offshore activities, research, protection of the environment, and prediction services”.

In this context, first of all I would like to identify some of the main hydrographic information we are referring to, those we think are of great general value ; what type of activities can be benefited from the hydrographic information to finally attempt to give some thoughts as regard to the influence this information plays in the decision making process.

From our perspective we also differentiate hydrographic data from hydrographic information, being the later the result of a process that makes the original raw data of use for a particular purpose. In this context we shall consider nautical charts and nautical publications as the two main traditional products compiling hydrographic information.

It might be prudent to consider the definition of these two elements given by the International Maritime Organization (IMO), for which:

**‘Nautical chart or nautical publication is a special-purpose map or book, or a specially compiled database from which such a map or book is derived, that is issued officially by or on the authority of a Government, authorized Hydrographic Office or other relevant government institution and is designed to meet the requirements of marine navigation.\*’**

**‘\* Refer to appropriate resolutions and recommendations of the International Hydrographic Organization concerning the authority and responsibilities of coastal States in the provision of charting in accordance with regulation 9.’**

(See Regulation 9 “Hydrographic Services” in Annex A).

It is difficult to find a maritime country that does not depend on the availability of nautical cartography. It might be said on the contrary that almost all maritime countries are strongly dependant on nautical cartography and nautical publications for their maritime commerce and development. Nevertheless it is extremely difficult to make an analysis that could easily show the economic benefit for a country derived from the use of these two information sources.

Products such as Nautical Charts and Nautical Publications Nautical have some very interesting characteristics from an economic perspective, being these characteristics the ones that make any economic analysis a challenging exercise. They are:

- a) an intermediate good
- b) almost always a good from the public sector
- c) a public good or a public service

A nautical chart or nautical publication is an intermediate good as on its own has little utility and therefore must be incorporated to another good, activity or service, to have a real economic value. As an example, a paper chart is just a paper with information. Its value only becomes important when it is used, for example in the shipping activity, but a paper chart on a shelf in a store worth very little.

Being a good almost always prepared by the public sector, it is very difficult to quantify its value as they are marketed by the national authority or dealers with a referenced price. Also, are subject to subsidies the costs of which are normally very difficult to determine.

Being a public good or a public service, its value cannot be determined precisely and this situation precludes the private sector to participate in 100% of the full process, from the planning to the provision of the product.

Finally there is no competence in the consumption, that is to say that the service provided to one user can also be provided to many other users without an extra cost. The edition of a nautical chart or the provision of the marine safety information service constitutes a product and service the costs of which are independent of the number of users. Also, a person might decide not to use the service, but the service must be provided anyway as regulations request the use of nautical charts and publications for safety to navigation purposes, independent of the number of users. The last particularity of these services is that they cannot be refused; for example, a mariner will pay for the services of lighthouses in a particular route, no matter if he decides not to use the service.

Normally Hydrographic Offices sell their products at a marginal cost, that is to say, to recover the printing costs and the manpower used in the editing and printing phases. The recovery of costs such as ship's days, helicopter's hours, salaries of those gathering and processing the data, instrumentation maintenance and others, normally are not considered.

Well this introduction has located us in the general context of this paper. Now, let us move into some details.

## 2 HYDROGRAPHIC INFORMATION OF MAIN VALUE

The nautical chart and the nautical publications contain a complete set of information aiming at providing the mariner with the required information to sail safely. The following are some of this information:

- a) **Coastline:** For the mariner the representation of this line in the chart serves as a reference to interpret the representation offered by the radar, getting a good feeling of the ship position. But also this is the natural limit between the sea and the land at a particular moment, low water as marked on large-scale charts officially recognized by the coastal State. This line constitutes the normal baseline of a country and the bases for the establishment of the straight baselines, if ap-

ply according to UNCLOS. From here it is measured the breadth of the Territorial Sea, Contiguous Zone and Economic Exclusive Zone and the Definition of the Continental Shelf external limits or extension beyond 200 nautical miles if applies. Also constitutes an important limit for the definition of the beach and the neighbouring proprietary of the land, either of public or private domains.

- b) Coordinates:** The coordinates provide the mariner a standardize language to indicate his position, normally in degrees of latitude and longitude. This standardized system allows assigning each feature its corresponding coordinates. This coordinates are universally well known and facilitates delimitations, measurements and planning for different purposes.
- c) Currents:** The indication of the currents in the chart and its description in relevant nautical publications provides the mariner with the conditions he might expect during his voyage in different places and at different times. Also this information is requested for all submarine operations, coastal engineering works, and many others, as it will provide a forecast of the direction and speed of the current expected. Normally the information provided in charts and publications correspond to the mean values extracted after long observation periods. Hydrographic Offices might have detailed records of current observations available for other uses.
- d) Depths:** Depths provided in the nautical charts as well as the isobaths constitute an extremely valuable information, as they set the bathymetric characteristics of a particular sea area. The steepness or the flatness of the sea floor as well as the actual clearance between the sea surface and the sea bottom could be extracted from this information. It must be understood that not all the information can be made available in the nautical chart and much more information in the form of profiles are with the hydrographic offices that collected and processed the data.
- e) Geographic description:** A nautical chart is self explanatory, but there is information that must be made available in written form as it constitutes a geographic description of a particular area. One of the nautical publications that contains such description is known as Sailing Directions. In truth the description is an historical record or compilation of experiences offered by the hydrographers that surveyed the area and many mariners, port authorities and others that have contributed to enrich the description of the area. This will benefit mariners sailing the area for the first time as well as others aiming at knowing the particularities of the area for different uses.
- f) Limits:** A nautical chart and the complementary nautical publications draws and describes, respectively, the different limits established for different purposes. It can be international maritime limits; other administrative limits as in UNCLOS; or national resolutions as for example areas forbidden for a particular activity or areas where a precise activity shall take place. This information is of the utmost importance as the situation is opposite to the land situation, where the limits are materialized with clear marks and indications. Limits also contribute to the management and protection of marine spaces.
- g) Nav aids:** The information on aids to navigation that are included on charts and publications represents identifiable marks that physically exists or systems that

could provide a standardized position to a user. Also can be a service contributing to the safety of life at sea or to safety to navigation.

- h) Sea bottom:** It is a characteristic of the nautical chart to indicate the type of the first layer of the sea bottom. This information helps the mariner mainly to decide where to anchor. Also where landing crafts could land in the shore. Information collected by hydrographic offices could be much more complete than the general information included in the chart.
- i) Tides, Levels and datum:** The information on tides, the different levels adopted and the identification of the datum selected in the vertical control go all together. Long period of tide observation and the determination of the respective levels such as the Mean Sea Level, or any other, together with the adopted datum for depth reduction are decisions taken at each hydrographic office. A nautical chart indicates certain tides parameters and the datum. A special nautical publication known as tide tables provides the forecast for heights of the tide at relevant ports. Hydrographic Offices might have detailed records of tide gauge observations available for other uses.
- j) Wrecks:** This information included on the nautical chart prevents from hitting a sunken ship of which no evidence is seen from the surface of the sea water. Its precise position and clearance could avoid accidents, loss of fishing equipment and nets and collisions, with unexpected results.

I have provided a very brief description of each of these 10 elements, included in nautical charts and nautical publications, highlighting the use a mariner makes of each of this information.

The effort different national entities made to gather, process and generate hydrographic information, products and services is not trivial. The important message is to understand that this effort is a "national" effort. The cost/benefit ratio of the investment required for this to happen is improved if the information is shared and all potential national users benefit from this information to support their particular objectives. This requires a national coordination structure in the form of a National Hydrographic Committee or similar body.

By the way, all countries signatories of the Safe of Life at Sea Convention (SOLAS) and members of the International Maritime Organization (IMO) have agreed to undertake several obligations as regard to the provision of charts, publications and services. This matter is no longer of a voluntary character but a commitment of maritime countries. I invite you to give a close reading to this regulation accepted and adopted by signatory countries.

In the next section I would like to associate each of these elements with some key activities of relevance to maritime countries.

### 3 ACTIVITIES THAT BENEFIT FROM HYDROGRAPHIC INFORMATION

In the following Table we have a cross-referenced Hydrographic Information and the activities that benefit from that information. Certainly the list is not exhaustive, but gives an indication as regard to the main areas.

Hydro information activity	Coast line	Co-ordinates	Currents	Depth	Geodesic description	Limits	Nav-aids	Sea bottom	Tides, levels & datum	Wrecks
Aquiculture	X	X	X	X		X		X	X	
Cable/pipe laying	X	X	X	X	X	X		X	X	X
Coastal zone management	X	X	X	X	X	X	X	X	X	
Defense	X	X	X	X	X	X	X	X	X	X
Dumping		X	X	X	X	X			X	
Coastal engineering	X	X	X	X	X	X		X	X	X
Environment	X	X	X	X	X	X		X	X	
Fisheries, living resources	X	X	X	X	X	X	X	X	X	X
Health / red tides	X	X	X	X	X	X	X		X	
Marine delimitation	X	X		X	X	X		X	X	
Marine scientific research	X	X	X	X	X	X	X	X	X	X
Maritime transport / navigation	X	X	X	X	X	X	X	X	X	X
Natural hazard / modeling	X	X	X	X	X		X	X	X	
Non living resources	X	X	X	X	X	X		X	X	X
Ports	X	X	X	X	X	X	X	X	X	X
Real estate	X	X	X	X	X	X			X	
Safety of life at sea (sar)	X	X	X	X	X	X	X			X
Sports	X	X	X	X	X	X	X	X	X	X
Tourism	X	X	X	X	X	X	X		X	X

### 4 INFLUENCE IN THE DECISION MAKING PROCESS

#### 4.1 Aquiculture

National Authorities when adopting rules to administer this activity shall consider the characteristic of the coast, the adjacent bathymetry, currents and tides. Without this basic information concentration and distances between centres to avoid mutual interference cannot be seriously adopted.

#### 4.2 Cable/Pipe Laying

Precise bathymetry, sea floor bottom characteristic and current are essential for planning the layout of cables and pipes laying. Environmental characteristics such as currents have strong influence in the route to be followed in the laying process operation.

### **4.3 Coastal Zone Management**

A precise description of the coast and the consideration of bathymetry, currents, and tides are required to adopt administrative measures for a better planning. The use of the coastal zone needs to be prioritised and regulated in function of its particular characteristic. Questions such as which is the best use or what type of activities can coexist require an in depth study of these parameters. Criteria to manage and control maritime concessions are also dependant on hydrographic information.

### **4.4 Defence**

Naval exercises and operations require an excellent knowledge of the whole spectrum of hydrographic information. Special submarine exercise areas are to be defined and probably limitation for other activities shall be determined based on bathymetric characteristics of the area.

### **4.5 Dumping**

Dredging operations are commonly executed in almost all ports. Following strict criteria the dumping areas are to be defined, based mainly on depth, currents and ecosystems present. Dredges cannot discharge material elsewhere, but in areas predetermined and authorized.

### **4.6 Coastal Engineering**

The study of the coast line and the influence of tides, currents, waves and the bathymetry constitute a must in all coastal engineering projects. The impact of any work on the coastal dynamics needs to be assessed through models for which detailed information is mandatory.

### **4.7 Environment**

Environment is at permanent risk of accidents and plans are required to react in case of emergencies. By knowing the characteristic of the area the administration can adopt the most effective measures to control pollution.

### **4.8 Fisheries, Living Resources**

The fishing activity is very dependent on the bathymetry. Serious accidents could take place if the submarine topography is ignored as nets can be get caught by pinnacles or wrecks if not known. Administrative measures to protect certain species or to regulate its catch are as well bathymetric dependent.

### **4.9 Health / Red Tides**

Monitoring of harmful algae blooms can be best achieved if parameters such as currents, tides and bathymetry are known. Adopted contingency plans shall be more successful if these parameters are considered.

#### **4.10 Marine delimitation**

Nautical charts are vital for the establishment of maritime delimitations as requested by UNCLOS. Bathymetry and the characteristic of the sea floor sediment's layers are mandatory to access to extension to the continental shelf beyond the 200 nautical miles. The decision making process in this case has a strong international impact.

#### **4.11 Maritime Transport / Navigation**

Navigational routes are determined based mainly on the bathymetric characteristics of the area. Routes must provide ships a safe clearance and sufficient manoeuvring area for the operations, especially in restricted waters, due to the narrow of the passages, the existing depths and currents. Nautical charts, representing all the required hydrographic information for this purpose, is considered to be main aid to navigation.

#### **4.12 Natural Hazard / Modelling**

The success in protecting coastal communities from natural hazards such as tsunamis and storm surges are dependant on the availability of hydrographic information. Planning evacuation routes requires inundation charts that are prepared after running models based on some parameters and under some conditions. Coastal bathymetry and topography are a must in this approach.

#### **4.13 Non Living Resources**

The decision to exploit marine non living resources is also dependent on the geomorphology and characteristic of the sediments of the sea floor. The extraction of mineral or as simple as the extraction of sand to nourish rocky beaches demands a detailed knowledge of the regime that affects the coastal zone, such as depths, tides and currents.

#### **4.14 Ports**

Ports are extremely important national economic units. The exploitation of the best draft a cargo ship can have obliges to have a detailed command of two basic elements, bathymetry and tides. This information is nowadays monitored in real time to optimise the cargo limitations. As regard to the exploration of areas apt for the development of new ports, the full set of hydrographic information is vital for a wise decision.

#### **4.15 Real Estate**

As in land, the coastline and also the sea are exposes to a high pressure of increasing uses. New regulations and policies are put in place and innovative figures are demanding as well innovative legislations. Artificial islands for example. Perhaps hydrographic information is mostly required to set standards and new practice in the administration and control of such spaces.

#### **4.16 Safety of Life at Sea (SAR)**

Search and Rescue operations are well known. People and means participate in this normally risky operations. A complete hydrographic knowledge of the area of the emergency is required and special hydrographic missions are conducted whenever are necessary to support these activities.

#### **4.17 Sports**

The definition of areas apt to practice nautical sports also should consider hydrographic information, such as bathymetry, currents and coast line. Sports at sea can take different forms. They can be on surface or submerged and therefore to authorize any particular area, this one must be specially examined according to the environmental conditions, minimizing risks.

#### **4.18 Tourism**

There is a difference to be considered between shipping routes and cruise liners routes. The objective of the first is to transport goods from one port to another in the most safely and economic way (shorter route). Cruise liners privilege the scenery, the beauty. The identification of potential new routes and finally the decision to open new routes depend on hydrographic information.

Our message is that hydrographic information is absolutely necessary to adopt a number of decisions, all of which have an economic impact on the development of maritime nations.

## **5 CONCLUSIONS**

1. The International Hydrographic Organization provides all maritime countries the opportunity to benefit from its experience in improving or establishing national hydrographic capabilities. Due to the incipient or lack of national hydrographic structure in several countries in Central America, countries as for example Costa Rica, might wish to consider approaching to the IHO bodies, to get advice on how Hydrographic Services as established in SOLAS Regulation 9 could be achieved.
2. Capacity building is a key issue to achieve development. IHO structure considers regional hydrographic commissions to address regional problems for which a collective solution could be explored, identified and put in place. Countries in Central America should strongly consider participating in the activities of the Meso American and Caribbean Sea Hydrographic Commission and apply for technical support to develop its hydrographic capabilities.
3. Hydrographic Information the traditional representation of which constitutes the nautical chart or nautical publication has an immense value. The concept that hydrographic information only serves the purpose of producing these two products is wrong. Being the main purpose to contribute to safety to navigation and protection of the marine environment, hydrographic information strongly contributes to many other initiatives of economic interest.

4. The lack of hydrographic information precludes national authorities to adopt the best possible technical and administrative regulations aiming at the development and welfare of their communities in a sustainable manner. Funding hydrographic surveys and studies shall not be considered as expenditure but as an investment, and a real national asset of strategic importance.

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## **ANNEX A**

### **SOLAS CHAPTER V SAFETY OF NAVIGATION**

#### **Regulation 9 Hydrographic services**

1. Contracting Governments undertake to arrange for the collection and compilation of hydrographic data and the publication, dissemination and keeping up to date of all nautical information necessary for safe navigation.
2. In particular, Contracting Governments undertake to co-operate in carrying out, as far as possible, the following nautical and hydrographic services, in the manner most suitable for the purpose of aiding navigation:
  - a. to ensure that hydrographic surveying is carried out, as far as possible, adequate to the requirements of safe navigation;
  - b. to prepare and issue nautical charts, sailing directions, lists of lights, tide tables and other nautical publications, where applicable, satisfying the needs of safe navigation;
  - c. to promulgate notices to mariners in order that nautical charts and publications are kept, as far as possible, up to date.
  - d. to provide data management arrangements to support these services.
3. Contracting Governments undertake to ensure the greatest possible uniformity in charts and nautical publications and to take into account, whenever possible, relevant international resolutions and recommendations.\*
4. Contracting Governments undertake to co-ordinate their activities to the greatest possible degree in order to ensure that hydrographic and nautical information is made available on a world-wide scale as timely, reliably, and unambiguously as possible.