Note

Trends in Data Management with Hydrographic Offices

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1. Introduction

Hydrographic Offices (HOs), by definition, are government authorities which carry out responsibilities at sea that are in the public interest of a country. The spatial area of responsibility ranges from their coastline to the outer limit of their Exclusive Economic Zone (EEZ). Depending on the country's size, this may be in the range from a few thousand square kilometres to up to a million and more square kilometres.

Their responsibilities of a hydrographic office do not only depend on the mere geographic dimensions of a country's EEZ. A large number of additional factors can contribute to the responsibilities of an HO, such as:

- intensity of seaborne traffic within the EEZ,
- shallowness and changeability of the sea floor,
- the intensity of other types of uses of the sea area within the EEZ, e.g. the activity of offshore industry.

From the beginnings of mankind , shipping and fishing were the only prominent types of use of the seas, and consequently hydrography was primarily devoted to serving the needs of both naval and merchant shipping. Whilst shipping today remains a crucial, if not determining factor for the responsibilities of an HO – and shipping itself is growing at a remarkable rate -, the importance of other uses, as a result of the technological development, has grown significantly. One can say, that mankind has completed exploring and conquering the oceans, and is now starting to take up residence at sea. In the first phase this will be limited to building industrial structures at sea, but the next step will be to build marine settlements and we are already observing the first steps in this direction.

What technology has already accomplished, and what the trends are, one can derive from the development of offshore structures. For example, the BSH as the responsible German authority, has to deal with applications for building huge wind-driven power plants within the German EEZ. They consist of a large number of wind turbines with heights up to 130m and a power generation capability of 3 or more Megawatts each; the total number of wind power plants currently under construction or in a concrete project phase runs up to a total electric power of more than 3,500 Megawatts, or the equivalent of three nuclear power plants – and this is only on the small German EEZ, where there are numerous other uses as one can see from Figure 1.

Another, at least as amazing an example, is the development of offshore hydrocarbon production platforms (Figure 2). One can see that within 30 years time offshore structures have spread out from the shallow continental shelf into the deep sea, from depths around 50m up to depths of 2,200m today and they have also considerably increased in number. Finally, Japan has built a complete airport at sea.

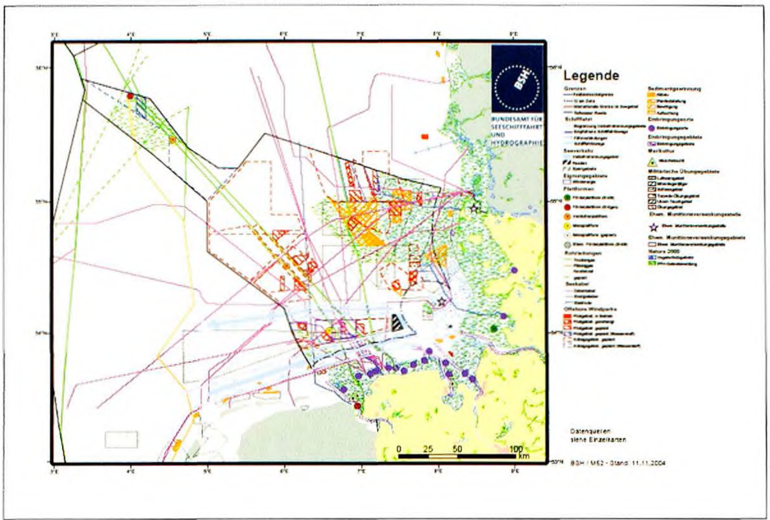

Figure 1: Uses of the German EEZ in the North Sea (from [1]).

These few examples may prove the thesis that the enormous increase of uses of the marine areas has caused a corresponding shift in the responsibilities of HOs: from facilitating shipping to facilitating all possible uses of the sea.

The increasing uses of the sea result in the inevitable need to control and to administer these uses. Similar to that which has already existed for a long-time on the land side, spatial administration has to be also developed for the territorial sea and the EEZ. This comes as a natural task for Hydrographic Offices who have the geodata competence at sea and who already maintain huge amounts of data, not only of the seafloor but also very often of the physical and dynamical parameters of the sea. For example, the BSH has been appointed by Federal Law as the German authority responsible for spatial planning of the German EEZ.

Generally, geographic information has been identified as a precious good which should be made available as a public good, in particular as far as it is collected and compiled using the taxpayer's money by the public sector institutions. There is, therefore, a tendency world-wide to facilitate the use of geographic information not only for public administrative purposes, but also for the private sector.

2. The Requirements of Data Management for Hydrographic Offices

The strategic objective of all HOs will obviously be *always to be able to meet, as efficiently as technologically possible, the developing and changing needs of the future*. This means, one has to continuously monitor:

- which services the national society, economy and administration expects from the national HO,
- how technology is developing with respect to meeting the HO's service and production requirements,
- the requirements at the interfaces of the HO with other national and international public bodies as well as with private industry.

2.1. Inside the HO

Today's digital technology has completely changed the work processes and is shifting their targets from products to collecting, compiling, and maintaining the data necessary to produce the products. In addition, the versatility inherent in digital data bases enables HOs to respond with much more flexibility to changing requirements and to create ad-hoc products on demand. The products itself are no longer bound to be 'hard' products such as charts and books: soft products are gradually superseding the traditional products, such as the Electronic Navigational Charts (ENCs) needed for ECDIS open new ways in navigation, moving the chart information from the chartroom somewhere in the back of the ship's bridge to the conning centre of the bridge. Here the ECDIS integrates various information flows (positioning, radar, AIS) into a central navigation information system.

The increasing diversity of products and services to be supplied creates the need for HOs to look for

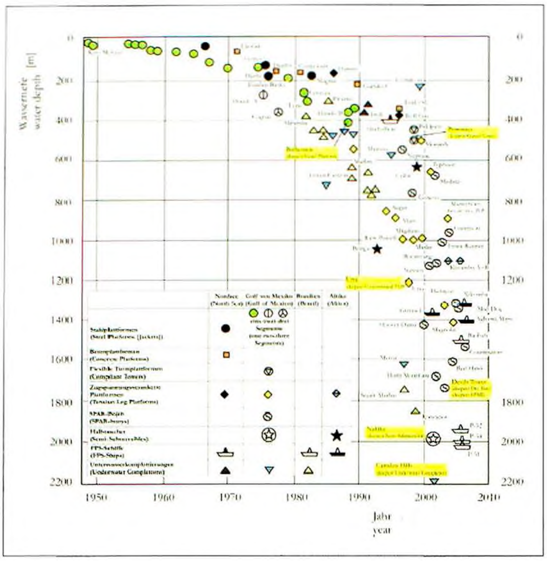

Figure 2: Offshore Platforms and Underwater Constructions (from [2]).

ways to integrate different work flows, to reduce redundancy of information bases to be maintained, and to enhance the efficiency of services and production through automated work processes.

2.2. The National Framework of HOs

Traditionally, HOs were used to generally work in isolation from other branches of governmental administration. HOs were looking on the sea, where nobody was living, while the other authorities were looking landwards, where they were directly connected to everybody's life, and they all were producing their products separately from each other. Already the increased environmental awareness in the eighties of the 20th century has slightly broken up that isolation. It was recognised how closely related industrial and agricultural activity ashore, and the impact of shipping are to the marine environment. The term 'Coastal Zone Management' (CZM) was coined in those days, and a new, hybrid type of chart was developed to facilitate the administration of the coastal zones. The UK,for example, developed the 'amphibious' CZM chart combining map and chart contents into a single chart [3], still a paper product. However, it was not successful and it was cancelled a few years later. Probably it was too difficult to meet the needs of Coastal Zone Management with such a single paper product.

The idea of a CZM chart has recently experienced a revival in the UK, following a careful examination of user requirements, but now it is a collection of vector geo-data bases from various authorities, based on a set of common standards and rules that can be accessed online [4]. According to the UK, the user acceptance is overwhelming.
The above example shows that it is the data that is needed for administering and managing the coastal and sea zones, not any 'hard' products, and that HOs have to co-operate with other authorities to satisfy all data requirements. Today the Internet opens new dimensions for the work not only of HOs, but of all institutions measuring and compiling geographic information. However, several conditions must be met to exploit the potential:

- The power of geographic information systems, combined with
- the connectivity of different data bases over the Internet, and based
- on a common set of data and access standards.

These conditions are collectively referred to as the Spatial Data Infrastructure (SDI). In other words, geographic information on a computer from a variety of different data bases networked together and mutually compatible under a common 'data culture' - the standards - can bring together all geoinformation needed for a task or purpose.

Hence, data management in HOs can no longer be considered in isolation of other authorities operating geo-databases. Rather, HOs must accept that the geographic space is connected and embracing marine and land space. Whilst the Internet technology readily provides for the physical connection of different data bases, this is not sufficient and leads automatically to the question which standards are required to establish inter-operability between different geographic data bases.

2.3. The International Framework of HOs

As the Internet is connecting different countries and even continents, and as geographic space finally embraces the whole globe, national standards are most likely not suited to establish the necessary SDI – one has to look for a Global SDI as a basis for the data management strategy.

The development of national SDIs is already underway in many countries. In the European region with its supranational structure, this has prompted a European Directive for establishing an 'Infrastructure for Spatial Information in Europe' (INSPIRE) [5] that is currently under consideration by the EU member states. As it is stated in the Extended Impact Assessment of the Draft Directive: "The overall objective of the INSPIRE legislation will be to make harmonised and high-quality spatial (geographic) information readily available across public sector bodies in the European Union at local, regional, national and European level in order to support policies with a strong territorial dimension." Thus, HOs, like other public bodies in Europe, will have to consider the need to fit in with a harmonised European spatial data framework.

Fortunately, Hydrographic Offices are in the position that the IHO has adopted a modern GIS standard, called S-57, which can be used for all hydrographic purposes, and that this standard has been incorporated by the International Standards Organization (ISO) in the development of a universal GIS standard. As the EU strongly relies on standards developed by ISO, the standards that can be expected to be adopted under the European Infrastructure will be the relevant ISO standards. One can anticipate that in future all GIS data structures that may become relevant in combination with hydrographic data will be compatible with the suite of universal ISO GIS standards. Thus, using the S57-framework as a basis for an HO's data management will become a requirement.

3. Conclusions

Today, data management in Hydrographic Offices has to be based on a long-term strategy. Current and future developments show that:

- Increasing uses of the marine zones result in a strong and growing demand for diverse, customised products and services from HOs.
- HOs have to adjust to an evolving international, ultimately global spatial data infrastructure where an HO performs functions as a specialised node, 'hydrographic server', acting as the national focal point and competence centre for marine data services - within a national spatial information service network that itself is imbedded in an international network.
- GIS technology, based on international GIS standards, offers the solution for HOs to meet the requirements of the future.

Thus, HOs have to prepare to migrate their entire data management from a heterogeneous system of different, product-oriented work-processes towards an integrated system based on GIS-technology, as the first step. In other words, a GIS-based production environment has to be developed that supports as many as possible data services, products (hard and soft), and that minimises redundancy of data maintenance. Using S57 as the core of the GIS structure will be a safe choice in view of the international developments.

However, S57 as it is standardised today will not yet suffice to accommodate all data holdings of an HO. For example, 3-dimensional oceanographic data such as salinity and water temperature, or even more complex, vector current data, need an extended data model of S57. Another dimension is added by time-dependency. The developing ISO standard, though, will be able to handle also multidimensional data sets. Thus, HOs will have to prepare for longer period of transitional phases.

For HOs to grow fit for a role as a hydrographic data server within a national/international spatial data infrastructure requires much effort. One requirement will be to provide for the metadata needed for external users coming through the network to identify the available sources for their data request. Metadata are not provided for in S57, but suitable ISO standards exist. Secondly, opening to the outside world requires HOs to adopt and implement rules and methods for allowing and facilitating public access to the data bases. There may be support expected from the governments who wish to establish and develop the national SDI to support administration and developing private sector businesses.

There is no alternative for HOs to taking up the challenges of the globalised information society. "HOs will survive or die based on the quality of data, and quality of data access that they provide, and partnerships fostered with other data providers" [6].

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