Improving Data Flow at UKHO

The UK Hydrographic Office, responsible for producing critical navigational charts and electronic navigational information to mariners manages large quantities of constantly updated geospatial and bathymetric information. Hazel Vallance and Peter Schwartsberg explain the major project to streamline workflow and data management to ensure up to date, accurate information is available to all seafarers who need it.

The United Kingdom Hydrographic Office (UKHO) is the power behind the world-renowned Admiralty brand of products and services. The Admiralty portfolio includes 3,300 Standard Navigational Charts and 160 Navigational Publications. There is also a growing range of digital products and services. Updates (Notice to Mariners) containing all the changes required to keep the UKHO's worldwide series of Admiralty Charts and Publications up to date are published weekly.

To streamline the flow of data though the organisation, the way data was processed into products needed to be transformed. The Hydrographic Database (HDB) project was therefore initiated four years ago and would become much more than just a replacement of the chart production system.

At the core of the now accepted HDB system is the CARIS Hydrographic Production Database (HPD). This will house the complete geospatial datasets that form the basis for the Admiralty chart portfolio. Tightly coupled to this is the CARIS Bathy DataBASE (BDB), which will provide storage, management and analysis of the extensive seafloor bathymetry data holdings of the UKHO. These commercial off the shelf CARIS applications have been stitched together with a workflow management system (Task Manager), a data source conversion engine (Source Interface Engine) and a geodetic parameter database (Geodetic Database). The project's prime contractor EDS, an HP company and sub-contractor LSC Group, have integrated these and additional commercial-off-the-shelf products (process management and file-format translation) to create a seamless system. See Figure 1.

Sources such as surveys, drawings and textual information are stored in a separate system called Source Data Receipt and Assessment (SDRA), the HDB system uses web services to search for and retrieve these sources for processing.

The Challenge

The UKHO has existed for over 200 years and has steadily evolved over that period of time. Changes in production technology and user requirements for new and different products have driven that evolution, resulting in the development of many different Branches within the Organisation. These Branches have tended to become knowledge "silos" with a high level of specific expertise and knowledge within each. Branch. Production systems have been developed to meet the specific requirements of each Branch. A single piece of source data could be assessed and processed many times for a variety of products and often assessed and processed more than once for the same product.

Some of the issues surrounding such development include:

- Re-processing of the same information for both the same product and different products,
- Many hand-offs between teams,
- Many verification steps,
- Incompatible data formats reducing interoperability between systems.

The initial vision for HDB was of a single, product neutral database of features, from which all products could be produced. The theory was to store each feature at its best scale so it could be assessed just once against incoming information. First-cut products could then be created following business rules and requiring only minimal editing to be ready to publish.

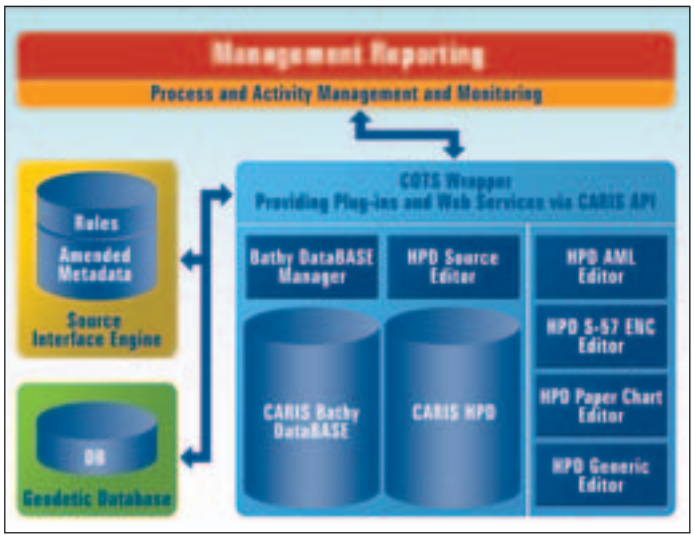

Figure 1 - Hydrographic database architecture, Source EDS Defence (an HP company)

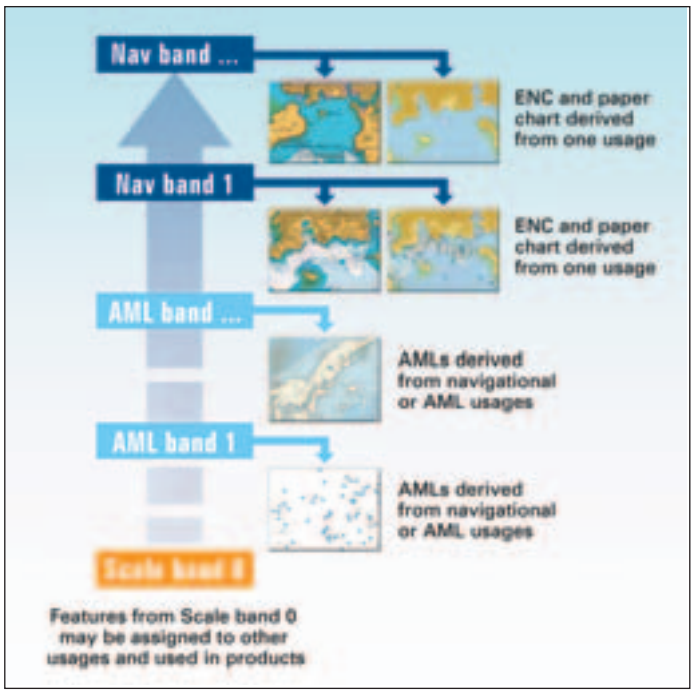

Figure 2 - Scale bands and derived products, Source UKHO

As a vision this would appear to be very logical but in practice the concept has its flaws. If working with point features only it may have been possible, but line and area features which are depicted quite differently on different scales, are much more challenging. Features of navigational significance are especially challenging, as any generalisation must include a navigational bias i.e. show the worst case scenario. Add the requirement of the International Hydrographic Organization Standard (S-57) for shared geometry for electronic navigation products and it becomes obvious that a significant amount of work would be required for each product, replicating the production "silos" the UKHO are trying to remove.

Accepting that the compilation of hydrographic products, requires a high level of skill on the part of the compiler in choosing how best to depict features at each scale and most importantly which features can be left out as the scale reduces and given that no computer software can currently equal the decision making required of the chart compiler, the key drivers become the re-use of this skilled compiler effort and the reduction of the number of verification steps.

Streamlining Data Flow

Vector Electronic Navigational Chart (ENC) production is currently a standalone production flow-line that inherits information changes made to the paper chart contained within a separate flowline. The HDB concept has layers of 'ENC Ready' data compiled into the various scale-bands from which both the ENC and paper chart is derived. Additional Military Layers (AML) data can be derived from this navigational data but can also be compiled on AML-specific layers. Scale band 0 is used to hold scaleless data that can then be assigned to other layers if required. This level of interoperability would not be possible with legacy systems. See Figure 2.

One of the important lessons learned through simulating data-flow scenarios on a development system and more recently through live Business Integration Trials, is the benefits of one team (and wherever possible one compiler and one verifier) taking source data items all the way through the production workflow from initial assessment to producing product updates for both ENC and paper charts. The complex nature of the decision making when assessing hydrographic data is such that inefficiencies can occur when a task is handed over to another team. Applying "Lean Sigma" (a process improvement toolkit) to keeping as much of the process within one team reduces re-work and the 'thinking time' that is required each time a person picks up a new task and has to work out what needs to be done. Updates to AMLs are done by a separate team due to the non-navigational nature of AML products. As future use of the HDB encompasses other products, optimum workflows will need to be developed.

This way of working, together with the functionality provided by CARIS HPD, significantly reduces the number of steps in the overall process of getting new source information to the mariner. The verification steps (and associated re-work) can be reduced by having thorough verification in the Source Editor. The key benefit of CARIS HPD is in removal of the duplication of effort that currently occurs in the ENC Production flow-line, which follows and repeats the process of the paper chart for both Notices to Mariners updates and New Editions.

Using CARIS HPD, more work is required at the beginning of the process but less work is required at production processes, and at the point of producing a New Edition most of the work will have been done and the New Edition will be able to be produced more quickly. There is of course the potential for some nugatory work to be done between New Editions but the database is maintained fully up to date at any time should there be a defence or other requirement for that data.

The interoperability between the components in the solution, and between the solution and external components (e.g. providing source data), have helped to ensure that data delivered in different formats and with very different context would have an efficient flow through the system. For example, new source data is automatically processed upon receipt where conversion or transformation is required, while compiled data is stored using a data model that can support the present and expected future data content requirements. Should unforeseen future requirements require expanding the data holding capabilities of the HDB, the system's flexible data model allows such extension without remodelling and development.

What's next?

At present the HDB project has focussed on the production of ENCs, standard navigational charts and AMLs. There are many specialist areas within UKHO which provide specific expertise and support to chart production by managing different data types. One of the key challenges for the future is in the integration of this data and the people who work with it. Once data is in the HDB there is a variety of opportunities to re-use that data for defence, leisure and non-navigational purposes like environmental management. The systems' flexible data model and extensible data dictionary should allow the needs of these other stakeholders and users to be met in a much more straightforward way and open up many exciting new opportunities for the exploitation of hydrographic information.

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