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Developing hydrographic management for the Saudi Arabian HO

An article by HORST HECHT

Within the framework of Saudi Arabia establishing a hydrographic office (HO) meeting the SOLAS requirements, a 24-months project was launched in 2014 to develop hydrographic data management as necessary technical infrastructure. The author, who was involved with the definition of the project and later on serving as advisor to the contractor, describes the objectives, structure and results of the project. Particular emphasis was on integrating bathymetry, hydrography and, as far as possible, oceanography into a single system supported by fully developed Quality Management and Work Flow Management. For final quality assurance, an independent company was hired who awarded high ratings for the outcomes of the project.

Hydrographic Office | hydrographic data management | workflow management | quality assurance

Author
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1 Prehistory

The author had been in contact with the General Commission for Surveys (GCS), Riyadh, for some time before 2011. In this time, in the course of a major restructuring the Kingdom of Saudi Arabia (KSA) had established GCS as the principal KSA geospatial agency. Associated with this, the vision emerged to develop the GCS hydrographic department to a fully operational hydrographic office satisfying the SOLAS requirements. Based on discussions with the then GCS Chief Hydrographic Advisor RAdm Srinivasan (former Hydrographer of India) that an essential part of that project would have to be the development of hydrographic data management capabilities to accommodate and process the envisaged amounts of data, GCS requested a study into the respective requirements and invited the author for a fact finding mission. Supported by an expert (Peter Schwarzberg, to whom the author is greatly indebted for his constructive contributions) who was hired part-time from Caris bv, this took place in March 2012 and resulted in a proposal detailing the requirements of hydrographic management in terms of software and hardware as well as for staff based on the GCS structure.

As next step the author was requested to produce the technical specifications for a Request for Tender (RFT), based on the study report of the fact finding mission. Again supported by the expert hired part-time from Caris bv, the final version of the technical tender specifications was submitted to GCS in March 2013. After allocation of a suitable budget, the tender was issued end of 2013.

The project was finally awarded to IIC Technologies in conjunction with the Saudi company Horizon-Geosciences Ltd. in late summer 2014 and started in November 2014. It was scheduled for two years. An option in the contract allowed a continuation for up to another 18 months, if need would arise.

2 Purpose and objectives

Purpose of the project was, as stated in the preamble of the tender, »to build the infrastructure and to develop the necessary hydrographic data management (HDM) capabilities to meet the governmental requirements of a national hydrography service, as set out in the SOLAS Convention, chapter V, Reg. 9. In addition, the hydrographic department will be responsible for marine sciences in general, i.e. it will have to collect and administrate a wide variety of oceanographic & marine sciences data.«

The objectives of this HDM project were (see Fig. 1):

- Establish the necessary hardware and software infrastructure for the operations of a hydrographic service including the design and development of the hydrographic production database base on an Oracle spatial platform.
- Training of GCS staff in the data management »best practice« and use of the hydrographic application software.
- Establish the work processes needed for the operations of a hydrographic service and develop the necessary Standard Operational Procedures (SOPs).
- Establish as part of the HDM a marine sciences database for tide, tidal currents and all other relevant oceanographic & meteorological data, using own data and from stakeholders.
- Develop a »marine sciences forecasting service« (MSFS) for stakeholders.
- Establish a quality management system that can be certified against ISO 9001.
- Develop the operational production of official paper nautical charts (PNCs) and electronic nautical charts (ENCs), Notices to Mariners (NtMs)and electronic ENC updates according to a specified chart scheme.
- Develop the capability in GCS to support a Marine Spatial Data Infrastructure based on international standards (ISO 191xx), and in particular the IHO S-100 suite of hydrographic standards as well as support the integration requirement.

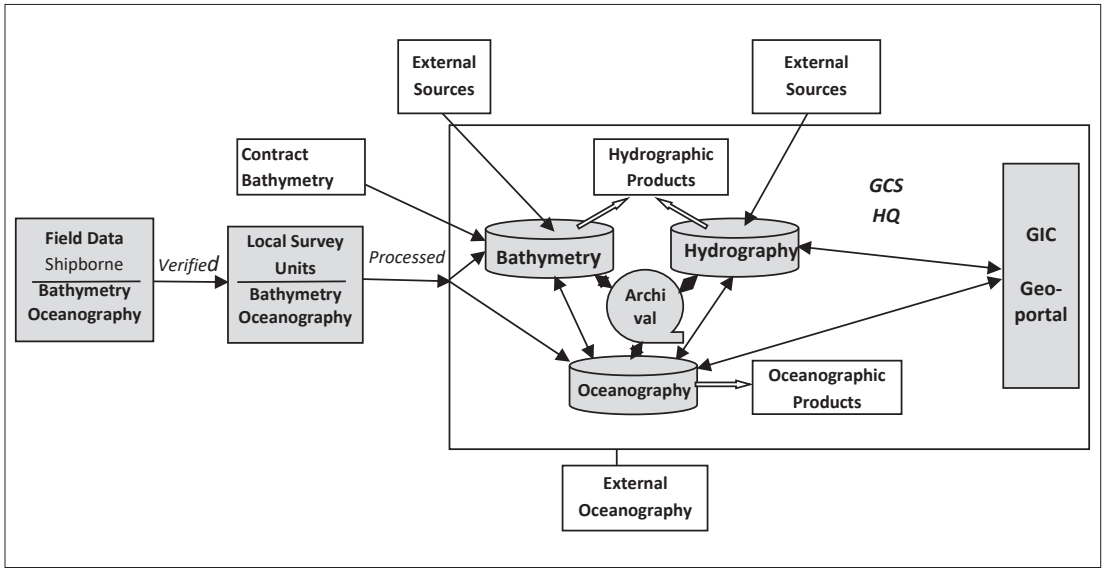

Fig. 1: Conceptual Data Flow Model

The HDM project was simplified by the fact that there were no legacy issues with old, incompatible databases.

In order to meet the objectives as efficiently as possible, some basic requirements were set out in the tender (see Fig. 2):

- Procurement of hardware and software is to be performed by the contractor in cooperation with GCS.
- All software including the databases for bathymetry, hydrography and oceanography should be interoperable with each other and with existing Caris software such as HIPS/SIPS, BASE Editor, S-57 Composer and Paper Chart Editor.
- All software should support the IHO S-100 suite of standards, as far as respective product specifications are released, or be upgradable otherwise.
- Production of PNCs and ENCs as well as related nautical publications including Notices to Mariners (NtMs) should be possible from a single source database based on S-57/S-100 content, and the source database should support multiple uses for different purposes and scales including user-defined products.
- All work processes should be supported by a comprehensive workflow management system (WFMS).
- After completion of production training, all production should be carried out by GCS personnel under supervision and coaching of competent project staff; the experience gained should be used for continually optimising the work processes, the workflows and their corresponding SOPs.
- The hydrographic databases should supply products to the GCS Geographic Information Center (GIC) in support of the evolving, web-based national KSA Spatial Data Infrastructure.
- The development of a certifiable, ISO 9001-compliant Quality Management is essential part of the project including full documentation of all work processes; certification itself is left for the time after completion of the project.
- As part of the project, the contractor has to provide the necessary project management and staff, and is responsible for adequate training of GCS staff.

Annexes were added to the tender providing an overview of hardware and software configuration, as well as illustrations showing the workflows for populating and maintaining the source database, for using processed survey data, as well as for chart production (PNCs and ENCs) and correction (ENC updates and NtMs).

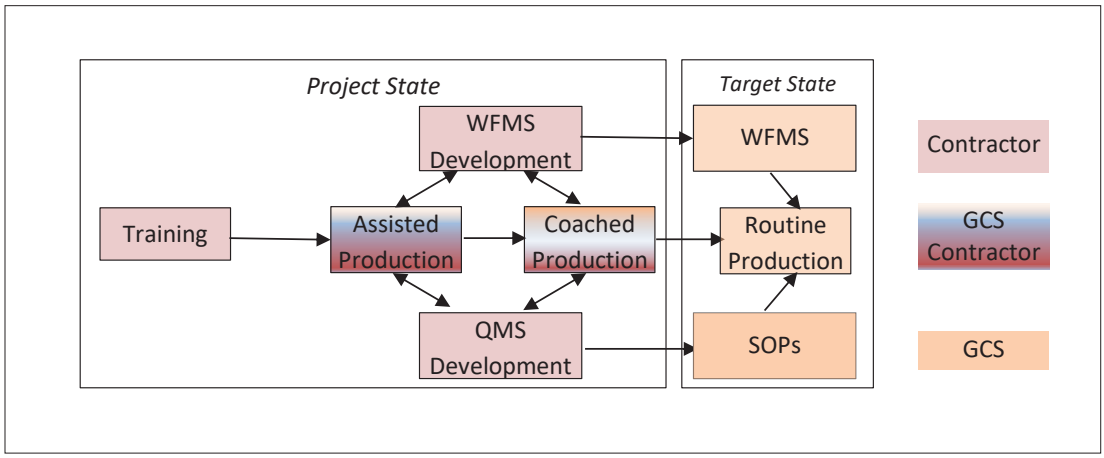

Fig. 2: Conceptual Project Model

The project was grouped into three consecutive implementation phases as follows:

Development and installation phase (Phase 1)
Target state: all necessary software has been installed; GCS staff has been familiarised and trained in using the software and has a good understanding of best practice hydrographic data management. ENCs, base chart data and additional layer data from separate projects are loaded into the production database; work processes and work flows, starting with processed bathymetric data and fairsheet production, up to PNC and ENC production, updating and archival have been drafted and are established; production by GCS staff of PNCs and ENCs has been started on a trial and on-the-job training (»supervision«) basis. These processes are required to be refined and necessary documentation prepared by the contractor, including QC/QA methodologies.
Estimated time: 6 months.

Operational set-up and optimisation phase (Phase 2)
Target state: Operational PNC and ENC database-based production (under supervision by project personnel) with updating (NtMs, ENC updates) is fully established, work processes and workflows have been revised and optimised as necessary, ENCs are available via IHO channels to end users, oceanographic database has been set up and available data is transferred, work processes for tidal analysis of current and water level data are defined and established, QMS documents (SOPs) for PNC and ENC production are drafted, QM organisation and work process are established on a trial base.
Estimated time: 12 months.

Final implementation phase (Phase 3)
Target state: Operational PNC and ENC production is running under project supervision, tidal analysis and management of current and water level data is operational, work processes for tidal predictions are established; QMS is being completed and ready for ISO 9001 certification.
Estimated time: 6 months.

3 Implementation of the HDM project

IIC Technologies subdivided the project into work packages including:

Phase 1:
- Hardware and software procurement and installation (production software: Caris BDB and HPD including the Publications module; Workflow management system: Bonita);
- Production software customisation;
- Definition, development and implementation of work processes;
- Development of Standard Operational Procedures (SOPs) covering the documentation of all work processes, as backbone of quality management;
- Foundation training and production training (carried out by IIC Academy);
- Production by GCS under coaching, and optimisation by IIC.

Phase 2:
- Implementation of Workflow Management System (WFMS);
- Implementation of Quality Management;
- Procurement and implementation of hardware and software for oceanography;
- Production by GCS under coaching, and optimisation by IIC (continued).

Phase 3:
- Production by GCS under coaching, and optimisation by IIC (continued);
- Final implementation of all work processes including WFMS;
- Final QM implementation including all SOPs;
- Final training;
- Acceptance tests.

At the beginning of the project, already four hydrographic surveys had been carried out under contract which had supplied valuable processed survey data and fairsheets which could be used as sources for populating the hydrographic source database. Further surveys have been commissioned and carried out during the project. Some of the data had been used in a separate project for training GCS survey staff at the GCS site in Jeddah, as well as for compiling base charts 1:25,000 as input to Coastal Zone Management programs.

The HDM project was managed by Mr. Edward Kuwalek, IIC Vancouver, Canada, and by the on-site manager Shyam Ganapuram, IIC India. Additionally, up to 13 persons IIC-staff were deployed on-site to GCS for training, coaching and project work. The author was requested as advisor and participated in the management meetings of IIC with GCS. From GCS, its management was involved through the Director of the hydrographic department and its senior staff with the then Chief Hydrographic Advisor RAdm Srinivasan as one of the driving forces of the project, and through senior staff from other departments, particularly from Geographic Information Center (GIC).

The procurement phase resulted in the acquisition of the following software packages: Caris BDB and HPD with all modules, Bonita as WFMS, as well as Oracle as database. Additionally, the necessary hardware was purchased after approval by GIC as the central GCS IT department, which is remaining also responsible for operating and maintaining the hydrography system, as well as for archiving, along with all other IT systems of GCS. During installation phase, Caris provided support on special technical issues.

The project manager visited GCS almost bi-

monthly and provided monthly progress reports showing the current status against the planned timetable of milestones. Management meetings took place roughly every six months. Between the meetings, the author was involved through email correspondence with both the IIC project manager Mr. Kuwalek and the Hydrographic Chief Advisor RAdm Srinivasan.

After the initial training phase, real production was started first under guidance by experienced IIC staff, which subsequently was carried over gradually to coaching and advising. All SOPs and the WFMS customisation developed and matured over the time in parallel to the production processes, in accordance with the specifications. The SOPs, as essential part of the QMS, contain detailed flow diagrams which are mirrored in the WFMS. Generally one can say that the project was unfolding surprisingly close to initial plans.

The only slight deviation from initial plans was that from the originally envisaged establishment of an oceanographic database solution for a comprehensive set of oceanographic parameters. The oceanography group was scaled down to only one scientist who was tasked with processing tide gauge data from automatic stations and deriving tidal constituents for computation of tide tables. Instead of a general oceanographic database solution, the specialised Tidal Analysis Software Kit (TASK) software, developed by the UK National Oceanographic Centre, was deemed sufficient, which was said to have an interface to the Caris Publications module.

4 Results and conclusions

At the end of the project all relevant milestones were achieved. In particular, GCS staff was educated and trained in using the application software on their own, some were further trained to act themselves as trainer or any new GCS staff. QMS and WFMS has been thoroughly tested and proven to support efficiently the work processes.

Within the project:

- 11 Caris Bathymetry SOPs,
- 15 Caris HPD SOPs,
- 5 Oceanography SOPs,
- 2 WFMS SOPs,
- 2 Coastal Zone Management SOPs

have been developed,

- 18,000 km^2 bathymetry data from three survey projects were loaded into the bathymetry system,
- 20 ENCs produced (see Fig. 3),
- 13 paper charts produced (see Fig. 4),
- 86 base charts for coastal zone management produced,
- tide tables and tidal current predictions for two years compiled.

In accordance with the initial project specifications, GCS had contracted an external consultancy, The Quality Geospatial Engineering Group (QCG), Saudi Arabia, for independent quality assurance.

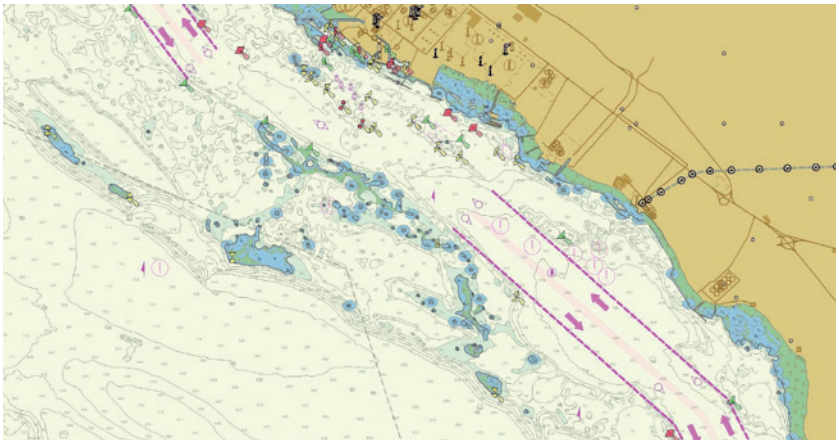

Fig. 3: ENC of Approaches to King Fahad Industrial Port, Yanbu (Kumar 2017)

This group had hired three experts from the then Marinegeosolutions Ltd. Australia who visited GCS five times. They monitored project progress and compliance with the project specifications and advised on the QMS, reviewed in detail the SOPs and their implementation into the WFMS. In their final assessment they concluded that:

»GCS now have the most advanced HDM system in the world in terms of hardware, software & production systems« (original quote QCG).

While QGC also expressed their amazement that a project of such complexity ran almost completely to schedule, they also raised concern that the high level of efficiency achieved with the HDM project is in jeopardy due to frequent staff fluctuation. Therefore, QGC recommended to take advantage of the contractual extension option, in order to stabilise skills and motivation of staff.

In an own statement, the author of this paper reminded that while a functioning HDM would now be in place, this would not suffice to qualify for a fully operational hydrographic office unless ENCs and PNCs as well as NtMs and navigational warnings would be routinely disseminated worldwide.

Contrary to the recommendation of QCG, the option to extend the project by another up to 18 months was not drawn, unfortunately, largely because of budget cuts. ⚓

References

Kumar, Vijay (2017): Hydrographic Data Management (HDM) for General Commission of Survey, KSA; Paper presented at the Teledyne CARIS 16th International User Conference 2017, Ottawa, June 19-22, 2017

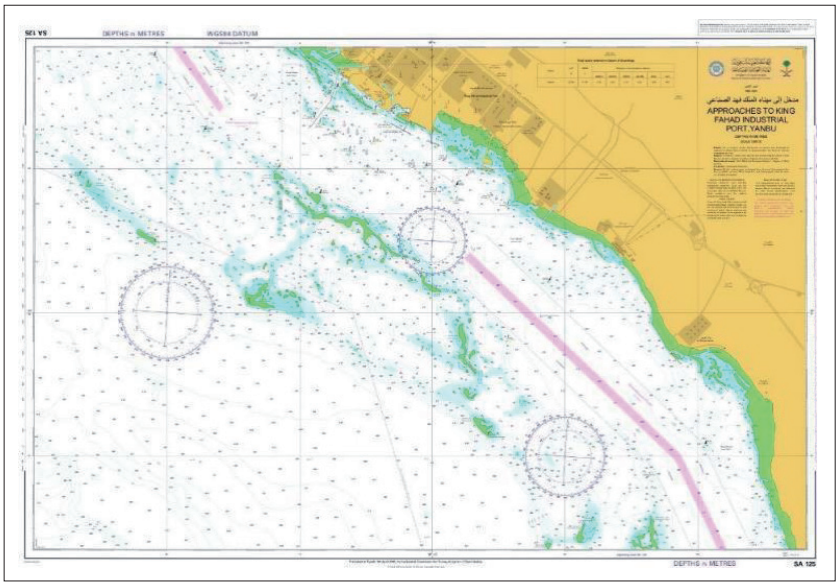

Fig. 4: Paper Chart of Approaches to King Fahad Industrial Port, Yanbu (Kumar 2017)