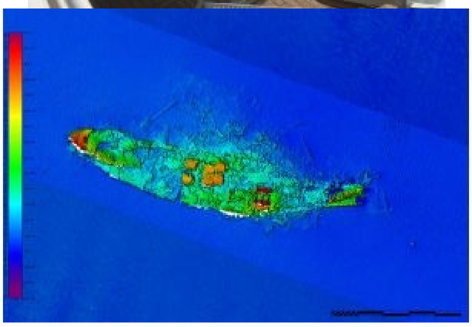
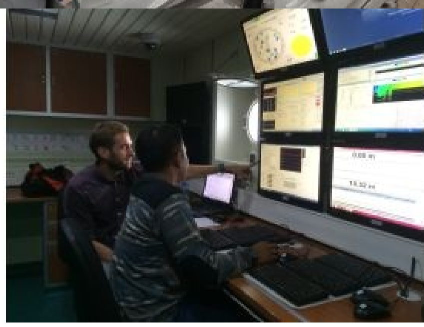
A FRUITFUL COOPERATION BETWEEN SHOM AND OCEA SHIPYARD

Two Oceanographic Research Vessels for Indonesian Navy





In December 2013, SHOM and OCEA French shipyard decided to enter into a technical cooperation for the construction of two modern 60m aluminum hydrographic/Oceanographic research Survey Vessels (OSVs) ordered by the Indonesian Navy, after an international competition won by OCEA. This article describes the close partnership that led to the successful delivery in 2015 of the Rigel (11 March) and Spica (17 October) sister ships of the OSV190 range of OCEA (Figure 1), fitted with hydrographic launches and undersea exploration vehicles (AUV & ROV). These two OSVs are dedicated to the exploration of Indonesian waters for a better knowledge of hydrography, oceanography, halieutic resources, and a better Exclusive Economic Zone supervisory.

The technical agreement between SHOM and OCEA involved assisting the shipyard in the integration of the scientific measurement systems onboard the vessels: general design review and preliminary studies, scientific equipment integration follow-up, support to harbour and sea acceptance tests, scientific and technical crew training.

The originality of the cooperation is that the partnership continues after the delivery of the ships on site, so that both partners support the Indonesian Navy for the operation and maintenance of the ships in its waters by the means of technical assistance that includes training, maintenance and guarantee follow-up, coaching for preparation and realisation of sea hydrographic trials and missions, and support in implementing an efficient technical organisational structure for the scientific activities.

Close Cooperation

SHOM expertise was useful at different steps of the construction, giving adequate advice when necessary to all actors in the shipyard. This cooperation took place at different stages:

- consolidation of the predefined scientific equipment in order to validate their relevance and consistence with the vessel missions;
- validation of integration of acoustic sensors in the gondola, and the mechanical, electrical and electronic integration of all scientific equipment in the different rooms and decks of the ships.

The specific gondola (Figure 2), sheltering acoustic transducers (single and multibeam echo sounders, sub bottom profiler, vessel mounted current profiler) under the hull, has a perfect design to limit hydrodynamic turbulence due to water flow, and prevents sensor vibration and acoustical noise of the ship platform.
One capital stage in integration was the elaboration of the vessel metrology file, the purpose of which is to keep records of the different

sensors bearing mounting tolerances extracted from suppliers' data sheets, and to keep records of the different sensor's offsets measured from a reference location in the vessel. This is the only way to guarantee a proper collected data geolocation when conducting hydrographic surveys.
This integration was formalised by interface documents describing equipment location and their interconnections.
Relationships between SHOM representatives, OCEA and subcontractors have been always fine and constructive, despite the usual constraints of such a project (technical, financial, deadlines).

Large Panel of Scientific Equipment

SHOM hydrographers have extensive expertise in both hydrography and oceanography. Throughout this project the representatives have used their extensive expertise in the field of hydro-oceanographic equipment to deal with the whole spectra of onboard equipment and to manage the computer networks dedicated to data acquisition and post-processing.

Let us emphasise that Rigel and Spica vessels designed and built by OCEA are broadly equipped with the most up-to-date, accurate and high-performance sensors, to cover all required missions in coastal, deep-sea and offshore waters.
Integration files and schemes are clear, easy to use and useful for operation and maintenance phases. All plug connections are defined to improve system understanding for end users, and to facilitate later modularity and autonomy.

The ships have multi-purpose capacities, and offer a wide variety and complementary data acquisition systems:

- precise positioning (GNSS) and attitude (inertial unit),
- hydrography and seabed mapping from shallow to deep water (7000m) with echo sounders and side-scan sonar,
- oceanography with subsurface water currents, temperature and salinity and sound velocity profiles from surface to bottom,
- Sedimentology and geophysics with sub-bottom profiler, sediment sampler and gravity corer, magnetic field tow fish,
- weather station,
- underwater exploration (ROV & AUV).

Operational Missions

The principal and complete missions that can be addressed by these modern ships are:

- nearshore hydrographic operations with the hydrographic launch (Figure 3), up to 500m depth: high density and accuracy sensors, low draft, good visibility from the bridge;
- offshore and deepwater operations with the OSV vessel: high density and accuracy and complementary sensors, with sea endurance and platform stabilisation system;
  o for hydrography: seabed mapping up to 7,000m;
  o for oceanography: temperature and salinity profiles from surface to bottom to map water masses circulation, sea water current measurements from surface to 300m;
- ROV operation for underwater exploration and deepwater intervention (1000m): high precision acoustic positioning, seafloor mapping with OSV multibeam echo sounders, VM-ADCP current measurements on the water column;
- AUV operation: as for and in addition to ROV capacities, the 'Hugin' autonomous underwater vehicle (Figure 4) is the perfect tool for very high accuracy exploration up to 1000m depth, with its own sensors (multibeam echo sounder, ADCP & CTD);
- Geophysics operations: both OSV and launch are equipped with sub-bottom profiler and towed magnetometer to investigate the first metres of the seabed sediments and the magnetic field.

Scientific Layout

The configuration of the scientific, technical and life rooms and decks has been specifically drawn by OCEA for the efficiency and comfort of the crew: centralisation of scientific rooms (operating, processing, wet and dry laboratories) on the same deck, spacious and efficient deck for the handling of winches and hydrographic launch.
The operating room offers a wide and modular screens wall of data acquisition work stations, configurable by operators according to needs and missions (Figure 6). Networking is easy and collaborative work is efficient thanks to modern computer networks and geographical proximity between hydrographers and ship crew (navigation, boatswains…).

High Measurement Performances

The sea trials proved the excellent stability of the OSV platform and showed greatly reduced noise, a convenient situation for good working conditions and a chance to collect good quality data.
The SAT (sea acceptance tests) have been defined by SHOM with OCEA to comply to suppliers' specifications and to qualify the data collected by each measurement system. Nonetheless, it is the efficient overall integration and interfacing of the systems onboard the platform that has been qualified.
The SAT was performed, where possible, on the SHOM reference qualification areas off the coast of Les Sables d'Olonne or Brest (France), especially suitable for the evaluation of the acoustic echo sounders data quality (Figure 5).
A remarkable behaviour of the ship and excellent quality of scientific echo sounders data, even in rough seas (state of sea 3 to 4), or at high speed (13 to 14 knots), were shown, whereas typical speed to perform hydrographic surveys is under 8 to 10 knots.
Thanks to this excellent integration, Indonesian hydrographers will be able to fulfill IHO standards required for hydrographic surveys (S-44), to achieve all orders of survey (2, 1b, 1a, special).

Technical Assistance

Addressing the Indonesian Navy requirement, both OCEA and SHOM representatives bring support to the Indonesian Navy in its waters through technical assistance during the 18 months following the delivery. This assistance began in May 2015 with the arrival of the Rigel in Jakarta (Figure 6).

This assistance is essential as these vessels and their subsystems (launch, ROV, AUV) are very complex and accurate, and need an excellent overall and detailed understanding. The following tasks will be dealt with by the technical crew and hydrographers: refresher training, maintenance and guarantee follow-up, coaching for preparation and realisation of sea hydrographic trials and missions, support in implementing an efficient technical organisational structure for the scientific activities.

Conclusion

Understanding and managing such specialised and innovative vessels is not simple and easy because of the variety of scientific sensors, gigabytes of data transiting, the number of cables, plugs and computers to tame, and the multiplicity of configurations to master. It is a long process to become comfortable with all the sensors and the vessel's capacities.
OCEA and SHOM offer a real partnership and support, from ship design to the first operational missions at sea, and the issue is the real and complete autonomy of Indonesian hydrographers on all the sensors and vessel equipment, including planning, configuration, data acquisition, data processing, troubleshooting and maintenance.
This collaboration resulted in a high added value vessel with operational capabilities allowing collection of data and samples of excellent quality at higher speed than usual scientific vessels. Accordingly, these innovative, multipurpose and efficient OCEA vessels will allow the Indonesian Navy to get to know their waters better and faster.

Acknowledgements

The experiences and skills of numerous persons contributed to the successful design and construction of the Indonesian sisterships. Many thanks to them, in particular to the SHOM engineers (Patrice Laporte, Sébastien Beuchard, Christophe Vrignaud, Julien Lagadec, Daniel Levieuge) and OCEA staff (Fabrice Weinbach, Luc Boulestreau, Franck Mayet, Jean-Marie Coudé, Gwenole Peronno and the production staff).