# A SURVEY VESSEL FOR SHALLOW WATERS

# Capella

The survey vessel Capella was commissioned at the Federal Maritime and Hydrographic Agency of Germany (BSH) in January this year. Capella has been developed especially for navigation in shallow waters and is a valuable complement to the other four BSH survey vessels, any operatively economical hydrographic shallow area survey of the Wadden Sea, narrow coastal inlets and Baltic coastal lagoons having been unavailable up until then. Traditional deep-draught survey vessels can only anchor in deep water, far from the shallow areas to be surveyed, necessitating survey launches having to cover considerable distances to their destination. This article introduces a shallow-draught survey vessel designed for operation in shallow sea areas, equipped with shallow-draught launches and an inflatable work-boat suitable for survey operations in extremely shallow water, under the auspices of German hydrographic surveying.

The main purpose of the vessel is survey of shallow near-shore waters. To accomplish this task, the ship carries two shallow-draught launches and an inflatable work-boat with mobile survey equipment. The parent ship has also a shallow draught of just 1.6m to ensure that launches can be deployed close to the area of operation. One essential property of the ship is her ability to be beached on tidal flats during ebb tide.
Unlike the other BSH survey vessels, *Wega*, *Deneb*, and *Komet*, *Capella* has no multi-beam echo sounder, because in shallow water its coverage would be so narrow as to render economical deployment impossible. However, in order to be able to search for underwater obstructions in the area adjacent to the sounding lines, one of the launches is equipped with an echo sounder with side-scan function.

Surveying Concept
The survey vessel and her launches have identical survey equipment. This means that survey data can be processed easier and faster and equipment components can be exchanged if necessary. The sounding equipment must meet severe requirements. The vessel should be capable of providing accurate, reliable measuring data in all types of coastal water, including difficult environmental conditions such as muddy sea bottoms and large amounts of vegetation.
In order to obtain reliable depth data of the sea bottom and to be able to check the measured depths and correct them if necessary, an echo sounder is used which stores complete sonar return data through the entire water column and makes this data available for post-processing. Apart from the depth measurements, the launches are capable of performing side-scan sonar surveys of the sea bottom in shallow areas to detect underwater obstructions.

Data Acquisition
Today, the transducer position is commonly determined by means of GPS. Meanwhile, it has also become possible to use GPS for the determination of transducer height, which requires a measuring accuracy in the decimetre range. This constitutes an alternative to the traditional method of referring measured depths to the reference datum - the chart datum - by means of gauge readings and special sounding reduction methods. Especially in some areas of the Wadden Sea, the accuracy of depth data can be improved considerably. However, very precise from coastal reference stations of known height are required, which is very difficult because of relatively large distances from the coast.
Hydrographic surveys in extremely shallow waters can be performed using the inflatable work-boat. For such operations the work-boat is fitted with a mobile system comprising sounding and computer equipment and a GPS receiver. In principle, this mobile equipment has the same functionality as that installed on the launches. It is well suited for precise mapping of objects near the shoreline. Both the shoreline itself and onshore objects can be mapped using a handheld receiver or a GPS receiver in a knapsack.

Data Processing
The surveying software WINPROFIL, which has been used successfully on the survey vessels *Atair* and *Wega*, is also used for processing the survey data on board the *Capella* and her survey launches. The software is used for planning the surveys on the vessel and monitoring them onboard the launches or vessel. The data is then collected and pre-processed onboard the vessel. An ECDIS display can be used as background to facilitate orientation during survey planning and survey operations. This allows the accuracy of the ECDIS display to be checked while performing the survey.

Technical Implementation
**Parent Ship:**

- Hull shape: the design of the underwater hull is flat, to meet the shallow-water specification and enable the ship to be beached. Good course-keeping and manoeuvring properties despite the shallow hull have been achieved by giving the ship a special afterbody shape and a special arrangement of hydroplanes
- Propulsion: the shipâ€™s main propulsion plant consists of two diesel engines with an output of 440kW, each acting on fixed propellers via reverse reduction gears. A bow thruster with an output of 150kW optimises ship manoeuvring ability
- Surveying equipment: The surveying equipment comprises a DGPS receiver with RTK function (Leica GPS system 500), a

hydrographic sonar system (Simrad EA 400) and PC-based data acquisition and processing software (Winprofil).

**Survey Launches:**
The 8-metre survey launches have jet drives, enabling surveys to be performed in water as shallow as 1m. Their surveying equipment resembles that onboard the survey vessel, consisting of a DGPS receiver with RTK function (Leica GPS system 500), a hydrographic sonar system (Simrad EA 400) and PC-based data acquisition software (Winprofil).
One of the survey launches has both single-beam and side-scan sonar systems. The Simrad EA 400 unit is used to control the side-scan sonar and map the sonar data. It should be mentioned that the survey launches are deployed using a one-arm davit made by Caley Ocean Systems, which allows deployment and recovery of the boats also in higher sea states. The system has been proven in operation on board the BSH survey vessel *Komet*.

**Inflatable Survey Boat:**
The inflatable work-boat is fitted with a water jet drive, so that surveys in waters as shallow as 50cm are possible. The surveying equipment also comprises a DGPS receiver with RTK function (Leica GPS system 500), a hydrographic sonar system (Simrad EA 400) and notebook-based data acquisition software (Winprofil).

Design and Construction
On 30th May 2001 a contract was awarded to the Fassmer shipyard in Berne/Motzen on the Lower Weser, who subcontracted the construction of the shipâ€™s hull to the shipyard â€˜SlovenskÃ© Lodenice KomÃ¡rnoâ€™ in Slovakia. The keel-laying on 28th May 2002 there marked the beginning of the construction phase proper. By March 2003 the construction of the hull had made good progress, allowing it to be towed on the river Donau through the European system of inland waterways and canals from the building yard to the Fassmer shipyard.
The tug and tow arrived at the shipyard on 8th April 2003, where the hull construction was completed by installing the navigational and surveying equipment and communication systems, the propulsion plant and all electro-technical components, followed by interior finishing and installation of sanitary equipment. The traditional launching ceremony took place on 30th October 2003 at the Fassmer shipyard. Dr Ingrid Stolpe, wife of Dr Manfred Stolpe, the Federal Minister of Transport, Building and Housing, had accepted a BSH invitation to become the shipâ€™s â€˜godmotherâ€™.
In the launching ceremony, the â€˜Mercator/Bessel replacementâ€™, as she had been called in dry officialese, became the survey vessel *Capella*. During the ceremony the shipâ€™s master, Captain Karl-Eugen von Abel, on behalf of the shipâ€™s crew, received from Dr Ingrid Stolpe a traditional bell clock engraved with a dedication. Meanwhile, the clock has won an honorary place in the shipâ€™s common mess-room.
The first sea trials were performed in the area off the Weser estuary in mid-December. Additional trials followed at the beginning of the New Year.

Outlook
*Capella* arrived at her homeport of Rostock on 17th January 2004. In the presence of Federal Minister Dr Stolpe and his wife and numerous other guests from politics, business and shipping associations, the vessel was commissioned by BSH president Dr Peter Ehlers on 23rd January 2004. Accompanied by the survey, wreck search and research vessel *Deneb* and other government-owned ships, *Capella* then left WarnemÃ¼nde and headed for the BSH pier in Rostock, giving the public and the press their first opportunity to take a look at the new survey vessel in motion. With the commissioning of the *Capella*, the BSH again has six hydrographic vessels.
Since her commissioning *Capella* has carried out successful surveys in the German North and Baltic Seas. During the first surveys in the Baltic Sea (Schlei), the crew became quickly familiar with the novel systems. The vessel later performed very efficiently in surveys of the Wadden Sea areas of the North Sea, where experience has been gained in operating under tidal conditions. During the rest of the year *Capella* will be deployed off the island of RÃ¼gen. The concept of a shallow-draught survey vessel for Germanyâ€™s numerous shallow sea areas would appear to be a success.
The survey system onboard *Capella* and the land-based system were integrated quickly and easily into the existing survey evaluation process due to their modular design. Efficient use of the survey and data evaluation systems has been achieved after just a short testing period, and personnel were quickly familiar with the equipment.