Low-budget Hydrography: the Hows and Whys

Hydrographic Charts for seafarers are based on years of survey data. Standard charts, paper or ENC, are available for most areas of the world and are quite inexpensive thanks to government-subsidised hydrographic surveys and volume of charts printed for numerous users. Dedicated charts for specialised and limited use, the offshore oil & gas industry, coastal engineering, cable-laying etc., cost about the same to produce but are much more expensive to buy: they have to include detailed sea-bottom morphology.

In both cases the basis for the hydrographic charts, bathymetric survey operations, have been and still are a rather costly affair. In the old days they were costly because the instruments used, lead line, sextant and the like, provided only a sounding every now and then whilst ship-time ticked by. Nowadays bathymetric information is typically gathered from dedicated survey vessels using single or multi-beam echo sounding systems. The prime cost factor in ship-borne surveys is the time and thus the expense involved in conducting the survey and in data post-processing. Delays due to such factors as weather-related downtime, logistics, red tape and instrument breakdown can send operational costs through the roof.

Cost-saving

The execution of a cost-effective hydrographic survey necessitates the use of a package of three: well-trained personnel, accurate, reliable instrumentation and a suitable survey vessel. How can we save on these Survey personnel have, historically, not belonged to the highest echelons of offshore personnel salary scales. There are signs that this is gradually changing - a necessity if we are to keep enough people in our business! and the only way to reduce costs here is to deploy fewer personnel on the job. Thanks to advanced survey systems and computer equipment this is possible, to a certain degree. The other way would be to work longer hours to keep equipment and ship operational for longer periods, but this is already being done: a 24-hour working day is no exception on most offshore survey operations.

Another possibility for optimising survey operations is to deploy more advanced, more productive survey systems. Positioning-wise we are already on dry land. The horizontal positioning world has been turned upside down in the past 25 years by the implementation of GPS and DGPS. Although freely available DGPS has a stated horizontal accuracy of +/-10 metres (95%), many mariners are claiming 3-metre or better accuracy with this system. With selective availability set to zero, the most basic GPS receiver in a non-differential mode may offer 10-15-metre horizontal accuracy. Some sophisticated survey receivers now advertise sub-metre accuracy, and with (long-range) RTK systems centimetre-accuracy levels can be reached for both horizontal and vertical referencing. What more could we want

Multi-beam

In terms of bathymetric measurements, great improvements have been made over the last two decades. In the past survey lines were sailed and only the depth directly under the vessel was measured using a single-beam echo sounder. Then multi-transducer systems were developed (Dr Fahrentholz) whereby an array of transducers was fitted on a pole fitted perpendicularly onto the vessel, giving a swath width the length of the pole. This system is still very useful for very shallow water. Nowâ€“adays we have multi-beam, providing fan-shaped coverage of the seafloor similar to side-scan sonar, but the output data is in the form of depths rather than images. The multi-beam system measures and records the time for the acoustic signal to travel from the transducer to the seafloor and back. For bathymetric purposes, multi-beam transducers are generally attached to a vessel rather than being towed like a side-scan. Therefore the coverage area on the seafloor is dependent on the depth of the water, typically two to four times the water depth. The production rate of multi-beam is many times that of single-beam, and for an increasing number of (larger) surveys it has become a cost-reducing survey tool. There is still a considerable cost impact in terms of post-processing of the results from this system due to the vast amount of data generated, but new processing packages such as the multi-beam software from Triton Images is quickly helping to overcome this.

Survey Platform

The third but major cost factor is the survey platform. Indeed, it may be well possible to select suitable personnel and equipment for a reasonable price, but the platform on which these have to be placed to perform the work, a ship, is still the major cost component of a bathymetric survey. Improved ship design, fewer crew, higher survey speed, less fuel consumption and on-board data processing and charting may increase the cost-effectiveness of a vessel, but ships remain expensive. For certain applications, such as surveys in relatively shallow, clean, water, Lidar solutions with combined RTK-DGPS/Inertial systems will provide alternatives. The high speed and enormous amount of data generated enables covering large areas in a short survey time. Lightweight Lidar systems (Hawkeye 2) are being developed, and smaller aeroplanes or helicopters can be deployed from remote airfields all over the world to execute such surveys. For large projects involving a multitude of sensors being deployed over prolonged periods of time zeppelin-type aircraft may eventually offer a cost-saving platform. With payloads of over 35 tonnes, endurance of several weeks in the air and airspeed of 150 knots, large areas can be surveyed at reasonably low cost.

Another possible cost-saving alternative (or combination) for a survey vessel is the AUV. This sensor platform may in certain cases be deployed from the shore and execute surveys in a stable (underwater) mode at high speed, without on-board personnel. A US Navy R&D team recently completed a study of the broader scope of AUV mission applications for the US Navy. The study, which looks ahead fifty years, provides a roadmap for the integrated use of AUVs in the battle-space of the future. One of the most significant recommendations in the â€˜AUV Master Planâ€™ was that many missions could be completed using multiple, inexpensive and small-size AUVs rather than

fewer, large and expensive ones. Several research institutes and AUV manufacturers, such as Hafmynd Gavia, are currently working on developing deployment of multiple AUVs from shore or ship. Various operational procedures and survey modes (lawnmower-pattern, Master AUV, multiple slave configuration etc.), navigation control, testing facilitation, are under development.

Personnel Costs

Although survey systems will develop even further, personnel costs can be reduced by deploying fewer, and AUVs, zeppelins, survey vessels and possible future creations may form a pool of suitable hydrographic sensor/personnel platforms from which the most cost-effective solution can be chosen. It will remain a difficult task to explain why hydrographic surveys are so expensive. As I had to point out years ago to a journalist outside our business: a small B/W paper chart with only few soundings taken in the middle of the Indian Ocean may cost a thousand times the price of a beautifully drawn, multi-colour chart of a similar area. This, complete with contour lines, coastlines, navigational marks etc., produced by us near the coast of France at the same time, with nearly the same equipment. Oh, and the same salary.