

36 MONTHS AND 25,000 KILOMETRES LATER- WAS IT WORTH IT?

AUV Sea Trials and Tribulations

In 1999, the oil companies BP, Amoco, and Shell jointly published a document detailing the industry requirement for a survey AUV (Autonomous Underwater Vehicle) that stated: "For industry to adopt these vehicles, survey AUVs must reduce costs or be at least comparable to conventional surveys". Taking this to heart, C & C Technologies financed the development of such a vehicle with only one condition: If it worked, industry would guarantee 100 days of AUV utilisation during the following two years. Likewise, if the development failed, industry would be under no obligation. BP agreed, so C & C placed an order with Kongsberg Simrad Maritime, A.S. for a Hugin 3000 AUV. Now, thirty-six months and 25,000 linear kilometres of surveying later, this revolutionary mapping tool remains predominantly idle.

C & C's Hugin 3000 is a third generation AUV vehicle manufactured by Kongsberg Simrad, Norway. It has successfully performed 52 mapping projects in 8 different countries for 26 different clients. So, why do we wonder: "Does a commercial AUV survey market really exist?"

Industry Requirement

From a technical perspective, the Hugin 3000 has met or exceeded every requirement set forth in the industry's AUV document including:

1. Highly efficient operations including rapid line turns and fast survey speeds
2. Limited weather dependence with safe operations (including launch/ recovery) in sea states of greater than 2 metres
3. An endurance of at least 48 hours
4. A cruising speed of 4 knots
5. The ability to operate in water depths of up to 3,000 metres
6. The capability to simultaneously collect data from the following sensor suite:
 - Sub-bottom profiler
 - Side scan sonar
 - Swath bathymetry system
 - CTD sensor
 - Precise depth sensor
 - Collision avoidance sonar
 - Heading and motion sensor
 - Doppler velocity log

Meeting the Requirement

As requested by industry, C & C integrated the AUV with a multibeam echosounder, side scan sonar, sub-bottom profiler, and CTD sensor. High & low speed acoustic links provide AUV command and control as well as real-time transfer of sensor and vehicle data. A proprietary aluminium oxygen fuel cell provides mission duration of more than 48 hours at 4 knots with all sensors running. Navigation is provided through the integration of USBL, an inertial navigation system (INS), Doppler velocity log, and a fibre optic gyro. Data positioning accuracy is 12 metres in real time and 3 to 4 metres after post processing. Also, as requested by industry, the Hugin has an operational depth rating of 3,000 metres and is integrated with a launch and recovery system that has been successfully used in sea states of 4 metres.

Unique Capabilities

The Hugin 3000's unique operational capabilities, which include a faster survey speed, faster line turn capability, ability to survey curves and arcs, and ability to traverse complex bathymetry, both increase efficiency and reduce costs. Survey specifications can now be based upon engineering needs rather than the technological limitations of deep towed systems. "Designer AUV Surveys" are being performed regularly as evidenced by Figure 2. In this example, the client requested that a high-resolution survey be performed around an existing oil platform. Rather than "boxing in the structure" with a surveying grid, as is normally done, four concentric circles of increasing diameter were mapped around the structure. This unique capability allows normally problematic surveys, such as curved or obstructed pipeline routes, to be performed without an increase in complexity or cost.

The Learning Curve

The Hugin 3000 was delivered to C & C in August 2000. This was subsequent to sea trials in Norway that included a successful 40-hour

dive. Even though the vehicle was delivered in "ready to go condition", it seemed impossible at times to transform it into a fully operational working-class vehicle. Problems seemed chronic. As aptly described by Thomas Chance, President of C & C Technologies, "It was like crawling our way through a briar patch". The Hugin's developmental struggle is characterised in the following chart, "Percentage of Up-time" (Figure 3). The jagged blue line represents monthly chargeable operations (on-station collecting acceptable data), divided by non-chargeable downtime (unable to collect acceptable data). The white line is a regression curve extrapolated through the monthly data. It is clear that by late 2001 the learning curve was flattening out, but as utilisation and ongoing development continued, system modifications were difficult and costly to digest.

Percentage Up-time

It required six months of hard work, coupled with the associated vessel and personnel costs, before the first acceptable AUV data was collected. The chart "Percentage of Up-time" reveals that in February 2001 the Hugin had at last attained a positive up-time rate of 61 per cent. At this point, the engineers were convinced that forward momentum had been achieved and that things would continue to improve. It was evident that there was "only one more problem to solve" and it stood to reason that up-time would increase the following month. Wrong! Up-time plummeted to 16 per cent. This confounding vacillation of performance continued until October 2001 when, for a six-month period, Hugin's up-time remained near 90 per cent. Then, in June of 2002 and March of 2003, software and hardware "upgrades" painfully resulted in reduced up-time rates of 51 per cent and 71 per cent respectively. Since February 2003, the Hugin 3000's up-time rate has remained between 80 per cent and 100 per cent.

Performance

Technically, the Hugin 3000 has been very successful. Not only has it met or surpassed all the requirements addressed by industry; its performance has improved over its three-year lifetime. In the following chart entitled "AUV Utilisation & Downtime", Hugin downtime includes all activity required to keep the AUV operational during a survey. This encompasses pre-dive preparations, maintenance, battery refuelling, and repairs. It is clear that downtime declined as operational efficiency improved. Downtime dropped from 99 per cent, a virtual one-to-one ratio in year 2001, down to 24 per cent in year 2003.

Utilisation

Although the Hugin 3000 has been a technical success, it would be difficult to judge it as a commercial one. C & C's AUV utilisation reveals an alarming trend; it has degraded each year. As further characterised in the chart "AUV Utilisation & Downtime" (Figure 4), in year 2001, the Hugin 3000 was utilised for 101 days or 28 per cent of the time. By the end of year 2002, utilisation had decreased by 24 per cent to 77 days. It now appears that year 2003 will mark another decrease in AUV utilisation. To date, only 53 fully chargeable AUV days have been realised for the year, a 31 per cent drop from the year 2002.

Epilogue

The Hugin 3000 was designed to satisfy the imagination of industry and it was developed at their request. Now it waits for crumbs to fall from industry's table. So, what has caused this unnerving trend? Oil prices have remained above US\$ 25 per barrel for the past three years and no other AUV has successfully entered the commercial survey market. Has the work dried up, are we victims of our own success, or has industry just got cold feet? While it is true that the Hugin 3000 is five times more efficient than traditional deep towed methods, it is equally true that industry has proclaimed the need for contractors to develop the technology. If industry has truly adopted AUV technology, it is time for industry to support it.