ROV PLANET

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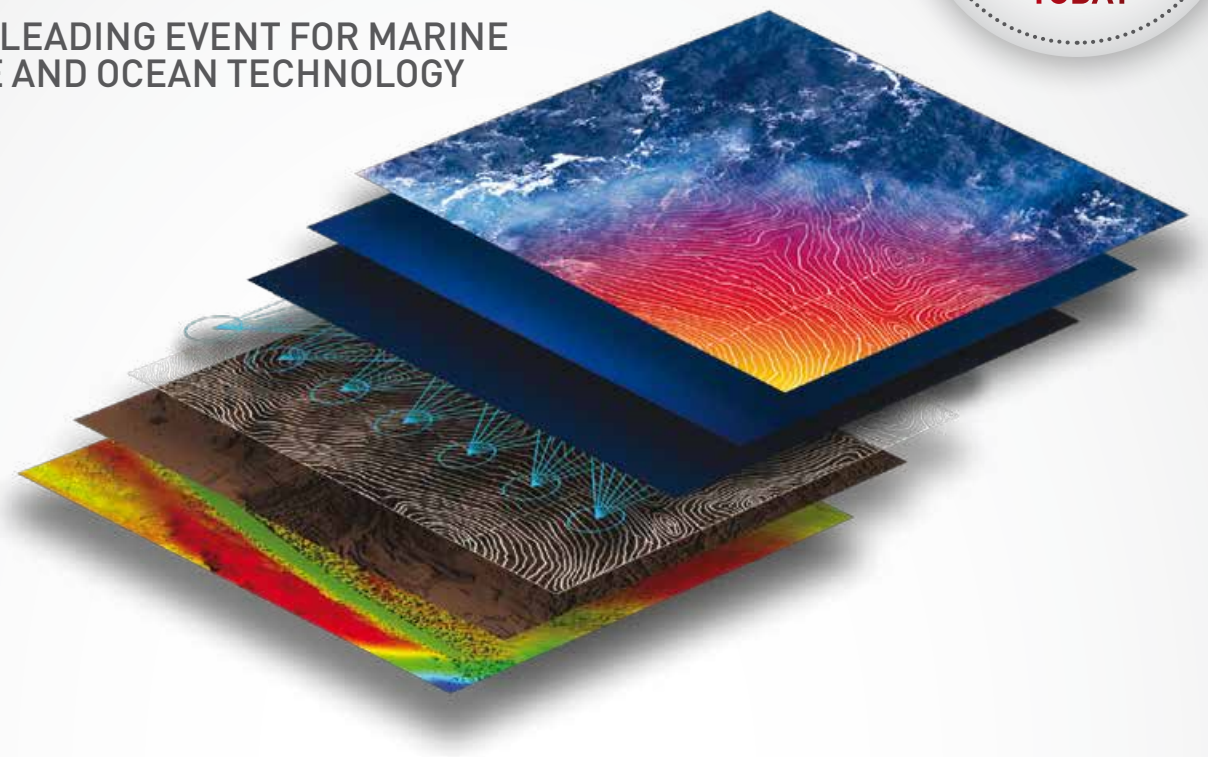

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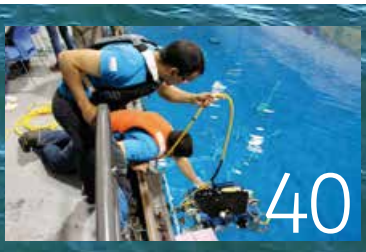

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WELCOME TO ROV PLANET

My name is Richie Enzmann and I would like to welcome you all to the latest issue of ROV Planet!

Currently the market shows a weakness short term, but we can anticipate a more positive outlook on the long term. The next 12-18 months in the oil industry is expected to be tough. Some companies diversify towards other industries to ride through the storm, meanwhile others look for partners that can complement their businesses or provide financial backing.

Despite the general slowdown, training is always important. Canary Islands based QSTAR provides ROV training in one of the best climates in the world, with practical ROV piloting opportunities in both shallow and deepwater. Located between two continents they are perfectly positioned to provide training, and the Canary Islands could very well become one of the offshore support hubs of Africa.

I have interviewed Andrew Hodgson, CEO of SMD about the recent acquisition of his company by CRRC, a Chinese technology company. The move will allow SMD to grow and even expand further in these critical times. Andrew was kind enough to share his thoughts on this acquisition and explained how it positively impacts the future of SMD with new opportunities opening up as a result of it. We talk about China, global opportunities, subsea mining, offshore renewables, and technological developments. It's well worth the read!

In our defence focus Double Eagle Down Under features the story of the Double Eagle System that has been successfully in operation with the Royal Australian Navy for the past 15 years. Also, we briefly feature the US Navy's PIV/WSP in the ROV Hall of Fame.

Finally, Jill Zande reports from the MATE 2015 International ROV Competition in St John's, NL, Canada, where students competed against each other with their self-built ROVs in the state-of-the-art-facilities at the Marine Institute of the Memorial University, simulating real life arctic conditions in line with this year's polar theme.

Sit back and enjoy the fifth issue!
Best regards,
Richie Enzmann

UPCOMING EVENTS

19-22nd October, 2015 – Oceans'15 MTS/IEEE – Washington, DC, USA
The premier North American marine technology event.

03-05th November, 2015 – Oceanology International – Shanghai, China
China's leading event for marine science and ocean technology.

03-05th February, 2016 – Subsea Expo – Aberdeen, UK
The World's largest annual subsea exhibition and conference.

23-25th February, 2016 – Underwater Intervention – New Orleans, USA
The World's premier event for diving contractors, ROVs, and manned submersibles.

15-17th March, 2016 – Oceanology International – London, UK
The World's premier event for marine science and ocean technology.

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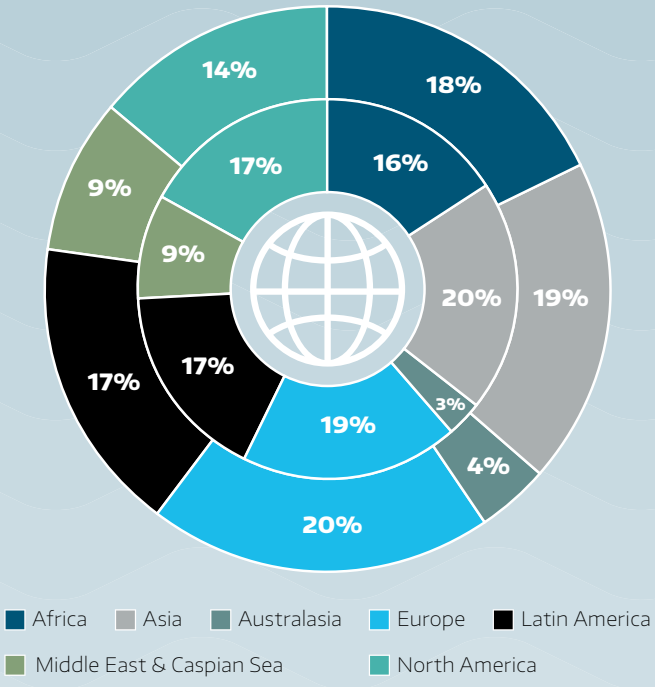
ROV DEMAND UPDATE

By Kieran O'Brien, Energy Researcher at Infield Systems
(Kieran.OBrien@infield.com)

Despite the current and forecast short-term weakness within the ROV market, a more positive longer term market projection is anticipated, with Infield Systems' new analytical tool, providing a quarterly demand forecast of the ROV market, expecting an ROV demand growth of 18% over the five years to 2020.

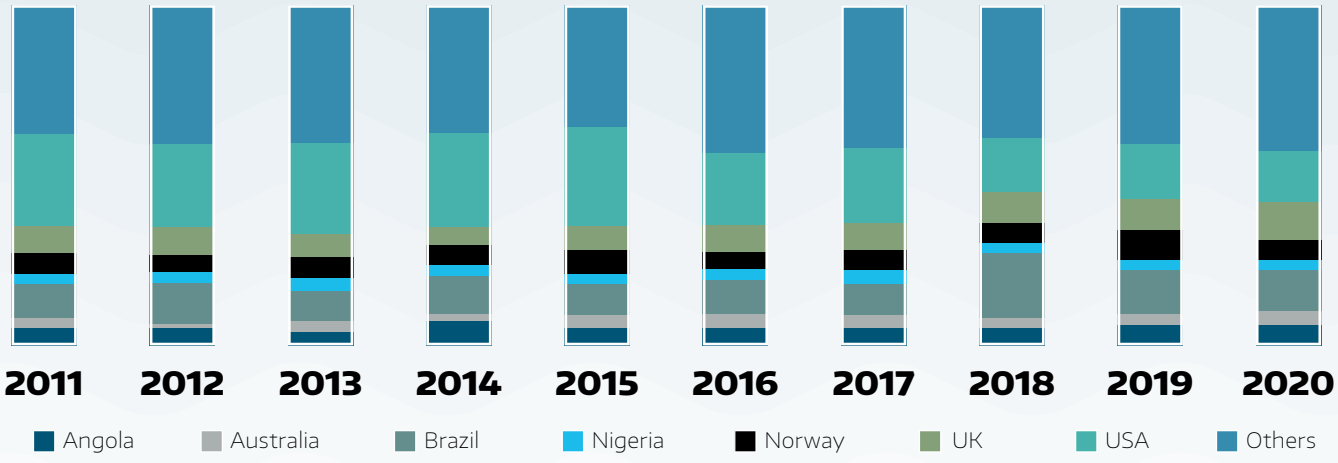


ROV Market Share (Days %) by Region 2011-2015 (inner ring) 2016 – 2020 (outer ring)
(Source: InfieldAnalytics – ROV)

The prevailing low oil price has affected all sectors of the industry and the ROV market is no exception: the sector's high level of exposure to the floating rig market results in a vulnerability to any decrease in drilling activity. However, after decreases in demand from 2014 to 2016, the floating rig and the marine construction markets are expected to recover from 2017 onwards. Over the longer term, higher levels of growth in demand for oil and gas are expected to return and with this the current market oversupply is expected to be rectified. With global energy demand increasing and near-term declines in conventional production expected, unconventional reserves, and more challenging prospects, including deep and ultra-deepwater fields, will need to be brought to market.

Africa in particular will benefit from this increase in the unconventional oil and gas supply. The huge reserves found in ultra-deepwaters offshore West Africa, in particular Angola, are expected to drive ROV demand growth at a higher rate than in any other region. The Latin American market, which has undergone substantial growth over the last five years, is expected to see demand flatten off going forwards, with the financial difficulties facing Petrobras contributing to delays in investment. Within the North American market, Infield Systems expects activity to decline, predominantly as a result of the removal of IRM targets through shallow and mid-water decommissioning activity. Indeed, by the end of the decade, the USA will represent just 15% of the global vessel based ROV market; down from 29% in 2015.

Infield Systems' analytical tool can be used to examine all relevant parts of the ROV sector. The granularity of data behind this enables an accurate forecast how the market will change over the coming five years. The ROV market will weather the current downturn, the oil industry will adapt to lower prices and deepwater reserves will buoy ROV demand in the longer term.



ROV Market Share (Days %) by Country 2011 – 2020 Excluding Wells/Rig based Demand
(Source: InfieldAnalytics – ROV)

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INTERVIEW
WITH ANDREW HODGSON, CEO OF SMD

ROV Planet interviewed Andrew Hodgson, CEO of the Newcastle, UK-based Solid Machine Dynamics Ltd (SMD) about the recent acquisition of the company by CRRC Times Electric. We wanted to find out more about the acquisition and the possible advantages it may have for SMD.

| RICHIE ENZMANN: Andrew, please tell us a bit about the Chinese offshore industry. When I think about China it's high volume manufacturing that comes to mind. I think it is fair to say that we haven't seen much Chinese activity in the international subsea and ROV industries in the past.

| ANDREW HODGSON: When China decides to do something, it tends to happen. They have a different way of thinking about the world. Now that China has got its Oceans policy you can be assured that it will happen. The only question is how it will happen.
This will lead to a bit of a shift. I don't think it will lead to such a seismic shift that Aberdeen, Houston, and Brazil will cease to be important, but I think it's interesting to look at the overall dynamics of the world. For example West Africa is forecast to be another Brazil if not better, and obviously China is investing a lot in the whole African continent. There we would have a linkage, as it's not just about the local Chinese market; it's about how China operates on an international playing field with various licenses, and what Chinese national oil companies are doing, the vessel based supply chain... there is a whole series of things that add up to [the projection] that we will see China play a much more significant part in the whole offshore and subsea game.

| RE: Yes, I think you're right. So do you see Shanghai becoming a possible hub for the Chinese subsea industry?

| AH: We are currently trying to analyse where we think the best location is for a Chinese hub. Clearly part of our strategy is to grow our Chinese market presence. We think Shanghai is a good location for a number of reasons: it's a major international city, it has major shipyards in close proximity, and we have a good relationship with Shanghai University. They have good subsea experience, so I think there are a number of things that mean that Shanghai could be good. But you know it's [only] one of the good places in China that could be attractive.
Obviously the downside is that it's more expensive and crowded, but there is a reason for that. Shanghai has a lot to offer; it's crowded for a reason. Obviously to accelerate the progress of activity you have got to think about where you can get people, as we are in an international industry and we need somewhere where people would travel internationally. Shanghai ticks the box there as well. I think Shanghai is a very strong candidate amongst others in our minds.

Courtesy of SMD

RE: Can you please tell us about the background to the acquisition of SMD by the CRRC group? I think it's fair to say that it has taken everybody by surprise. How did it come about?

AH: Strategic genius!! I guess like all good acquisitions you have got to look at it from both parties, so I will start with why CRRC were looking into our space. I already mentioned that China announced its Oceans policy, and it has been encouraging companies with capability to start looking at how China could start to build knowledge and understanding to gain a global position within the total marine industry. CRRC – whilst they're predominantly a railway manufacturing business – looked at their organisation business as a technology business, and technologies come from all kinds of engines, electrical power distribution systems, control systems, simulation systems: all of which ads up in the railway sector to allow them to have become a world leading manufacturing of high speed trains. But they have been looking into other sectors for a number of years now; they are in the automotive sector and the construction sector for example.

So they have been diversifying from rail but being a technology-led company they have started looking at the offshore and subsea fields in order to gain a foothold. They were out there to look for someone that ticks the boxes of a technology business with an engineering-led bias like they are.

At the same time SMD has been through a period of private equity ownership and what we were trying to do in the private equity cycle is to grow the business: mature the business from a process point of view, improve our research and technology, engineering development programme; improve our products, our market and offerings; improve our after care and support in a number of markets. We aimed to do this not only in oil and gas but also in offshore energy, renewables, interconnecting power cables, the offshore telecoms market, deepwater subsea mining market, tidal generation. So we have been working across high growth, but cyclical and volatile markets and we were trying to create a business that is able to withstand that.

To move the business forward, some of our potential markets offer us what we think are significant growth opportunities... we were looking for a partner with long term intentions, who are used to investing in technologies, who had some technological capability to bring to the party, but mainly a partner who had the financial strength to support our work and our ambition. Frankly we have been caught out before when we developed technologies. However the speed and upscale in those technologies when the market size is relatively large compared to the offshore ROV market: that has always been a challenge for us.

So we were approached back in 2014 by CSR as they were then known. They came and pitched this story what we could do for them and what they could do for us. We ticked their technology box with a lot of common baseline technologies that we require for our systems which they have huge capability and capacity to develop... Conversely they ticked our boxes because they have huge financial backing that allows us to change our business model again and will allow us to scale up some of our technologies. It will allow us to secure and mature some technologies in the offshore space which – because of the size and nature of that market – aren't high volume enough to support where we would like the technology to be. So we weren't looking to sell the business, but the pitch was a good one and made a lot of sense, it made a lot of sense for the future of SMD and for the future of CSR (CRRC) and we agreed to explore that. We agreed on a deal back in December 2014 and signed the deal on 8th February, 2015. The whole thing was completed on April 8th 2015 after achieving regulatory clearance.

RE: Do you think that SMD will stay as a separate company, or is it going to be further integrated into the CSR group at some point?

AH: The way that we have established the business is that our owners are very keen to recognise that we are a business with a very clear identity and a well-known brand. We have removed 4 non-execs who were British and associated with our private owners, and were replaced with 4 Chinese non-execs (3 from the parent company and 1 independent). I'm still the CEO reporting to the board of an independent business that has a clear strategy sanctioned by the shareholder. So they are very keen to maintain our independence whilst allowing us access to the technologies and capabilities, which at that level is a bit like the best of both worlds.

In reality we think that there is a lot to be gained from the close co-operation with other partners in our group, particularly on the technology side. We would like to see more sharing of programmes and some joint activity. That would make a lot of sense for us, but CSR's strategy is to acquire businesses like ours, provide us with the financial and technical capabilities that we require, and support our strategy, whilst letting us run independently. They have no background in offshore or marine industries beyond the marine power group that makes control systems for ships, but this acquisition is a much bigger thing for CRRC. The strategy is not to kind of interfere too much; we are the ones that are leading in terms of trying to pull more integration, as we have access to some fantastic technology centres and great market access opportunities in China.

I said before when I talked about Shanghai, that we are going to open up a business in China along the lines of what we have done in Singapore, Macae, and Houston which is the service support and business development base. I have appointed a managing director to that business... he is from my existing management team, so again that's being run by a UK national to keep the linkage and a clear line of management back to the UK. We are trying to find a blend but we are not under any pressure from our parent to integrate. In fact it's quite the opposite; our parent company is trying to diversify both away from rail and from China as they still get their revenues predominantly from China. They are trying to support two things:

don't put more activity in China as we don't need more cost base here... and don't try to integrate too much with us because we want the subsea business to grow as an international business, not just a Chinese business.

RE: But I think it's fair to say that your strategy is to be dominant in the Asian Pacific market, is that right?

AH: Our strategy has always been to be global. If you look at where we have been successful, well we have been hugely successful in Brazil, we have been very successful in the Asian market historically, and been very successful in the Russian market. These are key territories for us. We do think that the Chinese market is a latent one and we see growth there. We always had a good play in the Asian market, and we will continue to do that and manage the Asian market from our Singapore office, but there is a very specific Chinese market which gives us different opportunities. Obviously the Chinese shipyards are growing substantially. A lot of vessels and rigs are being built there now, and we think that our close proximity and our owners' links to those yards will give us splendid opportunities there.

We know that there is a growing subsea market within China as well; we think that subsea mining is another huge possibility. So we believe that China will be at a proportionately higher growth rate than other things as part of our strategy. But this is definitely not about a lack of focus on the other markets. Brazil is hugely important to us. We think West Africa will be incredibly important for us; Russia is incredibly important for us. This is why we have set up a different business unit in China to handle the specifics of the Chinese market and to make sure that we are well positioned there. This has always been part of our strategy... it will accelerate, but not to the extent that it focuses us away from other things that are important to us.

RE: You did mention subsea mining and I recently saw a presentation about the Solwara project in Papua New Guinea: now that all 3 parts (bulk cutter, auxiliary cutter, and the collection machine) of the mining equipment are completed, the project is now only waiting on the processing vessel. In your opinion, when will we see subsea mining taking off with an activity level comparable to the offshore oil and gas industry?

AH: I think that's still some way off to be honest Richie... certainly it won't be within a decade that we would see that level of activity, but that's not to say that it wouldn't be substantial in that period. Obviously the capital investment in any mine, whether it's conventional or subsea, is substantial. Interestingly in the subsea mining it is reusable capital investment as you can move your equipment from site to site easily which makes it one of its attractions. But anybody that will be willing to commit that level of money is going to want to see the outcome of the production levels at Solwara. I think when we cut first ore it will be a transformative day for the industry, because the finance community still perceive it as a technology risk. We don't think there is a technology risk there, but they clearly do.

I think with the SMS (Seafloor Massive Sulphide deposits of copper, gold, zinc, and silver) deposits at the depth where they lie, and the volume of them and what we have learnt about the technology, there is a huge economic case for subsea mining and hence what I was saying before about the size of our parent company being very important, as when the market picks up we will have first mover advantage but we would need to be able to exploit that. However it's not like I have a plan that within 5 years we have to manufacture 20 subsea mining machines; far from it! But I think once the first ore is cut a lot more of the people – there are already a lot of licences awarded – will move from the exploration licence phase to the production licence phase: once they have seen the ore cut and once people in the financial markets see that the technology risk is not there.

That's when we believe the market will really start to pick up and it will be just how quickly that goes so maybe post 2020 we will start seeing a pick-up in activity and then maybe towards the end of the 2020s that's when we will start to see major scale national operations, so it's a long term play. That's always been our picture. With mining it took a long time to get here and it's clear that our customers are subject to various pressures not least the changes in the commodity market which is there for the traditional mining, but they continue to raise the money and continuously improve the technology. Again China has got demand for raw materials and those raw materials need to come from somewhere and those SMS deposits are well positioned to the Chinese market. I think some of the other deposits – such as the manganese nodules that are deeper – are easier to collect, but much harder to lift because of the depth of the operations. So I don't see that happening as quickly as the SMS deposits.

RE: What other markets do you see into which SMD could successfully position itself in the near future?

AH: Offshore renewables is very interesting to us. Again we have been close to offshore renewables through our cable laying and burying technologies right from the start. A lot of the offshore renewables are in relatively shallow water. That's why cable protection becomes important. As offshore renewables moves into slightly deeper water, the challenge will be less about cable installation and more about the physical installation of the assets. But clearly the larger the turbine, the larger the tower, and the more that people want it offshore from a visual impact perspective. That's clearly what has been happening in the UK, which is why most of the shallow water installation has been done.

The traditional installation techniques such as those used in jack up rigs will become less viable. But with the use of deepwater technologies comes expense and the challenge is to make the offshore wind viable with these costs. We also see that with tidal power generation robotics has

got a huge part to play... we see the pressure on the cost being more recognised now. It's not only the cable installation technologies but using our larger, more powerful robots in place of traditional techniques together with various installation tools which are under development.

There is again a Chinese aspect to this. There is a huge movement of people towards the coastal cities in China, while the power generation infrastructure is inland. So you've got a growing population at the sea and China wanting to reduce its emissions, but it hasn't got the transmission network to support these coastal cities. So offshore renewables makes a huge amount of sense in China and that's one of the things that we think will grow massively within the Chinese market, and our position there is important... different countries have different generations of technologies that want to share their power. We think that will continue to grow and offshore cables and installations in telecommunications are clearly coming back as broadband takes over.

There was a huge explosion in the subsea telecom cables market and then it crashed around 2001 as everybody knows. But we definitely see that coming back because subsea cables have the best transmission capability, and increasing the sizes and capacity of that infrastructure is really important now in the world. We see opportunities in nuclear decommissioning, that's away from the subsea market, where we have been developing technologies. Again it's a slow market to get into because people are very conservative, but then again the cost and safety advantages of using robotics are important.

On the oil and gas side the arctic is where we see that robotics will play a much stronger role than the traditional methods obviously because of the ice shelf and the ability to operate in those weather conditions where more conventional technologies can't. If you capture all of that it would point you in the direction of bigger and more powerful platforms being used, and we see the bright prospects on that side. On the smaller ROVs, work class, and inspection class market it will be more service orientated. I think the platforms, ourselves, Shilling, Forum, Oceaneering, Fugro... we all make good work class ROVs now. I think that the physical platform is relatively standardised and we all have different ways of dealing with the same problems. But we are all pretty good at what we do and I think the reality... is that the service offering will become differentiated. We also think our ability to remove people from the offshore environment and to use more autonomous technologies for higher level tasks will define the next stage of development for the WROV market.

RE: Yes, there seems to be a clear shift there.

AH: Yes. With all technologies you need to converge a number of things together, and we would typically say that there needs to be 5–6 things moving through a transformational phase in order to be able to make a step change. We think that 3 or 4 of those 5 key stepping stones are really developed. The other ones are getting close to the point where the world of autonomy will move from being something that is used for inspection tasks to something much more significant. We are happy to be partners in a group that has knowledge in some of those technologies; it will allow us to accelerate those programmes in a way that you conventionally wouldn't be able to do in a niche subsea market.

RE: I have a final question. We have already spoken a little about the direction of technology and autonomy, but I was wondering if you see anything specific within the high speed rail technologies that could be applied to the subsea/ROV industry?

AH: High speed rail manufacturing is currently experiencing a high volume of activity. However it relies on remote monitoring, control, and access. My background is aerospace, and my observation is that those technologies are much more highly developed both in the rail and aerospace transportation markets, than within the subsea market... I think that's one of the technologies. Obviously power, power transmission, and distribution is something that an electric train does pretty well, and more efficiently than we do. I'm not talking about just having a remote control capability – we can pretty well do that now – but I'm talking about the sophistication of having multiple devices out there all interacting on a high speed rail system.

The integration of assets and how they communicate together and how they share information between assets as well as feeding back is a critical part of that technology, and obviously as we're planning on moving towards more autonomous environments you need to be able to do that. If you imagine in high speed rail where traditional signalling methodologies do not apply, separation of trains on the network is a huge safety – as well as economic – challenge. Maintaining all of that control and data flow that goes back to the central base is very critical, and they have to deal with it more than we currently do. We see this as one of the things that you need to be able to handle if you have multiple assets out there in the water to work autonomously, and that's an area that we can learn from.

Courtesy of SMD

SUB-ATLANTIC TETHER MANAGEMENT SYSTEMS (TMS)

TECHNOLOGY THAT SIMPLY WORKS...

By Ryan Lumsden, Global Product Director and Andrew Coughlan, Sales Engineer at Sub-Atlantic

They say the best solutions are the simple ones and this, more often than not, proves to be the case.
The functionality of a tether management system (TMS) is relatively straightforward, it's essentially an underwater winch that manages the excursion of a remotely operated vehicle (ROV) by lengthening or retracting the amount of tether cable deployed and connected to the ROV system.
So, in theory, it is straightforward. But, in reality, designing such a piece of equipment that works effectively in harsh subsea conditions is quite another matter and involves a great deal of expertise and engineering capabilities. Many have tried and failed.
As a company, Sub-Atlantic was founded in Aberdeen in February, 1997, and built a strong reputation for the design and manufacture of ROVs, TMSs and subsea components. It gained a reputation by manufacturing cutting-edge Electric Observation Class ROV systems and components which became the industry standard for Hydraulic Work Class ROV systems.
In 2007, Sub-Atlantic was integrated into what has now become Forum Energy Technologies alongside the well-known Perry brand as part of the subsea division.
With an established track record in providing best-in-class systems, Forum's Sub-Atlantic brand is a specialist in all areas of ROV work including the delivery of TMS that work effectively.

Courtesy of Sub-Atlantic

Courtesy of Sub-Atlantic

TMS USE

There are two commonly regarded configurations for operating ROVs. A live boat configuration, where a tether connects the ROV to the vessel, offers a lower level of complexity and cost but with increased operating challenges at deep depths or in turbid water.

The second configuration is where a TMS is used and acts as a clump weight that keeps the ROV at the desired depth and isolates it from vessel motions. In turn, the TMS connects to the vessel via a stronger armoured umbilical. The ROV is connected to the TMS by means of a flexible tether spooled from a subsea winch; making the ROV more manoeuvrable and less vulnerable to currents due to the reduced tether drag profile in the water.

Consequently, this second approach is marginally more complex and expensive - often requiring a higher safe working load (SWL) rated launch and recovery system (LARS) but which has significant operational advantages as previously mentioned. Alternative approaches such as the use of depressor weights at the end of the umbilical have been used but are uncommon and are regarded as less capable.


Courtesy of Sub-Atlantic

TMS TYPES

There are two main types of TMS; Top Hat and Garage. With a Top Hat TMS, the ROV sits underneath the structure and allows for numerous tooling packages to be fitted including side mounted. This approach makes the type of TMS ideal for mid-water applications. Historically, there have also been versions assisted by thrusters in an attempt to hold station and manoeuvre. A garage (or caged) TMS uses similar spooling methods as the Top Hat version but is designed to allow the ROV to park inside. It provides greater protection to the ROV through the splash zone, a faster and safer descent, and is ideal for parking the system on the seabed. In previous Sub-Atlantic projects, modifications have been made to the TMS to allow it to stow combinations of tooling or as previously designed by Sub-Atlantic; ELSS emergency life support stores(ELSS) pods for use with distressed submarines.

SIMPLICITY IS KEY

Currently, all of the Sub-Atlantic ranges of TMSs are of the Garage type. Typically enclosed Garage TMSs limit work packages however the Sub-Atlantic range features telescoping frames, allowing the fitment of tooling skids to the underside of the ROVs. The carefully considered decision was made to manufacture the TMS from stainless steel to minimise corrosion issues with the frame and critical components. Whilst the decision made the TMS marginally heavier, the efficient mechanical design offsets the additional weight. Constructed from plastics such as polypropylene, the guards and bumpers are designed to be robust and corrosion resistant.

The same type of thruster motors (and even housing) used on the ROV range have also been used on the TMSs to act as a single drive for the drum. This thruster motor also powers the level wind and traction wheel which effectively results in a single motor driving all moving components. It is this simplicity that drives the reliability of the system.


Courtesy of Sub-Atlantic


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Another major plus of this single motor approach is that it allows for commonality of components. Most importantly, this reduces the number of spares required by clients and significantly brings down the cost of ownership and maintenance.
The decision for a single drive was also based on a failure mode effect analysis (FMEA) that concluded if any one of several drives became damaged it would make spooling tether problematic and the greater number of drives would, in turn, increase the risk of one failing.

SPOOLING METHOD

When considering which spooling method to use, both bailing arms and diamond bar level winds (with the use of slip rings) were investigated. Whilst bailing arms, sometimes referred to as flailing arms, offered a lower cost solution due to the lack of slip ring, they gave inconsistent results and were deemed less reliable. Considering the importance of being able to reliably spool in tether and park the ROV in the TMS for safe ascent to the surface, and to avoid the potential of 'tether spaghetti', the diamond bar level wind approach was taken. Prior to its incorporation into Forum, Perry had also taken the same design approach on its work class TMSs for similar reasons.

SUBCAN™ / POWER SYSTEM

All Sub-Atlantic TMSs use the subCAN™ control system to communicate with the surface control unit. This allows telemetry from the TMS to be fed back along with live video from the TMS camera to assist in docking and recovery of the ROV. A range of LED lighting options and additional cameras are available and it is also possible to fit additional sensors such as altimeters. The design of the electrical system allows the ROV to remain powered in the event that the TMS is powered down or has a critical issue. Unique features such as high voltage, high frequency transformers have helped to reduce subsea transformer size and support more compact designs. For simplicity, the entire Sub-Atlantic vehicle and TMS range now both use the subCAN™ control system which provides a further reduction in spares requirements.

TYPICAL SPECIFICATIONS

The minimum depth rating of the standard Type 1, 2 and 3 TMSs are 2000 metres and the maximum tether capacity is up to 750m (dependant on tether diameter/size). Custom versions of TMSs have also been designed for use at 6000m.

LARS (LAUNCH AND RECOVERY SYSTEM)

Whilst the TMSs can often be used with clients existing LARS, Sub-Atlantic has worked closely over the years with its LARS manufacturer to develop one of the most compact system configurations available for a TMS based system. This has a more compact footprint thanks to tight design specifications and features such as a telescoping A-frame and folding platforms.

MARKET FLEXIBILITY

Forum manufactures components such as thrusters and valve packs to a very wide range of clients. TMSs are no exception as customers need a well-engineered solution. This has resulted in a number of TMS being sold for use with existing ROVs from alternative manufacturers. Sales of TMSs are extremely strong, which is an acknowledgement to their design and evolution.
The manufacture of all Sub-Atlantic ROVs and TMSs is now undertaken alongside the manufacture of 'Perry' systems at the Kirkbymoorside facility in North Yorkshire where Forum have created an ROV centre of excellence.
Being able to offer an extremely effective TMS, through delivering a product that incorporates innovations such as a reduced number of motors, reliable spooling methods and effective control systems has enabled Sub-Atlantic to deliver technology that simply works.

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THE POWER OF FOUR

J2'S INNOVATIVE TOOL CHANGER IS A GAME CHANGER: ADDING VALUE AND SAVINGS TO THE SUBSEA MARKET

J2 Subsea – based in Aberdeen – was established in 2008 by directors John Valentine and John Walker. The pair have extensive background in manipulator and ROV tooling services; John Walker previously worked for Fugro and Bennex, meanwhile John Valentine previously worked for Fugro and DOF.

The idea to start J2 came about when the two Johns realised that there was a gap in the market for a high quality manipulator and ROV tooling service and repair centre to meet the needs of ROV owners in Aberdeen. Since then J2 expanded operations through locations in Houston and Singapore, enabling them to provide tooling services worldwide and have quickly established a reputation for quality, reliability, and a customer-centric service which is second to none. What sets J2 Subsea apart is their attention to detail and tireless efforts to help customers overcome their challenges.

From their beginnings as a repair, service, and maintenance centre for state-of-the-art, technically sophisticated robotic manipulators they are now providing the market with innovative ROV tooling that challenges the status-quo.

CHANGING TOOLS SUBSEA

J2 developed the 4 Port Zero-Leak, Tool Changer as a means of saving operators costs and increasing long term value for the end user in the economic climate. The J2 ROV operated tool changer has significant benefits and is designed to revolutionise the way tools are used subsea.

The tool changer allows the ROV to connect with a tool on the seabed and simultaneously connect up to four hydraulic lines for power and control of the tool without compromising the ROV hydraulic system. The concept was conceived by J2 Subsea, Aberdeen and Walther through innovative design and manufacturing techniques. They took the concept through to a fully developed product to meet the design requirements. A comprehensive testing and qualification programme was then undertaken, including hyperbaric testing by Walther and J2 to ensure the changer met all aspects of the original design specification that it was robust enough to give reliable service in its intended environment. The flexibility of the final design gives further opportunities for development.

On the subject of that final design, it really is quite impressive. The finished model is depth rated up to 5,000m with a 250kg lift capacity (without buoyancy). Its stainless steel exterior is made from a combination of nitronic 50 and hiduron. Its components are self-sealing featuring clean break inserts, and are zero-leak certified to 345 bar. Finally, the hydraulic connections feature two NO4 JIC latching cylinder ports, and two NO6 and NO8 JIC ports, respectively.

FLEXIBILITY AND CUSTOMER COLLABORATION

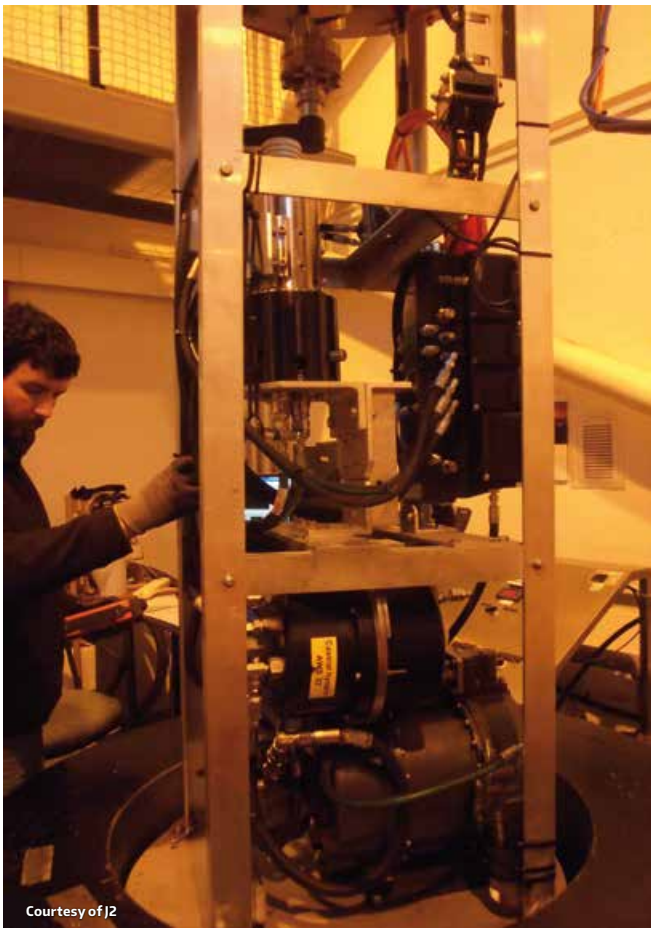
J2's new product also needed to be flexible enough to match a range of different scenarios. J2's ROV Tool Changer has been designed to allow any work class ROV to connect and disconnect from tools and intervention panels that require either high flow or high pressure applications. Vessel owners are therefore able to reconfigure their ROVs to utilise survey equipment, intervention equipment, and other specialist equipment. This removes the limitation on the ROVs, and increases their efficiency and utilisation.

This flexible approach is accomplished through J2's interactions with their client base. J2 works with customers to understand the unique installation aspects of the customer's ROV. This then enables customers to preconfigure the hydraulic equipment and connections to match the specification and configuration of their ROV.

In some cases customers may have applied modifications from the manufacturer's own design, and hence this prework is vital to prevent delays later on. Undertaking this work reduces the risk to the project by eliminating technician error, and preventing delays to the mobilisation and demobilisation of the equipment.

INNOVATIVE SOLUTIONS

The industry faces pressure to reduce manpower costs and in certain circumstances the skills on board a vessel. J2's ROV tooling packages are supplied with detailed lists of contents, pictographic displays of each item and labels in an easy to understand, "what's in the box" format, which



Courtesy of J2

comprises all spares and accessories required, to help technicians quickly assemble the components and get to work sooner. This approach also helps demobbing at the end of a project, by enabling the crew to identify which parts go in which box and ensuring that any missing parts are immediately identifiable. All necessary components and accessories are provided with the tool to give the "complete package" all in one box, from one place and J2 handle it all. Project managers like this approach because they are not hit with costs for lost or misplaced components. Purchasers also like it, because it saves them sending out numerous purchase orders to different companies with varying lead times.

J2 went further and identified other common problems and trends facing subsea operators. As the workhorse of the industry, the consistent running of Schilling T4 manipulators is integral. Unfortunately, as ROVs have increased the range of tasks that they can undertake, T4s are now being used in operations which put their joints under severe strain, resulting in high and ongoing repair bills. T4 manipulators cannot be repaired offshore and therefore have to be returned to the manufacturer for costly repairs, with long lead times, which result in ROV downtime.

J2 identified this issue and realised that the solution would be to use with the Schilling Atlas manipulator. This was easier said than done since the Atlas is purely a hydraulic arm and therefore lacks dexterous proportional control. They approached Fathom Systems with the problem, and together they developed an Intelligent Valve Pack (IVP) Proportional Controller using a remote handheld videogame


Courtesy of J2

controller. This set up makes it possible to perform many of the tasks which are normally only associated with T4s. The operation of the arm using the videogame controller is intuitive - especially for the younger generation - and can be combined with a T4 to give an ROV maximum capability. The system comes fully-self contained as standard with 8 functions which can be expanded to 12. The iVP fulfils not only the hydraulic control requirements for manipulator arms but also for skids, tracked vehicles, tether management systems and tool deployment units.

REDUCING RISKS

As previously mentioned, J2's Tool Changer technology - developed in partnership with Walther Precision Couplings - has been designed to address the need to connect and disconnect hydraulic lines at depths of up to 4,000m in a safe, reliable, and zero-leak manner. With the flexibility that this technology now affords, ROV crews can dramatically change the way that they work.

For example, it's possible to drop large baskets of tools down to the working depth whilst the ROV continues to work and change tools without having to fly the ROV back to the vessel and through the splash zone. This reduces the risk of damage to the ROV and ancillaries, as well as enabling the crew to keep the ROV at the working depth for weeks at a time. Switching tools is simply a case of holstering, unplugging the unwanted tool, and plugging in a new one and continuing with the task.

An example of where this technology can prevent a project from being delayed is when an unexpected issue occurs with a tool operating subsea. Should a cutting tool become stranded, replacements can be lowered down and simply be replaced, whilst the original tool is recovered to the deck.

Clearly, safety is a very important issue when introducing any new subsea tool to the marketplace. That is why J2 ensured that the 4 Port Tool Changer underwent a battery of test programs before being fully signed off for production. The test program was conducted by Walther and J2 jointly, and included factory design, manufacture, development and hyperbaric testing. Mate/De-mate testing was carried out using a hyperbaric set up on a 700bar rated vessel, subsea HPU, and control system. As a result of this testing some key changes were made. These included the addition of a lock/unlock indicator, a 2 stage lead in, and a longer nose cone and end stop.

The finished product also features a locking mechanism and an emergency disconnect and mechanical override release to ensure safety in the event of a dead-sub.

STANDARDISATION

Finally, another crucial factor in ensuring effective, efficient, and safe working conditions for ROV operators is tool standardisation. J2 have worked to standardise their tooling interfaces across their full range of products, and this has led to the development of their ROV Tool Changer. The aim for the 4 port zero-leak changer is to standardise the interfaces across tools, intervention panels, trees, and vessels so that in all situations an ROV with the male end can stab in and perform operations. The Tool Changer unlocks the potential for vessel owners to make better use of their on-board ROV fleets by enabling them to connect various tools from survey, inspection, cutting, and intervention. Furthermore, it provides a safe, reliable, and cost-effective measure for subsea operators of all backgrounds to fully unlock the potential of their vehicle or fleet.


Courtesy of J2

SITE INTEGRATION TESTS (SIT):

THE 7 STEPS TO SUCCESS

By Dan Fjellroth, Senior Technical and Operations Consultant at Workocean Ltd. (Dan@workocean.com)

Anyone who has worked with ROVs in the offshore industry knows exactly how costly mistakes can be, both in terms of time and money. This goes double for shortcomings and errors that aren't discovered until after the ROV has been deployed on a project. How do we avoid such expensive oversights? This is where System Integration Testing (SIT) comes in.

SIT is the process of testing subsea components, structures, and interfaces as a whole, pre-project to ensure that they can function as a complete system once they are installed and tied together once the project goes live.

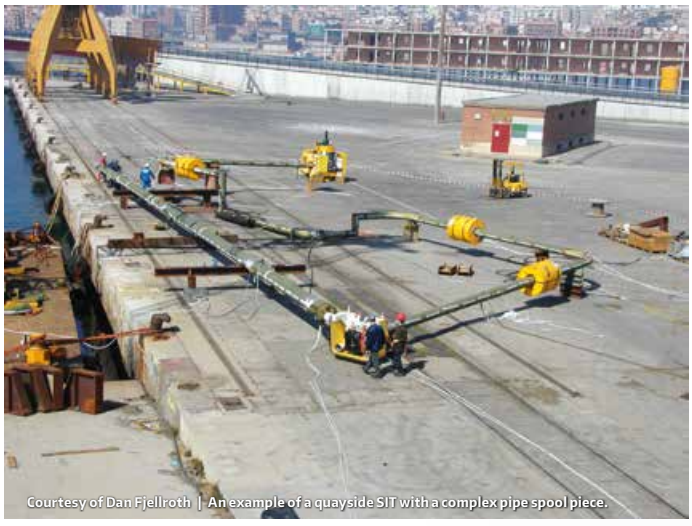
Technip – as an installation contractor – needs to confirm that the equipment can be safely and efficiently installed within specification, using only the equipment as detailed in the method statements and procedures. SIT also provides an ideal opportunity for familiarisation and training of offshore personnel and allows final modifications of equipment before deployment offshore.

SIT is usually conducted once the Factory Acceptance Testing (FAT) of all the structures and tools has been completed. However, it is not uncommon for the FAT to overlap with the SIT (which can complicate the development of SIT procedures).

THE IMPORTANCE OF SIT

SIT has three important purposes. First, it allows users to test the assembly for the sequence of offshore equipment, therefore verifying the necessary procedures. Second, it allows users to perform a complete system assembly, thus verifying the overall design. Third, it demonstrates the interface of specific components. This verifies the specific manufacture and assembly of the various components.

Note that the first and second functions can be partly offset by the thoroughness of the design process, but the final component can only be done by using the real equipment. Hard-earned industry experience has shown that time spent on adequate SIT is rewarded with success in reduced time spent offshore.



Courtesy of Dan Fjellroth | An example of a quayside SIT with a complex pipe spool piece.

The receptacle has been installed 180° incorrectly so that the handle falls into the unlock position of the J-slot. Hot stab is therefore insecure. This is a problem of assembly.

In this scenario, this issue was easily resolved by re-mounting the receptacle and remaking the pipework. This could not have been done subsea.

The torque tool cannot fully enter the receptacle because the tool slide is striking a structure beam. This is a problem in the design; the torque bucket should have been flush with structure face.

This type of problem is easily resolved in SIT (i.e. cut the ROV slide) but subsea it can be difficult to be sure if it is the receptacle or the slide that is the problem.

EXAMPLE OF SIT FINDINGS

To illustrate the importance of SIT it may be beneficial to look at some examples where issues were caught ahead of ROV deployment. The following examples were taken from a Technip project. Reasonable care had been taken during the design process but, nonetheless, issues were found during the SIT. Had these issues been encountered subsea, many days of vessel time could have been lost.

USING MOCK ROVS

While most other parts of the subsea hardware at SIT use real equipment, an actual ROV is usually replaced by a mock ROV. There are a couple of reasons for this. First, a real ROV is part of a working vessel. For that reason, it might not be practical to carry out an SIT. Second, real ROVs are heavy objects (in some cases they can weigh up to 5 tonnes) and have large, heavy support systems. And even when they can be made available, they are unsuitable to operate in air (hydraulics overheat quickly, lights can burn out, etc.).

As a consequence, mock ROVs are accepted as a more suitable alternative for SIT. Many contractors use very simple wood and aluminium frames for access checks. However Technip has long recognised the value of performing SIT work thoroughly. As a result, they have developed a set of mock ROVs with proper functionality: manipulators, lights, cameras, hydraulics, and so on. They even come with a combined air-conditioned control van and workshop, which contains the operator's console, monitors and recording equipment.

The mock ROVs have interfaces for workskids and spare hydraulic functions for tools, etc.

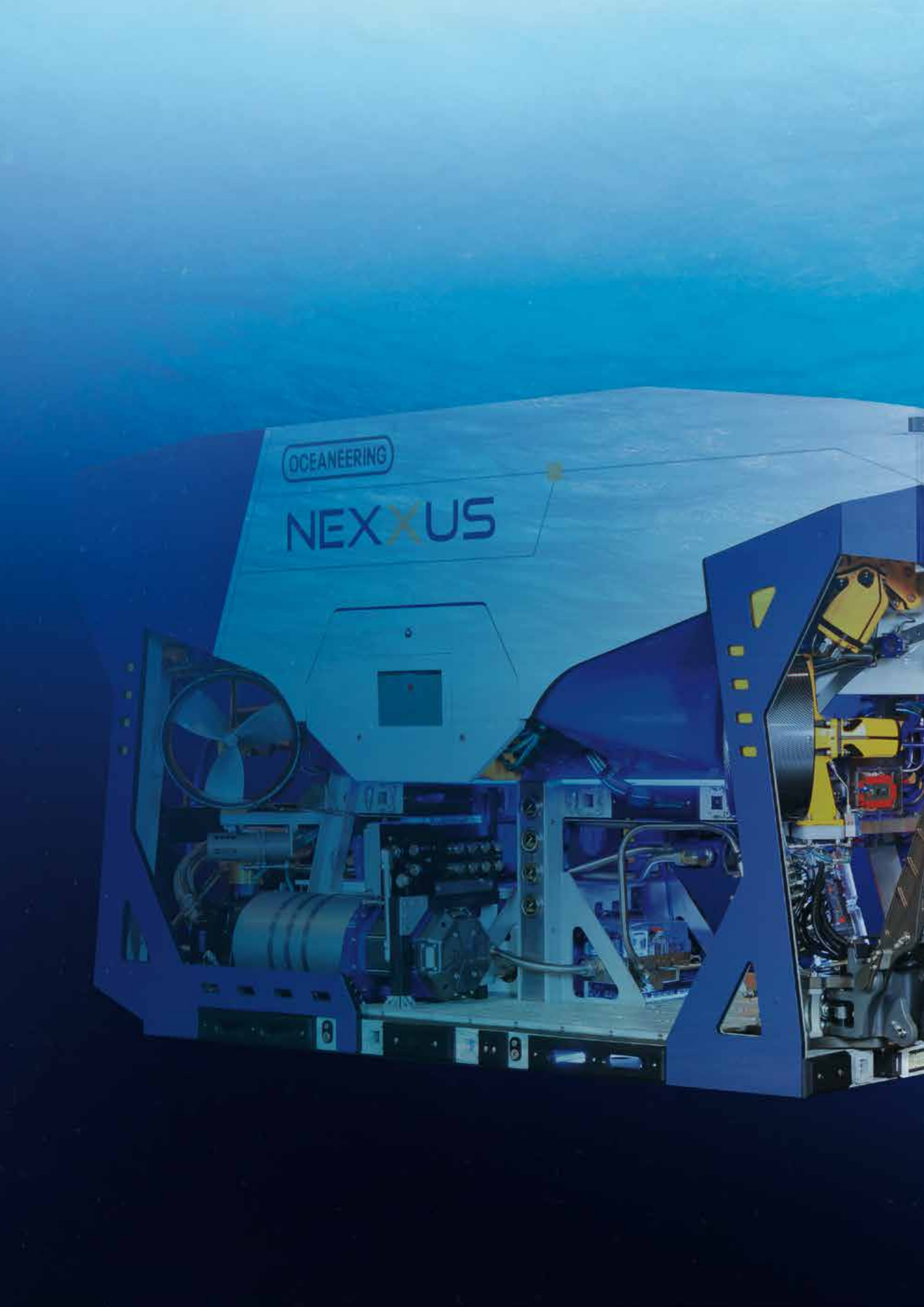
MOCK ROV (SHOWN IN XLX CONFIGURATION)

These mock ROVs can be physically reconfigured to correctly represent all three RSU systems: XL, TMRV, and XLX vehicles. They also can be used with most types of ROV skids.

One should note, as good as mock ROVs are, their limitations must be appreciated. SITs are performed in air as opposed to water. A mock ROV hanging from a crane does not have the same buoyancy as one in water. It is also not practical to represent an ROV's thrust in water in the air.

SIT GUIDELINES

To allow development of SIT procedures and requirements, a schedule for the SIT activities – including equipment logistics – should be agreed upon with the client at an early stage of the project. The agreement should include which structures and components will be available at the SIT, to facilitate a sufficient representation of all the interfaces.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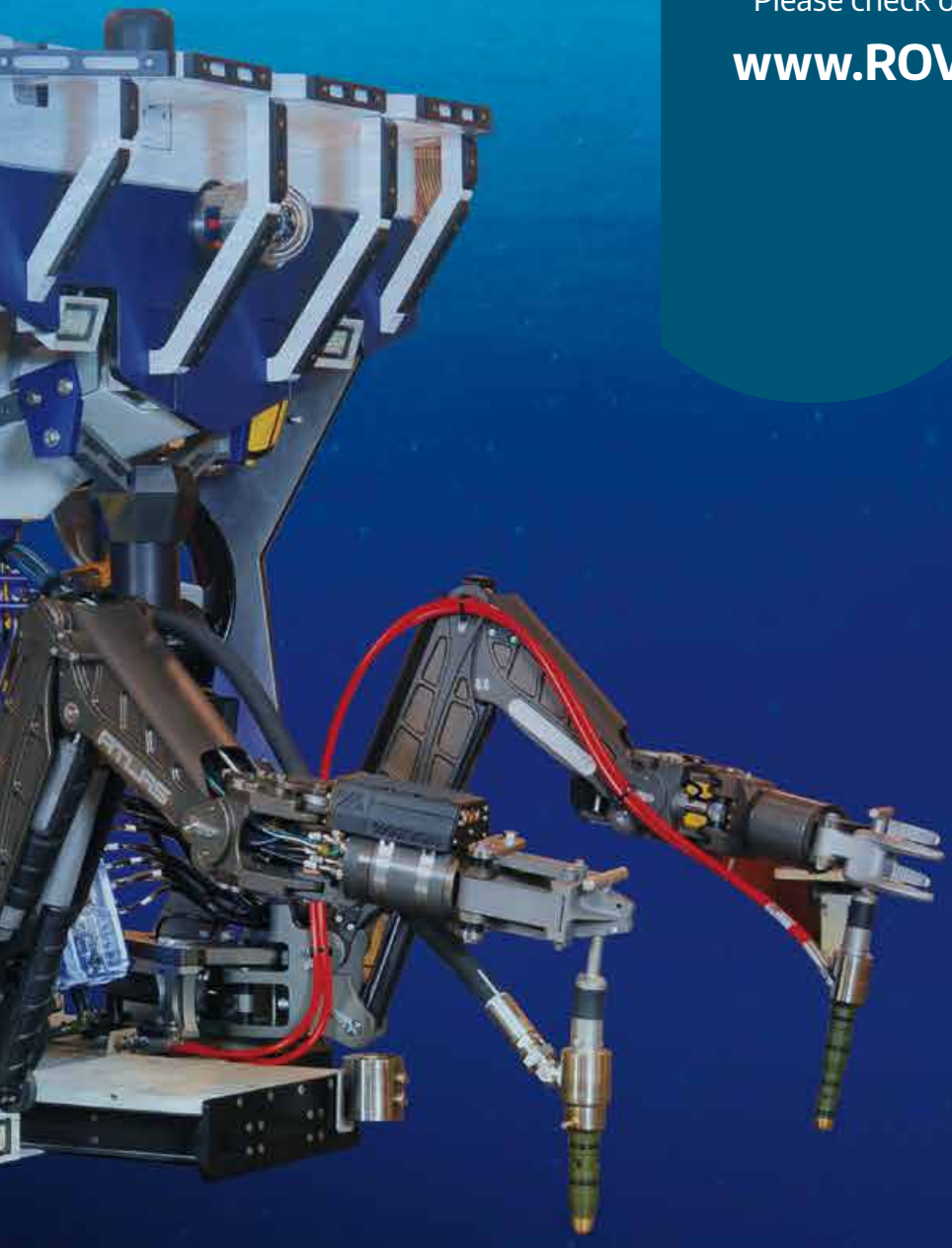


TYPICAL SITE REQUIREMENTS

There are several prerequisites that one should bear in mind before conducting any SIT. For example, the typical site requirements should include a hard stand concrete area if possible, good lighting (or mobile lighting if intending to work 24hrs / day), and access to single and three phase power for the mock ROV and testing equipment. This last item can be powered via, either mains or generator. Backup generator and spares should of course be considered for remote locations. One should also consider access to fresh water for cooling hydraulic systems, especially in hot climates. The user should also have access to forklifts and cranes for handling the mock ROV and any associated tooling for the duration of the testing, access to engineering workshops for modifications and repairs, and an office with full facilities, phone, fax, internet / email etc. The office should have heating or air-conditioning according to site location; an appropriately climate controlled office makes for a much more pleasant SIT.

PERSONNEL REQUIREMENTS

There are also a range of considerations that should be applied in terms of personnel before beginning an SIT. ROV personnel should include a minimum of 2 ROV crew per 12 hour shift, with 1 supervisor and 1 technician. Utilization of ROV personnel who will be involved offshore is recommended. Also, it may be appropriate to have the equipment manufacturer's engineer present for some tests. Finally, utilization of offshore riggers is preferred.

EQUIPMENT REQUIREMENTS

Last but not least, one should consider what equipment will be necessary ahead of time. It helps to list all the equipment and installation aids required for each task, for the duration of the task. Also, one should list items or equipment that may not be available for the SIT. For example, these may include flow line end fittings, bend restrictors, and anodes. It is very important to factor in all parts of the system for access checks, even if they are not available.

Finally, list all the mock ROV equipment and tooling required, which may include a dummy docking frame or under slung skid to simulate actual work parameters offshore. Consider the rigging needed for the operations. It is also very important to collect video and camera stills; photograph everything for the final project SIT record book to help subsequent offshore operations.

Also, have a healthy supply of consumables and hand tools. Typically these will include rolls of various sizes of poly rope for making monkey fists, rolls of duct and electrical tape, cable ties of all sizes, paint markers, and spray paint in white, yellow and black.

Step by step procedure and Inspection and Test Plan (ITP)

The procedure should simulate on land, as far as practical, all operations which will be done offshore. It should also verify all equipment and systems that are related to the permanent equipment installation. This should be a step-by-step procedure which follows, as near as possible, the same sequence as defined in the installation procedures.

As part of developing the SIT procedures, FAT procedures must be witnessed or reviewed before determining that access checks only will be sufficient. If FAT procedures are not sufficient, further functional checks may be required during the SIT to satisfy requirements.

To emulate as close as possible actual offshore operation, the pilot should perform mock ROV steps using only the monitors in the control room. Any outside help may reduce the validity of the trial.

It's important to keep a list of observations whilst conducting the SIT and these comments on steps should be included in the ROV SIT report. Examples of comments might be that the 'ROV needs to grab the top handle for this function', 'view the indicator from above the tool, not from the side', 'manipulator camera needed to view seal insertion', etc. As previously stated, photos and video should be documented and referenced for future review.

SAFETY

As always when operating machinery and electronics on a live site, safety is paramount. As such, when preparing for SIT one should consider safety precautions such as site inductions, toolbox talks, daily planning meetings, and safety precautions related to the handling of the Mock ROV. Accidents that occur offshore can have real consequences, and factoring this into your SIT could prevent dire incidents in the future.

ROV TOOLING AT SIT

It is important to use the same type and size of tool and handle configuration that will be used offshore, otherwise the testing will be invalid. If tools are not available consider substitute tooling or dummy tooling. Ensure handles and dimensions are relative to the actual tools being used. Use caution: tools are usually two or three times heavier in air than in water. This must be taken into consideration, especially with large torque tools. The manipulator may not be able to handle it without assistance. Also, dropped object risk is high. Always use safety lanyards with the mock frame to limit tool dropping risk, and protect the tool from impact damage. If practical, clamp the jaw of the manipulator to prevent the tools from dropping out.

The manipulator will struggle with anything over 50kg. Therefore, some external support to the manipulator may be required. One way to do this is with a 3/4" poly rope fed through a master link in the mock ROV lift bridal and tied back to the tool. In this way the tool weight can be reduced by someone on the end of the rope while the manipulator manoeuvres it into position.

DUMMY ROV TOOLING AT SIT

A dummy tool may be adequate for access checks and limited interface verification. Sometimes the use of dummy tools is unavoidable due to a variety of reasons. The actual tool may be needed offshore or not available, or it may be too heavy to safely and effectively use on land. Also, the dummy tool can be more effective when checking interface dimensions.


Courtesy of Dan Fjellroth


Courtesy of Dan Fjellroth

USING A DUMMY TORQUE "GAUGING" TOOL AND THE REAL THING

Note how the dummy tool is lightweight and readily taken around interfaces by one person. However, the real tool requires a 2 person lift and needs hydraulic hoses and a signal cable. In the specific case shown, the dummy gauging tool has been prepared at max tolerance and has identified a defective receptacle.

SIT DUMMY AIDS

Additional equipment may be required in order to make your testing more valid, and this is where SIT 'dummy aids' come. Usually these are permanent items which may not be available for the SIT but need to be factored into access checks.
A good example of this is checking access between Vertical Connection Modules (VCM), especially as the flow lines are progressively tied in and access becomes more restrictive. Usually just the VCM is made available for SIT. This does not include the goose neck, end fitting, anodes, and bend restrictor. The end fitting and bend restrictors are usually twice the diameter of the flexible. If this is not factored in at SIT, the testing may not be valid.
If concerns are raised about access to a certain area, it would be appropriate to fabricate dummy components to simulate these items. Make sure they are labelled boldly as 'dummy' for the photos and offshore report, to remove any ambiguity.

POST SIT – RECORD KEEPING AND REPORTS

Following the SIT and prior to installation, documentation should be updated to 'as tested' status. The ROV intervention report compiled should include all test comments, photos, and video. Any photos and video should include a full index to be referenced in the report.

Dan Fjellroth is a professional in the field of ROV technology. His experience has been gained through 35 years of working with ROVs both offshore and onshore. He has worked in management, manufacturing of ROVs, training and ROV simulations for major engineering projects. He has worked for many major ROV companies as an ROV Expert assisting subsea engineering project teams. Dan has been at the forefront of the development of Work class ROVs, ROV operations and ROV tooling since 1980.

THE SEVEN STEPS TO SIT SUCCESS

As mentioned from the outset of this article, we believe that there are seven core steps which are crucial in carrying out a successful SIT. It is not only important to perform SITs, but to know what problems to look and test for, dependent upon the project in question. These checks may differ, but it is always important to consider everything that may affect the project. Below are listed a number of generic checks that should always be made when undertaking SITs, and these are what we have dubbed 'the seven steps to SIT success':

1. ACCESS: ensure that the ROV has access to intervention locations.
2. STABILISATION: ensure that the ROV can stabilise itself (action/reaction), without damaging any nearby equipment.
3. MANIPULATION: ensure that the ROV can reach, manipulate, and do what it has to do.
4. INTERFACE: ensure that ROV tools interface without clashing.
5. VISIBILITY: ensure that the ROV pilot can see what he is doing.
6. INDICATION: ensure that the ROV pilot can read markers and position indicators.
7. OBSTRUCTIONS: ensure that the ROV tether will not get caught by snag points.

AND THEN, OF COURSE, CHECK EVERYTHING AGAIN!

We hope that you now have a better appreciation of the importance of conducting SIT pre-launch, and how this can save on time, manpower, and expenses in the long run, and hopefully this tutorial will help you do that in the future.

ROV HALL of FAME

THE WSP/PIV

By Robert L. Wernli

In the 1970's the U.S. Navy funded several programs as part of the Deep Ocean Technology (DOT) program. These included autonomous and tethered vehicles designed to reach depths of 20,000 feet along with systems to aid in large object recovery. One such system, the Pontoon Implacement Vehicle (PIV) stands out from the crowd as it is almost certainly the largest free-flying, tethered vehicle developed in the U.S., if not the world.

The PIV (Figure 1) was developed as part of the Large Object Salvage System (LOSS). The LOSS program evaluated techniques to recover large objects, such as submarines, from depths of up to 1000 feet. The PIV was designed to move 50 foot long cylindrical pontoons, with a lift capability of 100 tons each, into position on a sunken object. The vehicle's lift capability was provided by converting liquid nitrogen into nitrogen gas within the pontoon. The 20-foot-long PIV, with its 4 foot diameter thrusters, and a 2,000 pound variable ballast system, was well suited for the pontoon positioning task.

Following the LOSS testing, the PIV was transported to the Naval Ocean Systems Center in San Diego and mated with another DOT program development: the Work Systems Package (WSP). The WSP was a three manipulator work system, capable of exchanging a variety of underwater hydraulic tools to perform work and recovery operations to depths of 20,000 feet. The goal of the combined WSP/PIV system testing was to evaluate underwater recovery and work techniques in order to allow preparation of objects for recovery, and then to bring them to the surface in a controlled manner. The WSP/PIV is shown in Figure 2 with a claw attached to allow recovery of a jet engine. The ultimate goal of the testing was to recover an intact F-4 jet aircraft that had been placed at the test site at a depth of approximately 110 feet, which was shallow enough to allow documentation of the recovery operations. This was successfully completed by jetting two slings around the aircraft, rigging it for recovery and connecting a computer controlled lift module that would adjust the buoyancy and bring the aircraft to the surface in a controlled manner. Figure 3 shows one of the divers documenting the operation. The lift module, with the lift bag deflated, is sitting to the left of the F-4 prior to activation and recovery of the aircraft.

The technology developed under the DOT programs was transitioned in to industry, where much of it was adapted by early commercial ROVs and work systems along with those evaluating remote work techniques for the space program.

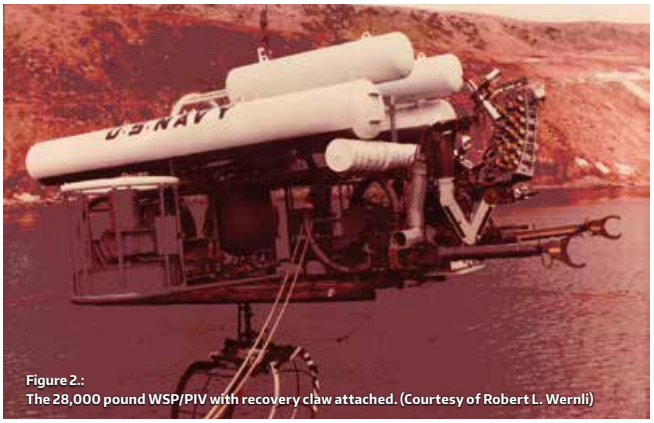
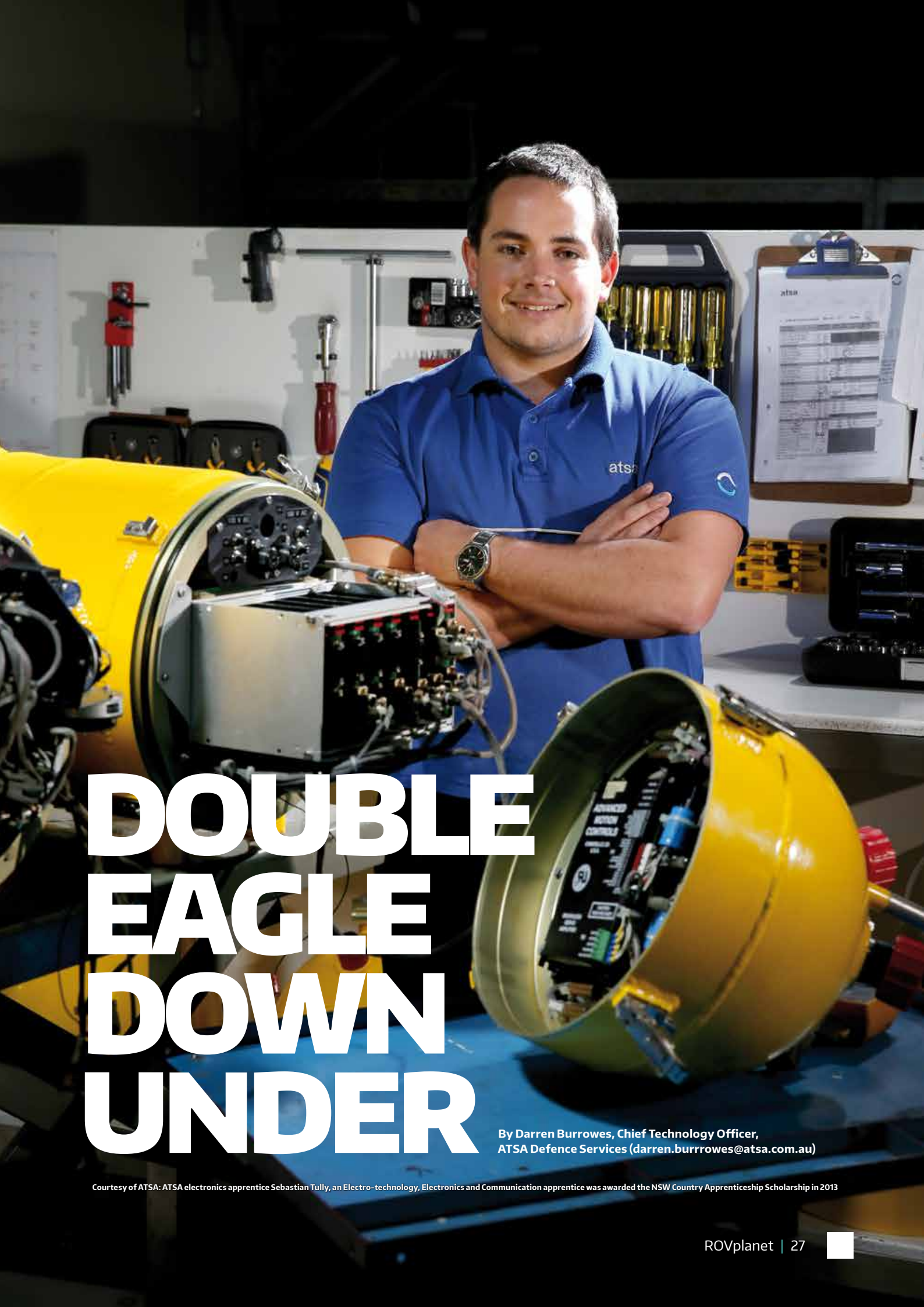


Figure 2.:
The 28,000 pound WSP/PIV with recovery claw attached. (Courtesy of Robert L. Wernli)

Figure 1.:
The Pontoon Implacement Vehicle (PIV) on top of a LOSS pontoon. (Courtesy of Robert L. Wernli)

Figure 3.:
Divers documenting the WSP/PIV recovery of an F-4 aircraft. (Courtesy of Robert L. Wernli)



DOUBLE EAGLE DOWN UNDER

By Darren Burrowes, Chief Technology Officer,
ATSA Defence Services (darren.burrowes@atsa.com.au)

Courtesy of ATSA: ATSA electronics apprentice Sebastian Tully, an Electro-technology, Electronics and Communication apprentice was awarded the NSW Country Apprenticeship Scholarship in 2013

The Double Eagle Mk II is arguably the world's most advanced Mine Disposal System, and is now in the service of seven navies worldwide. Incorporating advanced six degree-of freedom controls, thrust for speeds of up to 6 knots, and acoustic/magnetic signatures to meet STANAG requirements, the Double Eagle is an impressive and durable piece of technology. Having been used by the Royal Australian Navy (RAN) since 1999, the Double Eagle is operated from six HUON Class Minehunter Coastal warships and supported by ATSA Defence Services, from workshops in Newcastle, New South Wales, Australia.

BUILD PROGRAM AND SHIP INTEGRATION

The Double Eagle Mine Disposal System (MDS) was originally specified as the primary mine disposal equipment for the HUON Class Minehunter Coastal (MHC). The build program for these ships was completed between 1994 and 2003. During that time six highly advanced glass-reinforced plastic ships were built to a modified Gaeta design at the ADI (now Thales) purpose-built shipyard, also in Newcastle, NSW.

The Double Eagle system was tightly integrated into the overall MHC Combat System, with the pilot console incorporated into the ship's Operations Room. Interfaces between the MDS and the Tactical Data System (TDS) have enabled designation of the ROV to contacts of interest directly from the TDS, while information from the MDS could be received and displayed on all TDS consoles as required.

Courtesy of ATSA: ATSA Design Engineer, Curtis Schur, with the Mk2 Portable Operator Control Board developed by ATSA for the RAN

The integration into the ship platform required positioning several elements of the system within the tight restrictions of a warship. The console is now located forward in the Operations Room, together with other elements of the Combat System. This has ensured that the MDS is at the heart of tactical operations. An Automatic Tension Control (ATC) winch is located on 02 Deck, with the ability to manoeuvre in a wide arc around the ship without risk of fouling the tether on the ship's structure. The specialized power for the ROV is generated by a Power Control Unit (PCU) located in a diesel generator space.

Two ROVs (or Mine Disposal Vehicles) are located on the Sweep Deck, ensuring 100% redundancy in the event of the loss of one vehicle in action. The tether (umbilical) to the vehicles could be swapped from one vehicle to the other in the event of damage. Each ROV is capable of carrying the 50kg Danish Mine Disposal Charge (DAMDIC). A ship-fitted specialised magazine and hoist arrangement enables loading of the charges directly from the magazine to the ROV thus minimising requirements for the handling of ordnance.

SEA TRIALS AND NEW CAPABILITY

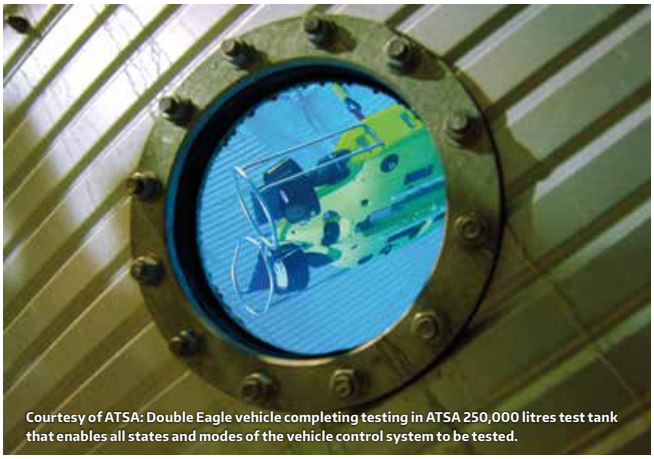
Initial sea trials and training were conducted for the Double Eagle in the first-of-class ship, HMAS Huon. The trials conducted off Newcastle and in Jervis Bay showed that the Double Eagle represents a quantum leap in performance compared with the previous RAN ROV: a PAP Mk2. The method of operation of the PAP was simple; dive towards the seafloor where a drag weight was used to control altitude. Manoeuvring was similar to driving a tracked vehicle, where port/starboard and forward/backward controls are the only control options.

In comparison the Double Eagle ROV, can be pitched down so that full forward thrust from two 5kW thrusters can be used for rapid transit to the seafloor. When near a contact of interest the highly manoeuvrable Double Eagle has the ability to move through six degrees of freedom so that rolling, pitching, and rotating are all options for closer investigation of mine-like contacts. Six 400W thrusters positioned around the vehicle provide for full control authority. The "Reference Adjust" function has introduced the capability to balance vehicle thrust against the prevailing current. This means that from an adjusted setting delicate manoeuvres are possible for situating the vehicle for best aspect on a contact. The vehicle provided a stable platform for operation of the Reson 6012 sonar, colour, and black & white cameras.

An interface to the Tactical Data System provided for designation of contacts directly to the ROV. Using the Computer Aided Tracking function the ROV can be automatically piloted from launch to contact with the pilot operating "hands off".

Courtesy of ATSA: ATSA instructors with Royal Australian Navy electronics technicians as they complete a full disassembly/assembly of a Double Eagle Mk 2 ROV

Courtesy of ATSA: RAN technicians where trained by ATSA Defence Services for several years in Double Eagle system fault-finding and shipboard maintenance



Courtesy of ATSA: Double Eagle vehicle completing testing in ATSA 250,000 litres test tank that enables all states and modes of the vehicle control system to be tested.

THROUGH LIFE SUPPORT

Through Life Support (TLS) is a highly important element for systems operated by the Navy that can be in-service for multiple years. Support for the Double Eagle System is provided by ATSA Defence Services, based out of a specialised facility located in Newcastle, NSW. As a service partner for Saab Dynamics, ATSA provides all levels of support for the system, as well as a proactive approach to responding to evolving RAN requirements in the face of changing operational and tactical environments. The facility at Newcastle provides the opportunity for maintenance, modification, and modernisation of all aspects of the Double Eagle system.

MAINTENANCE PROGRAM

At the core of the maintenance program of the Double Eagle is the maintenance of the ROV itself. This maintenance commences with a complete "swim test" in ATSA's 8m x 5m test tank. The large test tank enables thorough tests of the ROV in all states and modes in order to identify any issues for further inspection and test. Because the ROV can operate in both an earth-referenced "global" mode and an internally referenced "relative" mode, there are a large variety of controls that can be tested in a six degree-of-freedom vehicle. The ATSA service team of experienced technicians and engineers work closely together to identity any faults and ensure that the vehicle behaviour is as originally specified, and is fully demonstrated in a final swim test.

Other components of the system are also subject to maintenance routines.

The Automatic Tension Control (ATC) Winch is a sophisticated system that can handle 1000m of ROV umbilical and can haul up to 1000kg. The winch can operate in an "auto-tension" mode, so that the umbilical is automatically paid-out and recovered as required in order to maintain a set tension level. This is very useful when the ROV is operating close to contacts and careful manoeuvres are required in a strong cross current and where movement of the ship is limited by suspected mine locations. In auto-length mode a set length can be specified, and when this amount of umbilical is paid out the tension is increased to maximum.

Maintenance of this system includes full mechanical and electrical checks, including service of the motor-drivers, load cell, and the umbilical itself. The umbilical incorporates two electrical conductors, two fibre optic conductors, and a Kevlar strength member overlaid with a polyethylene floatation jacket. An umbilical diameter of only 11mm is relatively small, resulting in very low drag when operating in areas of high current (as are commonly found in Australian waters).

The Power Control Unit (PCU) converts shipboard 440VAC power to a nominal 1500-volt and 10 amp supply for the vehicle. Careful and thorough maintenance of the high power circuits in the PCU is required to ensure reliability.

Courtesy of ATSA: Double Eagle vehicle undergoing being launched for a post-maintenance swim test in ATSA 8.0m diameter and 5.0m deep test tank

Courtesy of ATSA:
Double Eagle vehicle being recovered into a HUON Class Minehunter Coastal ship

The net result of the Australian-based maintenance program for the Double Eagle has been trouble free service. Many of the ROVs are in an "as new" condition ensuring that Navy can set mission requirements with no concern about system operation or reliability.

MODIFICATION

Responding to local needs a number of modifications have been designed, developed and implemented by ATSA Defence Services for the RAN.

Obsolescence of the original optoelectronic system has been addressed through development of new optoelectronic surface and vehicle units. To speed connection and disconnection from the vehicle, a new umbilical connector "Tether Connection Mk 2" was developed. This connector has incorporated a plug-and-play hybrid electrical/optical connector that enabled fast connect/disconnect to the vehicle without the need to breach the pressure hull to make connections. The Portable Operator Control Board has been modified from the original rather large and heavy unit, to a lighter plastic construction that eliminated corrosion issues and was suitable for upper deck use in all weather.

Local modification of the system components was conducted with the close cooperation of Saab Dynamics resulting in a fast response for the Navy to meet local needs, and a source of innovative developments for Saab: a win-win for both parties. The Tether Connection Mk2 has been further developed into a Mk3 variant for single-mode fibre operation and is in service with other Saab customers.

MODERNISATION

Modernisation of the Double Eagle fleet is now under consideration by the RAN. Saab Dynamics have taken a modular approach to development of the system providing flexibility for various Mine Countermeasure operations. The Double Eagle can be configured in three main ways: mine reconnaissance (remotely controlled or remotely performed), mine disposal, and rapid environmental assessment. Using a combination of propulsion packages, energy packages and payloads, the system can be configured to meet user needs. This modular systems approach presents the RAN with both highly capable and configurable options for extending the life of the Double Eagle system.

CONCLUSION

The RAN operates the world's largest fleet of Double Eagle Mk 2 Remotely Operated Vehicles under the harsh conditions "down under". With operation theatres ranging from the tropics (mine clearance in New Caledonia), to New Guinea (search for submarine AE1), and all along Australia's 35,000km coastline there are always challenges for ROV missions. A comprehensive support program for the system in Australia has enabled maintenance, modification, and modernisation activities to be completed using local resources. The net result for the RAN has been a highly performing and highly reliable system which is building significant experience in ROV operations and options for future capability development upon a sound and experienced industry base.

ABOUT ATSA DEFENCE SERVICES

ATSA Defence Services **www.atsa.com.au** is the specialised defence service arm of the BlueZone Group bluezonegroup.com.au of companies and is based in Newcastle, NSW, Australia's largest regional port facility.

ATSA provides excellence in support for the world's most advanced electronic systems. Core areas of expertise cover the full life cycle of all electronic systems, from initial development through to production, including technical support and training.

ATSA is more than a high-tech maintenance provider. ATSA has developed close partnerships with Original Equipment Manufacturers such as Saab Dynamics (Sweden), which enables provision of quality systems engineering solutions to all our clients and cooperation with Saab in product development and enhancement.

QSTAR: PROVIDING STELLAR ROV TRAINING

By Jose María Sepúlveda López, General Manager of QSTAR ROV Training & Subsea services

Photo: Francis Pérez

THE COMPANY

Established in 2007, QSTAR ROV Division and Subsea Services are based jointly out of Las Palmas, Canary Islands and Barcelona, Spain. The vision behind QSTAR was to offer services for offshore and onshore industries that need effective solutions for subsea projects. We have achieved this through the use of our fleet of ROV and experienced qualified personnel.

QSTAR has come a long way since its initial inception. We originally provided oceanographic research for several governmental agencies, and this has led to the company gaining a reputation as a reliable reference for underwater robotics and hydrographic surveys.

QSTAR's philosophy is simple: we provide the highest quality service and the all-important attention to safety aspects for both personnel and equipment. Our goal is to deliver the best possible service, without accident or incident.

Over the years QSTAR has grown in the Spanish market. Now we're expanding even further into international markets, while simultaneously investing in R&D and training qualified personnel.


Courtesy of QSTAR

INVESTING IN THE FUTURE

In 2012 QSTAR SLU saw the need to introduce ROV training both nationally and internationally from a strategic location. Consequently, we expanded our ROV division with the opening of an ROV Training Center (www.rovs.eu) and became a Training Establishment Member of the IMCA (International Marine Contractor Association). This was very exciting as it allowed us to become the first established ROV training center in Spain.

Accordingly, the QSTAR ROV training program is built on (though not limited to) IMCA guidelines. This has meant that our trainers can provide real-world knowledge and skills for students in compliance with the actual requirements of today's oil and gas offshore industry. This is in addition to expertise in other sectors such as search and rescue, oceanography and marine research, marine archaeology, hydrology, subsea operations, and aquaculture.

Besides being able to provide the highest quality training based around IMCA guidelines, we provide real working conditions on board active work vessels. This allows students to work as part of on ROV team on board an actual ship, and provides the best training assessment for a newly qualified ROV pilot.

Since the creation of the ROV Training Center division, QSTAR has trained more than 200 students of various nationalities and backgrounds, and many of those have gone on to secure places with the world's best ROV operating companies.

CORPORATE ONSITE TRAINING

In addition to providing high quality training courses, QSTAR specialises in supplying corporate training. We also offer certification for ROV personnel from different companies worldwide by performing specific on-site training, tailored to the company's individual needs. Furthermore, QSTAR have been undertaking ROV installation and commissioning projects internationally, from both offshore vessels and onshore operating bases.

In 2014, QSTAR SLU – represented by its General Manager, José María Sepúlveda – became part of the IMCA ROV TSG (Training Steering Group). This places our training program firmly alongside the big players of the ROV industry.

TSG includes individuals from IMCA member companies of all types: contractors like Fugro, Bibby, i-Tech 7, Subsea 7 and Saipem; training providers including MTCS-England, The Underwater Centre-Scotland, School of Ocean and Technology, QSTAR ROV Training-Canary Islands/Spain; and suppliers and manufacturers such as SMD, SAAB Seaeye, Schilling, and Forum; with the IMCA technical adviser Neil Evans. Over the past year, the committee has been working on the drafting of new documents and guidelines that will facilitate a more global approach to the development of ROV training.

The companies involved contribute with their experience and by updating the competency schemes in order to fulfil their operational requirements. The QSTAR ROV Training center has recently become an IADC (International Association of Drilling Contractors) member, with the aim of having a more focused involvement in offshore drilling.

LOCATION

As previously stated, QSTAR SLU Subsea Services and the ROV Training Center's headquarters are located in Las Palmas de Gran Canaria, Canary Islands: a strong reference point for both the offshore and maritime industries. QSTAR's operations are also firmly established in Barcelona, where ROV training courses and subsea services are on-going.

'This location was one of the reasons for developing the training center [in the Canary Islands].', explains Technical Manager, Victor Javier. '[The] Islands are a strategic location between three continents: Europe, Africa, and America. We are in the middle of the offshore industry's routes.

'The Canary Islands [have] cheap flights and very good connections heading all over the world, and the island of Gran Canaria offer a great variety of industrial services for the offshore industry, not only sun and holidays.'

The fortuitous nature of this location has allowed for connections with other regions of interest, bringing in the island's port rigs, drilling, and construction vessels from all over mid-Atlantic and Mediterranean. This composition gives our students a rich and in depth experience of the offshore industry. We are even able to set up visits to specific vessels and rigs.

However, the surrounding area isn't simply swathed in floating steel and plastic, florescent-coloured boats. The local government takes stringent care of its tropical resources. These include crystal clear waters with sudden depths of up to 3,000m. This is yet another reason why the region is the perfect location for ROV training as we can lead practical ROV piloting in both shallow and very deep waters.

The training center itself is approximately 100 km from the African coast and relatively close to the main and second reserves of West Africa, Nigeria, and Angola. Out of consideration for the geopolitical environment of the location, QSTAR offers European quality, safety, and security to the offshore sector of the African continent. Recent reports have indicated approximately 55 oil rigs operating in this area, in addition to vessels performing exploration, survey, and construction activities.

Another fantastic feature of this sunny locality is the region's weather has previously been referred to as the best in the world: minimum-maximum temperatures lie between 18 and 28 degrees Celsius year round, and wind conditions are mainly calm. These conditions are ideal for living in the area. and are definitely conducive to conducting offshore operations.

This is a virtue for QSTAR as it enables us to give our students coastal and offshore training experience in a safe and pleasant environment, before taking their experience onboard their own multipurpose vessel, the 'Atlantic Explorer'.

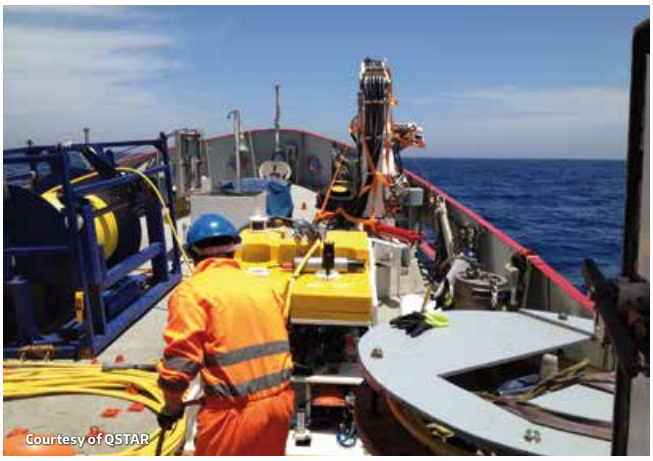
The Government of the Canary Islands – through the Canary Islands Hub (www.canaryislandshub.com) – is proud to have a strategy to promote these ideal conditions and many other attractive aspects of this region around the world, further positioning the Canary Islands as an international hub in the offshore industry and other sectors.

TRAINING AND FACILITIES

The QSTAR ROV courses are designed in accordance with industry requirements. The students are briefed about working offshore and the relevant safety regulations, and here they can gain skills in ROV maintenance and operation. The classes offer theoretical and practical input – depending on the students' or company's needs – with the goal of preparing them for real-life situations.

Many of QSTAR's alumni have great things to say about the time invested with our group. 'The ROV career is the shiny star of offshore', opines engineer Christian Gurgu, a QSTAR ROV instructor from Romania. '[Working] independently of


Courtesy of QSTAR


Courtesy of QSTAR


Courtesy of QSTAR

the offshore industry's phases, doing what you like (and) what you are good at, brings reliability and satisfaction.
He goes on to discuss his own experience working with QSTAR. 'Working offshore for years, I've been contributing to the global supply of oil, gas, energy. Presently, as (an) ROV Instructor, the value of contribution feels even more intense by giving... the experience and knowledge to the new entrants in the industry. Shaping people's future is what we do at QSTAR, shaping for the brightest.'
Someone else with a high opinion of QSTAR's training opportunities is Marius Molstad, an ROV pilot and technician from Norway. 'The ROV course opens lots of opportunities in my country and internationally.' says Molstad. 'Personally, QSTAR gave me the most complete education. I got to refresh my electronic background and [awarded me] new competencies that make me feel prepared for even the hardest technical and operational challenges offshore.'
He goes on to say 'The center's facilities and local climate – as in weather, social vibe – is the perfect environment for an international study. For all these reasons I also chose to do my apprenticeship for ROV Pilot Technician, Grade I, with QSTAR.'
Candidates who complete the course are provided with all the relevant documentation to present to existing and potential employers. After successfully completing the theory, workshops, practical training, and exams the students are provided with an IMCA ROV Personnel Logbook and the QSTAR competency certificates.
Furthermore, from October 2015 QSTAR will be organizing via an OPITO Training Center for BOSIET and HUET, offshore survival training courses. These courses are very important to all those working in this offshore industry. QSTAR will start including these OPITO courses as part of a full premium package together with the ROV training courses, so as to give a full qualification. Offshore medicals will also be available through QSTAR SLU.
The course coordinators at QSTAR ROV's Training Center endeavour to make sure that course content is kept up to date with the offshore and other ROV industries. This helps ensure that we maintain the very highest standards and retain our place as one of the industry leaders in ROV training globally. What's more, we are also offering an internship program with ROV operating companies worldwide, so that our trainees can have their first experience as part of an ROV team.
All of these reasons combined mean that the Canary Islands are the perfect location for somebody just starting out in their ROV training. It's possible to do everything that you need to in order to become a qualified ROV Pilot Technician trainee and more, and all set against a picturesque backdrop in one of the best climates in the world.

QSTAR'S IN-HOUSE RESOURCES INCLUDE:

- Spacious facilities of 2,500 m²;
- Accommodation;
- Teaching classrooms;
- Electrical, Electronics, Hydraulics, High Voltage, and Fibre-Optic Workshops;
- Training pools (open and closed);
- Work class ROV simulators;
- A large fleet of ROVs;
- An ROV control room;
- A work class 7-function manipulator;
- A multipurpose vessel for coastal and offshore training;
- Subsea tooling and sensors;
- Academic and industry experienced personnel;
- English and Spanish speaking staff.


Courtesy of QSTAR


Courtesy of QSTAR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ROV Training courses are held every month. Check out our web site to see the full training schedule and special offers. WWW.ROVS.EU

Apply now with the following code and get an extra discount for the ROV Premium Pilot Course: ROVPLANET2015

ROVS FOR MARINE RESEARCH

Michael Porritt,
Director, ROV Innovations
(michael@rovinnovations.com.au)

Due to electrical components becoming increasingly miniaturised and affordable, the observation class ROV is now capable of excelling in underwater projects that were once only available for divers and work class machines.

ROVs come in a wide variety of sizes and shapes, and are all designed for a specific application in the underwater environment. Finding an ROV that is best suited for the industry and projects that are required, can often be a very difficult and misleading exercise for many clients.

Many ROVs are mass produced using cheaper components that aren't suitable for continued commercial use. These ROVs may initially seem cheaper. However, continually repairing damaged components or collecting inferior data, soon outweighs the initial costs of the commercial grade machine. Also, the lack of customisation inherent with off-the-shelf ROVs, limits their later use in a project-specific environment.

One ROV manufacturer that designs and hand builds industrial grade observation class ROVs is Seamor Marine. Based out of Vancouver Island, Canada, Seamor custom builds their ROVs for each of their clients, offering a level of customization that's not usually available from other manufacturers.

ROV STABILITY AND DESIGN

One of the most overlooked aspects of an ROV – and most important – is its inherent stability whilst being deployed at depth. The ability to collect smooth, stable footage from the ROV's cameras is paramount for any underwater inspection, survey, or research.

Much of the stability comes from the overall design and hydrodynamics of the ROV itself, while the size and composition of the float and ballast also plays crucial rolls. Syntactic foam is the material of choice for most commercial grade ROVs, which offers increased stability through a wide range of depths whilst also remaining incredibly rugged. Having the float cover 100% of the ROV footprint also makes for a very stable platform.

Most industrial ROVs today have a minimum depth rating of 300m. This should cover any onshore marine research, however ROVs can usually be upgraded to 600m if the areas of concern, or even possible future projects may call for these sorts of depths to be explored.

Courtesy of Seamor

Courtesy of Seamor

RESEARCH METHODOLOGY

Depending on the actual research methodology applied, the ROV should be able to adapt to each project and allow maximum flexibility to collect the data required. Quadrats and Transects are typically used to collect quantifiable data, which requires the ROV to be able to host additional cameras focused on the different research parameters, and underwater lasers to accurately measure distances and size. These cameras may either be built into the ROV itself – allowing live streaming of the video footage – or the ROV should allow by design, the attachment of multiple third party cameras recording to their own local media storage. Most third party 'Action Cams' record in high definition and come with a water proof housing up to around 40m depth. If deeper habitats need to be surveyed, custom designed housings can usually be found. One should note that these deeper housings usually take up considerably more room on the ROV. Therefore the ROV needs to be able to accommodate the increased space, as well as have the required torque in its thrusters and the stability to operate with the additional payload. The reason multiple cameras are required is that the primary ROV camera is usually focused on piloting the ROV safely, not collecting footage of the marine environment.

If the environment needs to be sampled, the ability to easily and effectively collect these research samples needs to be paramount. Either with a dual function manipulator for collecting one off samples – or for more delicate sampling – having the ability to collect multiple items and store them within their own sample container without having to return to the surface, is a necessity.

CAMERA AND MONITOR

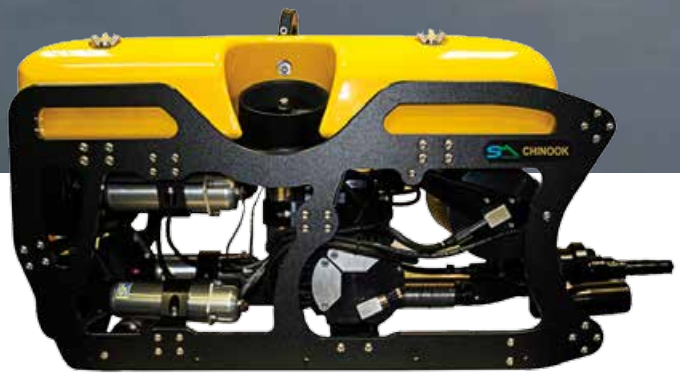
Even though the primary camera is used for piloting the ROV, collecting qualitative data on species composition and relative abundance can still be obtained. Therefore it is always recommended that a quality high definition camera be used. Quality HD cameras such as Sony provide confidence in species identification, allow an extremely high level of information to be captured, operate well in low light conditions, and are able to zoom in to usually over 200 times, both live and on replaying of the footage. A large LCD monitor within the control panel of the ROV, allows for an increase in situational awareness, allowing the research personnel to accurately pilot the ROV to the required sites for data collection. Recording in HD also allows the captured footage to be played back on large, ultra HD LED screens, where even the smallest details can be seen and recorded.

OPEN FRAMEWORK AND MODULARITY

Another extremely useful and cost saving design feature for marine research is to have an open framework for the ROV. This allows researchers to attach any number of additional probes, water quality meters, and custom designed equipment to the ROV without compromising the attached equipment or ROV itself.


Courtesy of ROV Innovations

Courtesy of Seamor



Courtesy of Seamor

Modular ROV accessories such as manipulators, sonar, underwater positioning systems for habitat mapping, laser scaling, additional LED lighting, and additional cameras should also be 'plug and play'. This allows the ROV to be enhanced at any stage either at purchase, or after sales, without the costly need to send the entire system back for upgrade. Having all systems as modular is also beneficial if there is a system failure of any component. The ability to quickly swap out a failed thruster in a matter of minutes is crucial when working on site is costing thousands of dollars per day.

PORTABILITY AND RUGGEDNESS

As most research is conducted in remote areas, it is important that the ROV itself can be easily and safely transported either by air, road, or sea to arrive at the project site undamaged. When all ROV components come standard either stored or built into quality Pelican Cases, the chance of any damage occurring is greatly reduced. When the system takes up only 4-5 pelican cases in total, it becomes an incredibly portable piece of scientific equipment that is fundamental to any marine research.


Courtesy of Seamor

ROV SEAMOR 300 F 2/4 c/w SKID-MOUNTED (7F-H-ARM)
7 FUNCTION HYDRAULIC ARTICULATING MANIPULATOR

SUMMARY

For any ROVs that are going to be used in the field of Marine Research, either by Academics, Environmental Consultants, or even Documentary and Film Makers, we would recommend the following features and functionality –

- High Definition (1080p) quality camera
- Additional LED lighting
- Large LCD monitor for live viewing
- Underwater Lasers for accurate distance measurements
- Modular ROV accessories ("plug and play")
- High stability and Open frame design
- Ability for multiple cameras, or significant "real estate" on the ROV to house third party HD cameras
- Minimum 300m depth rated
- Rugged Industrial design
- Easily and safely portable to remote locations

This is a fairly brief introduction that will hopefully assist in the decision making process for any researchers looking to increase their underwater capacity by purchasing an ROV.

If you have had any experience with the design of or experimentation with ROVs in this field, we would love to hear from you. It would be great to hear from you about the project itself, how the ROV assisted, if there were any issues, and if the ROV was easily adapted to the project requirements. For hiring suitable marine research ROVs for any specific project, please feel free to peruse www.underwaterinspections.com.au

MATE'S 2015 UNDERWATER ROBOTICS COMPETITION

CHALLENGED STUDENTS TO BRAVE ARCTIC WAVES AND ICE

By Jill Zande, Co-PI, Associate Director, & Competition Coordinator, MATE Center (jzande@marinetech.org)

In June, the Marine Advanced Technology Education (MATE) Center held its annual international student underwater robotics competition in Canada. Student teams from all over the world competed against the clock in simulated extreme polar conditions using underwater robots known as remotely operated vehicles (ROVs).

The MATE competition requires students to design, develop, and pilot ROVs capable of completing underwater missions that simulate real-world problems from the ocean workplace. Along the way, they learn and apply science, technology, engineering, and math (STEM) skills, and become proficient in 21st century workplace skills such as entrepreneurship, marketing, and teamwork.

This year's competition was held in St. John's, Newfoundland & Labrador, Canada, at the Marine Institute (MI) of Memorial University and the National Research Council's (NRC) Ocean, Coastal, and River Engineering (OCRE) facility. Fifty-six student teams from around the world, including the U.S., Canada, Egypt, Russia, Hong Kong, Taiwan, China, India, Mexico, Norway, Denmark, and Scotland participated in the event.

To expose students to the various aspects of the marine technical field, the competition theme changes every year. The Canadian location inspired a focus on the use of ROVs in Arctic environments. Students were required to complete tasks related to scientific research and offshore oil industry operations in polar conditions.

Courtesy of Tom Donovan and Jill Zande, MATE Center

Courtesy of Tom Donovan and Jill Zande, MATE Center

COMPETITION HAS ENTREPRENEURIAL FOCUS

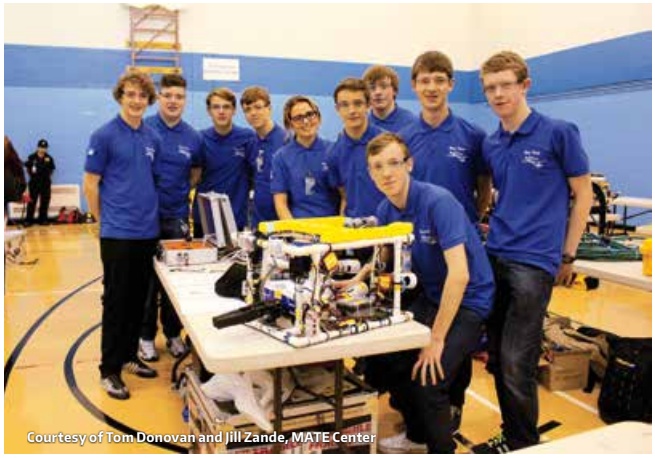
Because the competition is grounded in real-world business and technical applications of marine technology, MATE requires teams to organize as "companies," with each team member taking on a specific role such as CEO, CFO, engineering manager, marketing manager, etc.

Transported from the classroom to the business world, the


Courtesy of Tom Donovan and Jill Zande, MATE Center


Courtesy of Tom Donovan and Jill Zande, MATE Center


Courtesy of Tom Donovan and Jill Zande, MATE Center


Courtesy of Tom Donovan and Jill Zande, MATE Center

student-run companies design, manufacture, market, and sell products and services such as ROVs and operational personnel to their "customers" – MATE and the organizations that contribute to the development of the competition theme. This process requires students to manage a project and budget, brainstorm innovative solutions, and work as a team – all critical skills for success in today's global workplace.

In keeping with the competition's entrepreneurial focus, teams were required to:

- Pilot their ROVs to complete a timed product demonstration
- Deliver a sales presentation to a customer consisting of a panel of volunteer judges from marine and technology industries
- Prepare technical documentation for their ROV
- Create a marketing display

Each team is evaluated on the design, construction, and performance of its ROV; the members' ability to communicate what they learned; and how they put their knowledge to use in developing their ROV.

Although students from K–12 schools, home schools, community colleges, and universities participate, the competition is structured to ensure that students only compete directly with teams that have similar skills and technology sophistication. At the international competition, they competed in two classes, Ranger (advanced intermediate) and Explorer (advanced), based on vehicle design and mission complexity.

Ranger teams earned the opportunity to participate in the international event by participating in one of MATE's 24 regional contests, held throughout the U.S. and Canada, as well as Egypt, Russia, Scotland, and Hong Kong. Teams competing in the Explorer class were required to pass a rigorous vehicle demonstration.

Regional contests also provide opportunities for student teams in beginner and intermediate classes, known respectively as Scout and Navigator, to learn STEM skills and compete with ROVs. In 2015, approximately 8,000 students participated in the MATE network of ROV competitions.

STATE-OF-THE-ART FACILITIES SUPPORT POLAR-THEMED COMPETITION

The product demonstration consisted of complex underwater tasks such as sampling organisms, deploying scientific instruments, inspecting pipelines, and testing deep-sea oilfield equipment while battling currents, waves, wind, and ice. These and other challenging tasks were made possible by the unique features and capabilities of MI and the NRC.

One of the most respected centers of marine learning and applied research in the world, MI is Canada's most comprehensive center for education, training, applied research, and industrial support for the ocean industries. The NRC is Canada's premiere technology and research organization supporting industry with consulting and applied research services in ocean engineering, coastal engineering, water resources management, marine safety and marine renewable energy assessments, and technology.

The MI and NRC host facilities include:

- The largest flume tank in the world, with a water capacity of 1.7 million liters, and water velocity ranging from 0–1 meters per second
- An engineering basin that is used to evaluate the performance of ships and structures by testing scale models in various sea states by simulating waves, wind, and currents

An ice tank where the water surface can be frozen and the air temperature maintained at a uniform –30 to 15 degrees Celsius used to test the performance of ships and structures in extreme Arctic environments.

In 2016, the ROV competition will move from chilly Newfoundland to humid Houston. It will be held at NASA's Neutral Buoyancy Lab (NBL) at the Johnson Space Center in Houston, Texas. With controlled neutral buoyancy operations to simulate the zero gravity or weightless conditions experienced by spacecraft and crew during space flight, the NBL is used for pre-flight training of astronauts.

TWO TEAMS AT THE TOP

Two teams – and their ROVs – rose to the top. Jesuit High School of Carmichael, California won first place in the Explorer (advanced) class. AMNO & CO, a home school team from Seattle, Washington, took the first-place honor in the Ranger (advanced intermediate) class. Jesuit High School is a veteran in the MATE winners' circle; this is the third year in a row that the team has won the top Explorer prize. Ranger class winners AMNO & CO are the first home school team to win the competition, and with only three members, the smallest team that has ever won.

Jesuit Robotics also won prizes for having the highest product demonstration score, best sales presentation, best technical documentation, and design elegance of their ROV. AMNO & CO won an award for design elegance and a special health, safety, and environmental excellence award that was created and sponsored by competition supporter Oceaneering International.

ROVS HELP PREPARE STUDENTS FOR TECHNICAL CAREERS

MATE was created in 1997 with funding from the National Science Foundation (NSF). Headquartered at Monterey Peninsula College (MPC) in Monterey, California, the organization's purpose is to improve marine technology education and prepare students for technical careers. In partnership with the Marine Technology Society (MTS), an international professional organization, MATE created the ROV competition to:

- Engage students in STEM
- Expose them to science and technology careers
- Help them develop and apply technical, teamwork, and problem solving skills
- Support student learning with funds, materials, and technical expertise
- Provide industry with skilled technical and business talent

Now in its 15th year, the MATE ROV competition is organized by MATE, and supported by the MTS ROV Committee, the NSF, Oceaneering International, NASA, NOAA, and many other ocean- and science-related businesses and organizations.

WINNING TEAMS FROM AROUND THE WORLD

The list of the winning teams represented countries from all over the world. A complete list of winners, awards, and prizes can be found online at:
www.marinetech.org/scoring-2015/


Courtesy of Tom Donovan and Jill Zande, MATE Center

Courtesy of Tom Donovan and Jill Zande, MATE Center

EXPLORER CLASS WINNERS

- First place – Jesuit High School of Carmichael, California
- Second place – Memorial University of St. John's, Newfoundland and Labrador
- Third place – Hong Kong University of Science & Technology of Hong Kong
- Top technical documentation – Jesuit High School
- Top marketing display – Memorial University
- Top sales presentation – Jesuit High School
- Top product demonstration – Jesuit High School

RANGER CLASS WINNERS

- First place – AMNO & CO of Seattle, Washington
- Second place – The Center for Robotics Development of Vladivostok, Russia
- Third place – Palos Verdes Institute of Technology of Palos Verdes Estates, California
- Top technical documentation – Ozaukee High School of Fredonia, Wisconsin
- Top marketing display – Highlands Intermediate/Pearl City High School of Pearl City, Hawaii
- Top sales presentation – Taipei American School of Taipei, Taiwan
- Top product demonstration – Palos Verdes Institute of Technology

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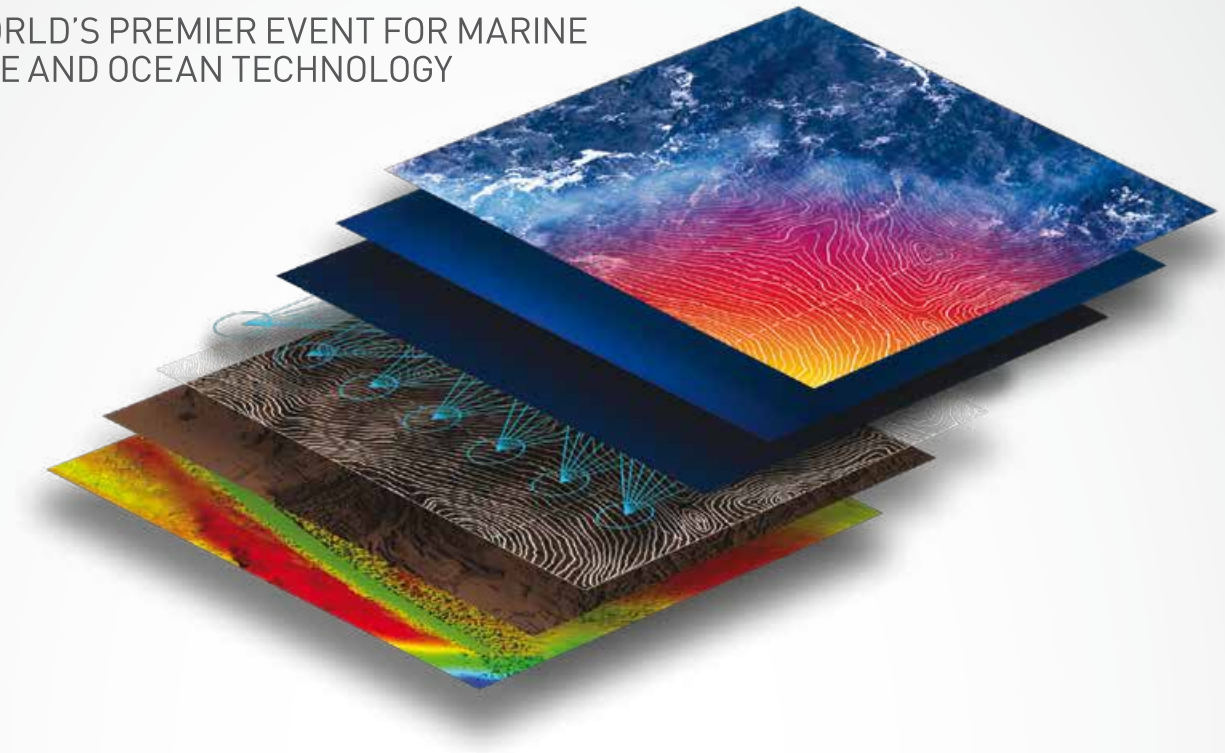

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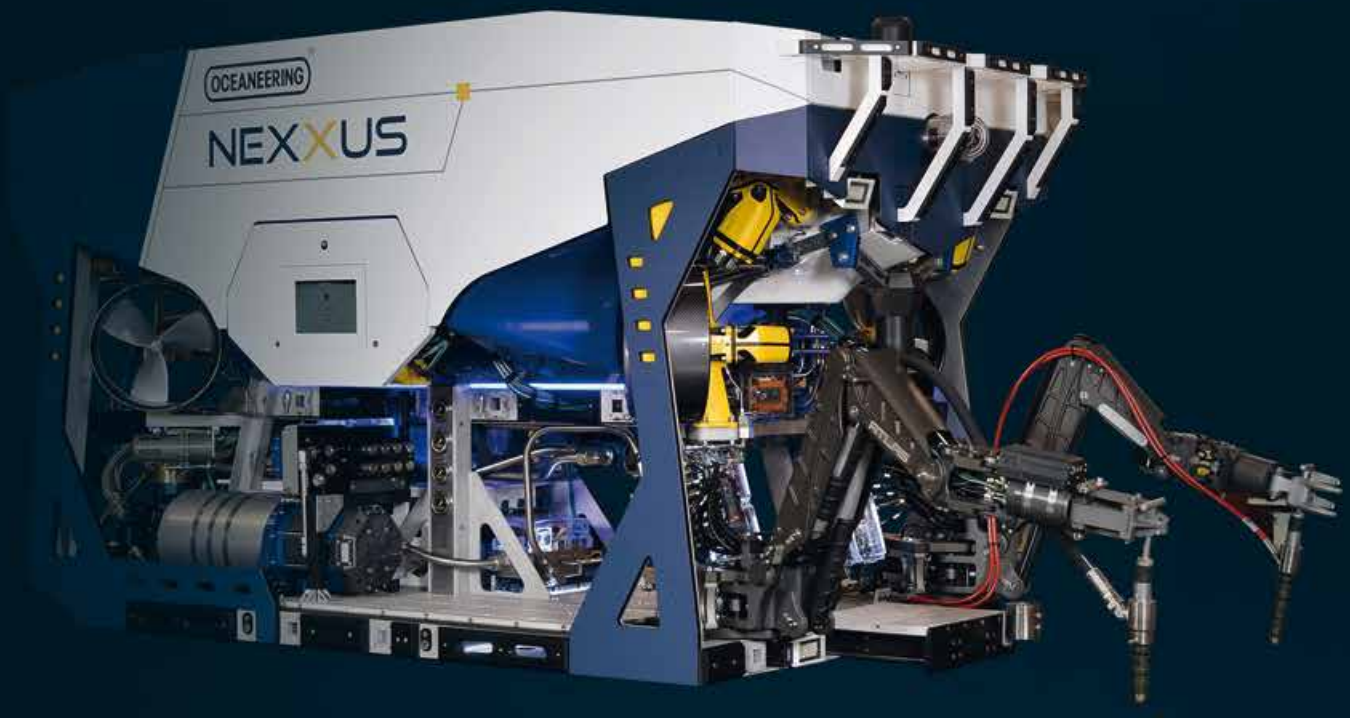

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