Offshore Network

INCREASING WORK-OVER EFFICIENCY IN THE ASIA PACIFIC

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Introduction

Maintaining and increasing production volumes from existing wells and facilities is a major priority for operators in the Asia Pacific. The region suffers from a 10% annual decline in recovery, 80% of the basin's fields are operating in the brownfield phase and a huge volume of well stock (40%-50%) is currently shut in and not producing. Globally there has also been a 25% increase in the abandonment of existing wells (Almukhaitah et al, Fonoiki 2013) and a 65% decline in the oil price, resulting in a huge cut in CAPEX for new field development (U.S. Energy Information Administration EICA 2015).

Trends like these put pressure on E&P companies to better utilize well intervention applications to maintain production at a sustainable rate of OPEX.

In May 2016 SKK Migas outlined these challenges at the annual Offshore Well Intervention Workshop, showing that in order to arrest production decline, major, independent and national oil companies in the Asia Pacific have shown a more pro-active workover approach, based on:

- Well intervention activities being the backbone of production volume increases
- New technology offering more viable workover strategies
- Use of *Heavy Well Intervention* capabilities to re-activate suspended wells

These three elements can go a long way to minimize production deferment. In the same presentation the following well intervention applications were highlighted as having specific value in the region:

- Smart Gas Lift
- Slickline Perforation
- Smart Coil Tubing
- Snubbing
- Thru-Tubing
- Tractor Work

Both in terms of employing new technology and using established methods in a different way, superb results can be met by executing these services.

As the cost base of well operations in the Asia Pacific is lower than most other regions, a position of strength is created in terms of capitalising on the return created from working over existing assets with simple 'tried and tested' solutions and delivering complex work on high value assets, including shut in wells.

Below is an example of the works that could offer a significant return to regional operators:

Tried and Tested Solutions

- Stimulations
- Perforation
- Tractor Milling
- Scale/Solids Remediation

Complex High Value

- Shut in Well Restoration
- Rigless Workover
- Conductor Repair
- Downhole Integrity Remediation

The findings of a 2015 well intervention efficiency study (conducted by a multi-national management consultancy) demonstrated that these workover activities are one of the highest and most viable methods of achieving recovery gains, resulting in:

- Lowering the bottom line of OPEX
- 10% production gains (potentially more in the APAC considering the volume of shut in assets)
- 5% additional barrel protection
- Incremental barrel cost of just $6 (in place of $20-$30 from infill drilling for example)

There is a clear understanding of the huge opportunity well intervention offers, so why isn't this work taking place in huge volumes across the region? The reason is simple, there are significant and unique challenges to the Asia Pacific which need to be addressed to offer viable projects in the $50 oil environment.

This whitepaper will outline some of the most important challenges and offer insight into some of the innovative operators and contractors who have developed new technologies and processes to offer a sustainable workover solution that achieves the production potential outlined above.

Identifying the Core Challenges

Depending on the data source, there are approximately 4000 wells in the Asia Pacific which require workover, side tracking, re-instatement or P&A. Given the current market conditions it is clear that P&A is not a preferable option for the mature well stock (although inevitable in extreme cases) as it will not aid the mission to support production volumes. It is therefore important to focus on brownfield rejuvenation works as the basis of this discussion. Also, as the majority of these assets (90%) are in the shallow waters of South East Asia, the following analysis will narrow on the challenges of these wells rather than the subsea well stock.

Integrity:

Historically the platforms and wells of the Asia Pacific's offshore industry were designed to operate for 20-25 years, however 40, 50 or even 60 years later these assets are still producing and are being pushed into very mature operational phases. This raises a number of challenges:

- Size (1): Most of the brownfield assets were designed at a time where smaller was better! These old platforms have very limited deck areas, making some applications difficult/impossible. For example, large items such a spools of coil are not able to be safely housed alongside running equipment. This creates a huge issue as many brownfield assets need these 'heavier' capabilities
- Size (2): The structural integrity of the smaller platforms also impairs the ability to house the weight of *Heavy Well Intervention* units, including snubbing/hydraulic workover units. Their weight makes the platform unstable and unsafe, and with approximately 50 percent of wells being shut in, this is a significant issue in regards to bringing wells back online (or even abandoning them if necessary)
- Downhole Integrity Challenges: Approximately 30-50% of wells have significant downhole integrity issues/ failures. Of this well stock a further 40% have tubular failures and 20% have zonal isolation challenges
- Limited Recovery/Production Deferment: A range of common issues including calcium carbonate and barium sulphate scale, downhole safety valve failures/damage, high water cut, sand and solid production etc. are impairing the safety and recovery potential

The opportunity of remediating integrity flaws like these would provide a fantastic return and important production uplift.

Environment:

Although the shallow depth of the assets infers easier access to the wellbore, environmental barriers create an obstacle in achieving full production potential:

- Climate/Weather: As the region is subject to hurricane/monsoon seasons the operating window for well work is relatively small in comparison to other basins. On average there is just six months of the year where well work can take place. This increases the risk profile and economic viability of workover campaigns
- Swell/Wave Loading: The wave loading and swell across the region is not to be taken lightly. 3 meters of swell/loading is regularly experienced. This places significant volumes of fatigue/integrity issues on critical equipment, including the wellhead and conductors during well interventions

Efficiency:

Noted that this is somewhat a symptom of the previous two issues, there is scope to expand on this point as we remind ourselves that the opportunity of improving recovery from the existing well stock is huge, but many projects may never be commissioned due to fears of *Non Productive Time* (NPT) questioning the economic viability.

- OPEX Control: The Asia Pacific holds a higher project risk profile due to historically lower intervention success rates than basins in the North Sea for example (operating at an average efficiency rating of 60%). With 40% of NPT to be addressed, a rigorous benchmarking exercise for marine operations coupled with a more active intervention calendar to improve experience and competencies is required
- Technology Availability: Due to the platform sizing, the advanced technologies that could effectively service this market (including lightweight e-line/slickline, digital slickline, micro-coil etc.) may not be widely readily available in region. The difficulties in obtaining/importing tools can affect the viability of smaller, spot or individual well campaigns

By addressing these integrity, efficiency and environmental challenges, the Asia Pacific market can employ the workover/intervention solutions that other basins are utilising to achieve and even exceed their production targets.

This seems like a big ask, but the appropriate solutions are available in the current supply chain – they are just underutilized in the Asia Pacific.

Addressing the Core Challenges

As previously mentioned the Asia Pacific is subject to monsoons and 3 meter sea swells that limit the annual workover window to just six months. In 2014, when the barrel price was over $100, efforts were made to address this by:

A) Attracting a rig/high DP class vessel to the region which could better cope with the conditions and swell when working over the assets

B) Then developing a rig/high DP class vessel schedule to identify when the tools/personnel and appropriate workover unit were available to run regional campaigns

It was argued that this could offer better efficiency by allowing a wider working window and understanding of when and where the workover units are (and their future availability). Although the higher barrel price perhaps protected economic risk somewhat, there were still obstacles with this approach back in 2014:

1) This is a heavily engineered solution for small assets, meaning the margin/return could be narrow, making workovers less desirable

2) There would still be some swell/wave loading force via the connection with the wellhead and increasing fatigue

3) As a heavily engineered solution there is a lot of weight over the asset, again causing increased fatigue on critical equipment

The market today is very different. It could be argued that at the current rig rate you can take the risk and use one of these units with an expert drilling crew in a cost-effective manner. However, this is not sustainable given that as the rig rates rise with the oil price the opportunity to use them will lessen as drilling increases.

A simple solution which is being widely adopted in the Middle East and Southern North Sea (SNS), would be to use a more advanced form of lift boat for well operations. Although this technology is nothing new, the units are not utilized in the Asia Pacific at the same level as other regions – for example in the SNS one lift boat provider stated that well intervention activities make up 50% of their chartered days across the entire fleet. Although available in region, these units are generally being used to house accommodation or additional deck space for pumping operations/other machinery.

These vessels easily work in the depth, house relevant equipment and simply avoid environmental challenges as:

- A lift boat can jack over well centre, placing weight on the sea floor rather than the wellhead/critical equipment
- The unit does not float on the surface during well operations, making swell/wave loading and other environmental conditions irrelevant to operations
- It is a tried and tested method of working over older platforms by offering 'rig-esque' capabilities

The basic design characteristics mentioned above also mitigate some of the integrity concerns (wellhead loading fatigue) and offers the additional desired deck space to house the appropriate *Light* or *Heavy Well Intervention* equipment (avoiding the issues with small platforms). This allows the 'complex high value' intervention projects to take place on smaller, older assets. By addressing the significant integrity failures (tubular damage/shut ins) a significant percentage of idle/deferred assets can be brought back online.

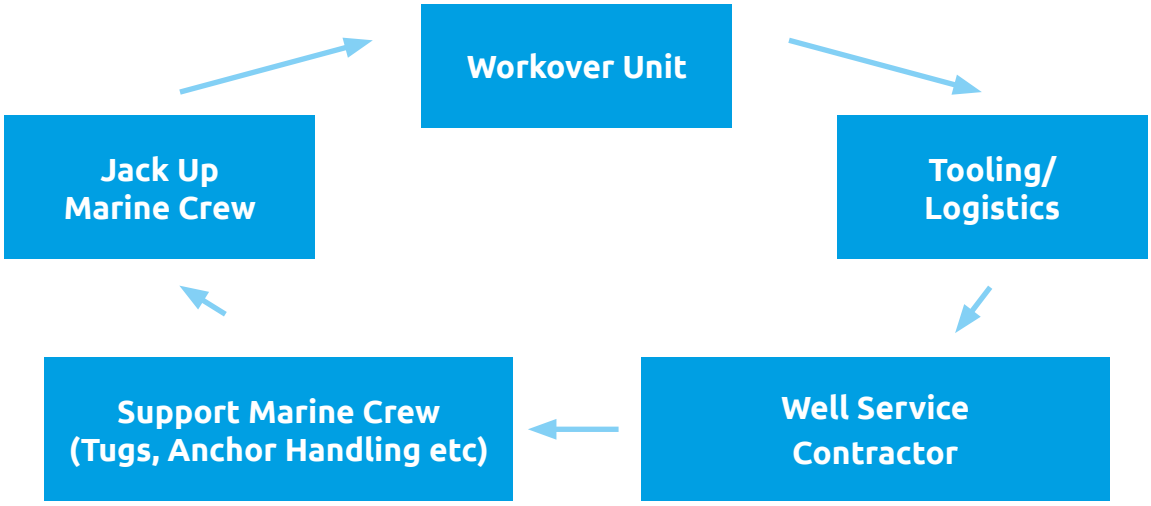
Aside from the technology benefits, advanced lift boat providers have also worked hard to increase the efficiency of operations to cut project duration and reduce NPT. These issues relate to human factors, experience of running tools and the familiarity of staff with well intervention as a discipline.

Dealing with efficiency and NPT within marine and well operations is key in order to:

- Address brownfield assets/prepare for P&A
- Bring the large volume of shut in wells back online
- Workover the 30-50% of wells with integrity flaws

40% NPT combined with a 6 month window does not give enough time to deal with the scope of work mentioned above.

Using a traditional floating jack up barge workover campaign as an example (which is widely used in the region), multiple individual elements need to work in perfect synergy and be managed correctly to avoid delays, overruns and NPT. A brief example of this is evident in graph below:



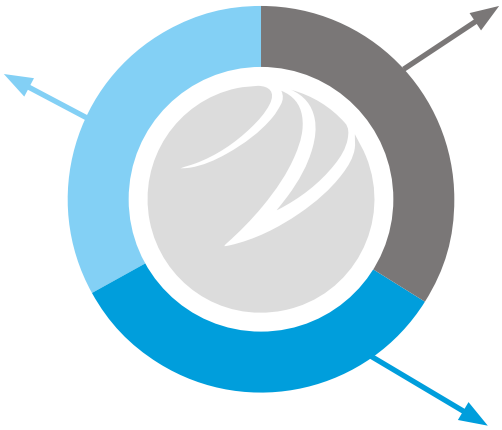
Many of these elements are from different disciplines (marine and well services for example), between different crews who might not understand the well intervention program as a whole, or perhaps communicate effectively between one another. This creates difficulties with refining efficiency. Examples of recent inefficiencies experienced in regional jack up campaigns include:

- Not getting the work-over system and tooling in country
- Delays in mobbing up/mobbing down and positioning the access point over the well centre
- Capability limitations of a 'not fit for purpose' unit

Over the past few years, a number of advanced lift boats have been brought to market. These new units show that from a new technology standpoint and also from a philosophical standpoint, a real world solution to efficiency, technology and performance is now available.

Below is an example of one lift boat provider who closed the efficiency gap by combining proven competencies, new technology and expertise holistically. Rather than individual teams/crews assembled per job, they offer a consistent consortium:

Expert Well Service Crew
Part of the team include an expert well service crew with experience of working over multiple assets with similar environmental and integrity characteristics. This includes drilling and abandonment expertise to ensure flexibility in application from a human factors stand point.



Advanced Lift Boat Technology
Advanced self-propelled W/O lift boat and experienced marine crew, who are also trained in well intervention operations – so they understand the mission goals of the entire program and can communicate effectively with the well service crew.

Automated Workover Technology
This technology is provided by an experienced well intervention equipment provider, ensuring that human error is minimized through automated operations and a flexible intervention toolbox is not only in region, but on the vessel.

By collaboratively utilising technology, marine experience and well intervention expertise under one banner/ package, this new approach to lift boat projects effectively offers a one-stop-shop with:

- Increased sailing efficiency - no need for tugs or marine support vessels
- Specifically designed vessels for work-over operations
- More efficient for work-over operations
- Full integration and automation to reduce human error
- Reduced feet/spudcans to allow work in more environments

There have been a number of models to demonstrate how these advanced units can improve efficiency, this includes over 70% of contracted time being spent on well operations (rather than less than 50% of time spent over the well on a standard jack up barge campaign) and halving rig-up/rig-down time. Review the services that can be effectively achieved below:

LIGHT WELL INTERVENTION

- Water Shut-Off (increasing production)
- Gas Shut-Off (increasing production)
- Mechanical integrity repairs (increasing production)
- Scale Remediation (increasing production)
- Stimulation (increasing production)
- Conductor repairs (extending operating life)
- Annular integrity remediation (extending operating life)
- Well Evaluation (extending operating life)

HEAVY WELL INTERVENTION

- Side-tracks (increase production)
- ESP change out (increase production)
- Slot Recovery (increase production/extend asset life
- P&A (end of life solution)
- Shut-in Reinstatement (increasing production/ avoiding asset retirement)
- Workover (increase production/extend asset life)

By increasing the regional utilization of lift boat well intervention services to be in-line with other shallow water basins, the ability to take advantage of the above operations whilst mitigating the identified risks would allow the Asia Pacific to operate at a lower rate of OPEX, give +10% production gains and 5% barrel protection at a cost of $6 per additional barrel.

Conclusion

These assets need to be worked over and P&A needs to be avoided in most cases, allowing for more production to be achieved in the downturn when new assets are not being developed.

Weather for LWI, HWI, single or multi-well programs, the rigless capabilities of advanced lift boats which are currently available to the Asia Pacific offer a solution to the environmental, efficiency and technical challenges.

By utilizing the rigless capabilities of the units, the region can leverage the flexibility of these vessels (some with MODU capabilities) to perform the wireline, coiled tubing, snubbing and even P&A work, which is commonly performed by these units in other regions such as the Southern North Sea.

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