Achieving Deepwater Success

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Despite some uncertainty in the global economy, the long-term outlook for energy demand remains strong and the industry will continue to be challenged to meet hydrocarbon supply over the next decade. In its latest outlook, the International Energy Agency estimates that approximately 32% of oil production needed by the end of this decade has yet to be discovered or developed, and by 2035 it will be closer to 50%.

In response to this challenge, the exploration and production (E&P) industry has become more ambitious in searching out new frontiers, with some notable successes over the past few years, particularly in deep water. More than half of all oil and gas reserves discovered worldwide over the past 10 years have been offshore and the majority of large finds have been in water depths of more than 500 m (1,640 ft). We are reminded that 10 years ago pre-salt reserves offshore Brazil were still not proven, and that deepwater discoveries in areas such as French Guiana, Tanzania, and Ghana were not even on our industry’s radar screens.

It is estimated that approximately 200 new deepwater fields will enter production over the next 4 years. By 2020, production from deepwater fields will represent about one-third of total offshore production, representing about 10% of total global oil supply. Deepwater well capex is expected to grow from USD 47 billion to approximately USD 128 billion by 2020, with 71% of this growth taking place in the Atlantic basin—particularly in Brazil, Angola, Nigeria, the US Gulf of Mexico (GOM), and Norway. Other countries with solid deepwater activity include Australia, Egypt, and India. To achieve this significant growth, an increase in the number of floater rigs is forecast, from 200 in 2008 to more than 400 by 2020—an average of more than 20 new rigs per year. This estimate is consistent with mid-term forecasts of new deepwater rigs and suggests that the trend will be maintained until the end of the decade.

Over the period 2013-2020, deepwater well costs are expected to slightly increase in real terms. While efficiency gains are expected in regions such as the US GOM, thanks to next-generation rigs entering the market and the continued integration trend of new drilling technologies, these will be offset by increasingly complex and deeper wells. Exploration and appraisal activity is set to continue along the same trends for the rest of this decade, with further expansion in basins with recent discoveries such as the Mexican GOM, Equatorial Atlantic, east Africa, and the eastern Mediterranean. Activity will also be strong in basins with less-recent discoveries but where technology and/or access drivers have opened additional opportunities, such as Brazil, west Africa, and the US GOM.

Deepwater Challenges

On the basis of recent successes, we can expect many of the new exploration and development projects to be in the more remote areas of the world. These environments can present logistical difficulties, often compounded by complex geological and reservoir conditions. For example, we are seeing an increasing proportion of higher pressure and temperature wells, adding to the
challenges of operating safely in deep water and adhering to strict regulatory frameworks. Tackling all these factors puts our industry into a higher cost environment with drilling spread rates often in excess of USD 1 million/day, and in some cases beyond USD 1.5 million/day.

In such environments there is clearly no room for failure. However, despite the huge costs, some operators have reported nonproductive time (NPT) levels in their deepwater drilling operations at above 26%. Assuming conservative numbers on the deepwater rig count and an NPT rate of 5%, the cost of NPT associated with deepwater drilling is estimated to be USD 4 billion in 2014. Furthermore, NPT is only part of the cost—a recent study by a deepwater Gulf of Mexico operator found that only 56% of high- and medium-rated objectives for its exploration wells were being achieved. The cost of not reaching the targets can equate to the failure of an entire exploration program.

Improving success rates in deepwater operations requires a focus on three major elements: people, process, and technology. It is essential to develop the competency of field crews and teams of petrotechnical experts to support deepwater operations, and establish ways to leverage their expertise. Planning and risk management assessment tools are being adopted to ensure readiness for complex deepwater projects, particularly important for operational startups in remote areas. New integrated technologies, supported by 24/7 seismic, petrophysics, and drilling experts located in regional centers around the globe, equipped with an ever-growing knowledge management database and proven real-time work flows, are essential to minimize the operational risks.

Integration
Technology—and its reliability—play a huge role in reducing risk, saving well construction time, reducing NPT, and placing wells to maximize reservoir exposure. These objectives are being met by the effective integration of an expanding portfolio of logging-while-drilling (LWD) measurements delivered from advanced bottomhole assemblies (BHAs). Mitigating risk in drilling operations helps to prevent incidents such as stuck pipe and lost circulation, which cost the industry hundreds of millions of dollars each year. Combining real-time drilling and formation evaluation data with the reservoir model, and using advanced interpretation techniques to quickly analyze the data, helps avoid kicks from over-pressured zones that could lead to uncontrolled situations.

Seismic-guided drilling is a good example of new de-risking capabilities. This involves combining LWD data with the seismic model in real time to reduce depth uncertainty and identify over-pressured zones in front of the drill bit. By leveraging advances in computing power, the seismic model around the well can be reimaged while drilling, enabling the drilling program to be modified to achieve its objectives while avoiding problems and operational delays.

Optimized Drilling
Drilling faster is key to reducing time and cost. The industry is reducing NPT by engineering and manufacturing more reliable drilling tools and by taking a more scientific approach to the maintenance of drilling tools in the field. The ultimate goal is to drill each hole section in one run, thereby eliminating NPT linked to downhole tool failures. The second means of drilling faster is to increase the rate of penetration (ROP) when the bit is on bottom drilling. This is driven by how fast rock is crushed and removed from the borehole.

Today, a significant part of the energy passed from the top drive does not reach the drill bit, but rather is lost through undesired shock and vibrations throughout the drillstring. By optimizing the total drilling system—much like balancing the tires on a car to ensure a smoother drive—we can better utilize the energy applied from the surface. This total system optimization is achieved through computer models that can predict the behavior of the entire drillstring from top drive to drill bit as it rotates, and these models can then be used to optimize upfront design as well as real-time drilling operations.

The ultimate goal is to position the well in the optimum location in the reservoir with respect to net pay and reservoir quality to maximize production and recovery. This can be achieved by matching formation evaluation measurements from LWD tools to the reservoir model in real time, and adjusting the well path based on the new information. New generation LWD tools are providing measurements for well placement that can see 360° around the well and as deep as 30.5 m [100 ft] into the formation. This is particularly important when landing and steering deviated or horizontal wells in thin layers to very tight tolerances.

Competency
The need for developing the competency of field crews and teams of petrotechnical experts in deepwater operations has led to the adoption of a “Competency System Framework.” This framework is based on training to provide basic skills to deliver the required tasks; experience based on job exposure in deepwater environments; and technical assessment, which provides validation of skills and proficiency acquired during the certification process. The framework also contains additional components that solidify the process such as task-risk evaluation, competency record, and continuous improvement through verification and audits. For example, Schlumberger started a deepwater certification process in 2010, and currently there are more than 1,250 deepwater-certified professionals in different product
lines, mainly focused on services that are critical factors for success in deep-water operations.

**A Collaborative Approach**

Finally, the world is increasingly hungry for energy, and deepwater provinces are providing some of the most promising prospects available to the industry for meeting future demand. It is an exciting domain both in its potential as well as its numerous challenges. The E&P industry will need competent and assured personnel to push the limits of technologies and processes while being stretched to meet infrastructure and logistical needs. The prizes are potentially huge, but to achieve them we must anticipate and manage complex environments, with inherently higher risk profiles and associated infrastructure costs. Looking ahead, there should be no room for failure and as an industry we have to make a step change to increase our chances of success. The evolution of technology and integration can, and will, help us in that respect, and a collaborative approach to risk management and planning, with early engagement between operators and service suppliers, is critical to our success. **JPT**