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Optimizing System Design And Field Architecture

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An industry trend to engage early on with contractors for subsea production systems (SPS) and subsea umbilicals, risers and flowlines (SURF) during the early phases of a project is rewarding early adopters with significant benefits. These operators are witnessing added value from reduced costs, improved schedules, risk mitigation, improved interface management and more predictable delivery outcomes, combating the industry's challenge of increasing cost and diminished returns. An aligned SPS and SURF approach is helping to address issues of suboptimal processes, cost inflation, nonstandard specifications and under-recovered resources.

Traditional engagement strategies create a significant number of possible permutations and combinations during project execution, making it difficult to deliver complex projects at a viable cost. There are areas within the process that create gaps associated with interdependency and interaction of technical and commercial processes.

The integrated approach to SPS and SURF collaboration in the field development phase and throughout subsequent execution phases offers opportunities to close those gaps and efficiently reduce costs, improve schedules and maximize overall returns.

Potential benefits during field development phase

In addition to these benefits and improvements, early engagement with SPS and SURF contractors can result in enhanced system performance that offers potential for enhanced overall production recoveries; access to the most current available technologies that are often economic and technical enablers; optimization of development costs based on the aligned SPS and SURF interfaces; and accurate and current benchmarks to derive a robust cost estimate, execution schedule and risk evaluation.

Typical evaluation criteria include estimated cost, expected field production and recovery, operability and flow assurance, delivery schedule, and technology readiness. Applicability of an early, aligned approach depends on the specifics of each project or field prospect.

Optimizing field architecture

Examples of how the integrated SPS and SURF approach can make a difference in project planning

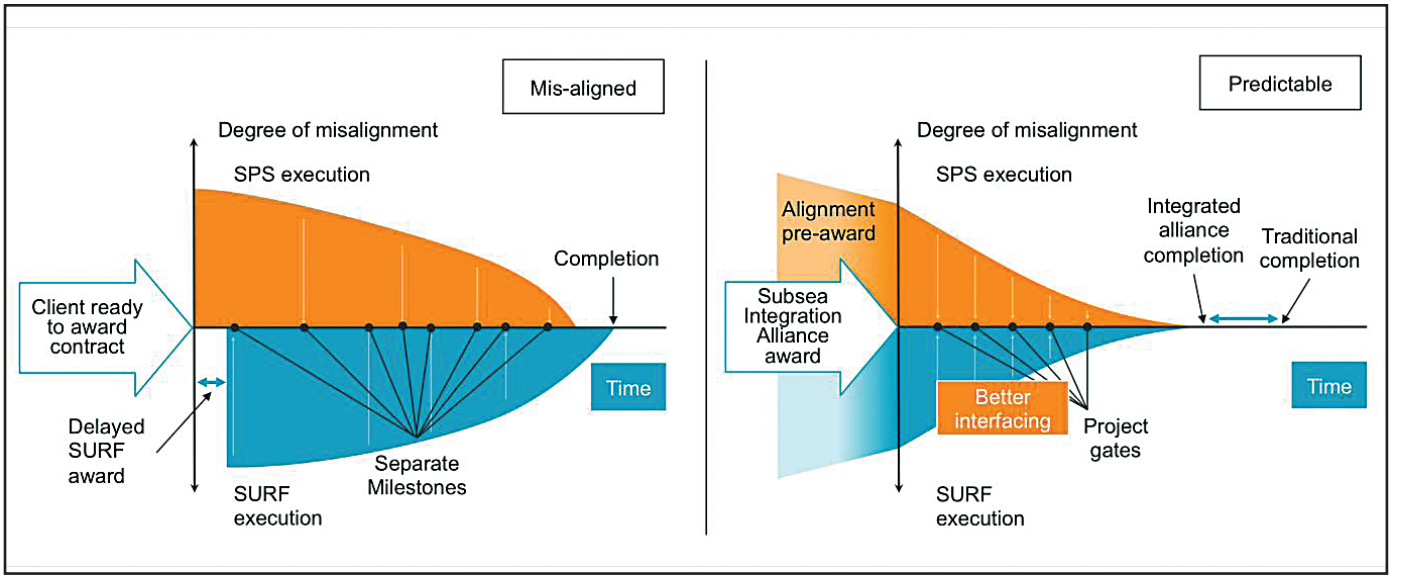

FIGURE 1. The left graphic is a traditional model showing SPS and SURF working separately and misaligned. The right graphic is an integrated model showing SPS and SURF working together, aligned, with a predictable outcome. (Source: Schlumberger/Subsea 7)

and execution might include the following categories: system operability, reservoir performance and pressure management. The capability to evaluate the operability of a proposed development in accordance with the design and flow assurance philosophy of the project is a key aspect of the integration of flow assurance in the SPS and SURF concept workflow.

When it comes to reservoir performance, the asset models typically in use are often a representation of reservoir production potential using data from a reservoir forecast. However, the reservoir is dynamic and the response is affected by the drawdown from the surface network. Establishing a strong link between SPS and SURF contractors and the operator can result in building an asset model that adequately captures reservoir dynamics and the performance of the surface network. This type of model can accurately predict the degree to which any newly proposed wells would choke production from existing wells. This has a direct impact on the feasibility of any development concept and selection of field architecture.

Most fields exhibit a rapid decrease in pressure as the reservoir is depleted. Water cut increases and the natural production diminishes. Therefore, pressure enhancement in the form of artificial lift is often needed to lighten the fluid column, boost the flow rate and improve field economics. Integration of an SPS and SURF work scope helps fine-tune the field architecture to optimize system design, resulting in significantly increased revenue and an improved revenue stream. The diameter of flowlines can be smaller, which reduces capex. Also, hydrate issues can be avoided and chemical injection requirements streamlined. For long step-outs, production enhancement can eliminate terrain slugging at the riser.

Installation aspects

Following determination of the subsea tophole location on the seabed and control system optimization at the drill center, a benefit of an integrated approach to SPS and SURF is to simplify the interface between designers and installers of SPS elements by improving understanding of drivers and constraints of each party. The traditional method of issuing SPS elements as "company provided" items to installers often can lead to interface issues, misunderstanding, increased complexity and imperfect solutions. A contingency cost is generally needed to cover the inherent risk.

Another way to minimize costs is to allow influence on the design of subsea structures so they can be installed with the most cost-effective and suitable vessels. For example, some heavy subsea structures could be split into modules to allow separate installation of each subsea module with a lighter intervention vessel. A subsea separation unit could be installed in several lifts by having several modules installed one after the other.

Alternative installation methodologies and system configurations also can be considered. An integrated approach would greatly facilitate resolution of challenges and careful assessment of system design to ensure a positive impact on the overall project.

Additionally, umbilical packing considerations can contribute significant costs. Having long sections of umbilicals on the field may end up with the installation vessel having to transit to the umbilical factory to load out the product in a carousel; having the umbilicals on reels allows much more logical flexibility as they can be transported on a heavy-lift vessel.

Project execution synergies

Recent lessons learned from projects that were considered successful showed that additional costs to manage gaps in the consideration and execution of SPS and SURF can potentially be 5% to 10% of the overall SPS and SURF contracts with associated schedule impacts of three to six months. On projects where interface issues are poorly defined and executed, the impact overall can lead to significantly higher cost and schedule overruns.

Three main success factors to deriving benefits from an integrated SPS and SURF project include goal alignment, convergence management and rationalization (Figure 1).

Risk and schedule assurance

An industry report by EY found that nearly two-thirds (64%) of multibillion-dollar technically and operationally demanding megaprojects exceeded budgets with nearly three-quarters (73%) missing project schedule deadlines. The previous method communicated in this report resulted in challenges to deliver complex projects and decrease continuity and familiarity with project goals. It also failed to address new problems and challenges bespoke to a specific development.

Building a more integrated approach to SPS and SURF delivery that is repeated on several projects concurrently in an ongoing collaboration greatly increases the potential for repeatable and more reliable subsea system delivery. The combination of early engagement, technical optimization and integrated project execution can reduce costs, mitigate risks, improve interfaces and deliver more predictable outcomes for operators. E&P