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Research paper



Operational Feasibility Review of the Well Design Standardization for Offshore Drilling Operations Optimization

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Abstract

Well cost is a major component in a field development's project cost. Various initiatives have been engineered and implemented to optimize the well design and operation to reduce the well cost. One of the initiatives that can be considered is the Well Design Standardization (WDS). It is a concept of having a set of standardized well designs with limited variation. The main objectives of implementing WDS are reduction to the overall well cost through economies of scale and equipment surplus consolidation. It is conceptually logical and simple. However, the concept may not be feasible in all operational conditions. This paper shall cover the WDS concept, implementation benefits, implementation challenges and mechanisms to make the concept operationally feasible. The objectives of this paper are to introduce the WDS concept, and provide some considerations that can benefit the planning and implementation of WDS in drilling projects. WDS is an opportunity that needs to be considered in an operation, because significant cost saving can be achieved if the right mechanisms were applied.

Keywords: *well cost, offshore drilling operations, cost reduction initiatives, well design standardization, drilling inventory management*

1. Introduction

Drilling a well for oil and gas has always been expensive and high-risk due to uncertainties and unknowns below earth surface. The power of imagination and science are relied on, to understand how entities work. High well cost is unavoidable to manage risks that requires in-depth study of the intended field and exploration drilling programs before planning for future development. Well Cost is a major component in a field development's project cost which can constitute about 50% of the total project cost, depending on the project's work scope [1]. Cost reduction studies have been focused on efficiency of operations, elimination or offline operations and use of technology (methodology, materials and equipment). Various initiatives have been engineered and implemented to the well design to optimize the designs and operations [2]. Most of these implemented initiatives are focused on well design and operation. Initiatives from a larger perspective like WDS would be effective to be focused on as well. The objectives of this paper are to introduce the WDS concept, discuss the issues of implementing the concept and to provide some ideas to make the concept operationally feasible.

2. The Concept

WDS focuses on project management, but with pre-requisite of sound engineering enforcing selected optimum designs. It is a concept of having a set of standard well design with limited variation, where a major project, an operator or a consortium of operators can have collaborated operations. WDS is about bringing the concept of manufacturing into the Oil & Gas (O&G) industry. Standardization is about copying from previous success to become a template and repeating the proven success repeatedly [3]. The aspects of well design that are targeted for standardization are; casing, tubing and completion equipment, where they will have the same size, material and connection type. Other aspects are drilling fluids and cementing.

In a program by Malaysian O&G industry practitioners, spearheaded by the Petronas, CORAL 2.0 emerged in 2015 with a 5-year program to inculcate cost-conscious mindset and support sustainability of the O&G industry [4]. This is envisioned in preparing for future industry challenges by optimizing cost, increasing efficiency and driving industry innovation across all operators. One of the initiatives is "low cost drilling" and WDS is one of the functions under this initiative.

Many operators have considered similar concept. In a paper written by the Abu Dhabi Marine Operating Company, WDS is about utilizing standardized criteria to develop well trajectories, offset well analysis, completion recovery procedures and drilling simulation models for hole cleaning, cementing, torque, drag, etc. [5]. This was also coupled with standard criteria for hole cleaning. It was established along with torque and drag simulation model criteria as well as standard bottom hole assembly (formation evaluation like logging while drilling may complicate the standardization). It was not really clear on the continuity of the process from start of design in a differentiated design stages to the well handover, the paper also covered the quality assurance, well design process and well delivery process. In another paper, the complete process is summarized as part of the Business Integration Implementation program which includes Drilling Technology Mastery, Integrated Well Planning Workflow and Data Management [6]. Another example is focusing on usage of software application to minimize engineering design time [7].

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3. The Benefits

Implementation of WDS materializes significant cost reduction through economies of scale and elimination of multiple back-up equipment. Based on the Cambridge dictionary, economies of scale is the reduction of production costs that is a result of making and selling goods in large quantities, for example, the ability to buy large amounts of materials at reduced prices. Economies of scale may also reduce variable costs per unit because of operational efficiencies and synergies [8]. In a Drilling operation, there are at least 30 contracts that need to be established including, drilling rig, directional drilling, drilling fluids, formation evaluation, cementing, tubular (casing & tubing), completion equipment and many others [9]. These contracts include provisions of equipment, material and services. When a contract is established, the scope of work includes description of work, requirement of equipment, materials and services, number of wells were to be drilled and duration of the contract. The larger the volume of wells and the longer the period of time, the lower the contract price will be.

Another form of economies of scale is contract bundling. This is where a few contracts are combined into one major contract. Contract bundling is not exclusive to O&G industry but applied in other industries as well. The concept is to have equipment and services that are closely related to each other, be bundled. All major contracts are awarded to two major contractors (drilling bundle and completion bundle). Wellhead and christmas tree, tubular and other individual equipment and services that cannot be lumped with another due to lack of common operational basis, are awarded separately. The advantages of contract bundling to the operators are contract value discount from the main contractor, one-point of responsibility, and less number of contracting processes.

Elimination of multiple back-up equipment is another major cost reduction through WDS. In drilling, back-up equipment is very crucial because most of the items are not "off the shelf" items. In drilling, "off the shelf" means common items, where almost all operators utilize, where the design is already established, tested and repeatedly manufactured. Uncommon items are referred to equipment which are not usually used (exotic material), may require designing (for new items), and may require testing (for non-established items) [10]. Suppliers do not keep stock voluntarily because the equipment are expensive. Operators do not want to be stuck with excess stock that tie up their capitals, use up warehouse spaces and require periodical maintenance.

With the factory approach to well delivery, WDS will have minimal well designs. Repetitions of the same design will not only reduce the time to design, quality assurance and approval, but also the time to complete the well because repetitions will increase the speed of operations [11]. It reduces the learning curve.

It is also in the interest of supplier/contractor that product or service differentiation remains the main thrust of their sales and marketing strategy. Hence, standardization may curtail the selling opportunity, while squeezing profit margin.

Implementation Challenges

Firstly, field requirements are unique, which require the well design to be unique to meet these requirements. One of the well design's components is well trajectory. Well trajectory design depends on the locations of reservoir target, number of the targeted formations, depth of the targets and pressure profile [12]. All these factors shall influence the well trajectory with variation in-depth, angle and casing scheme to reach the reservoir targets. Well completion design depends on the number of formation, types of fluids and contents, production rate, future requirements and additional downhole accessories for well monitoring. With so many conditions to be met, well trajectory and completion designs tend to be unique for an individual well. Furthermore, downhole formation can be complex, scattered and compartmentalized. These added complexities require the well design to be unique. It will be challenging for the subsurface to accept limited well design models to fit into the overall reservoir development program and management [13].

Secondly, limited options in the Field Development Plan (FDP) at conceptual design stage. The FDP is a document that puts together the "best technical option" for field development optimization [14]. It is not just about the best option for individual sub disciplines like health, safety, environment and quality assurance (HSEQ), drilling, reservoir, geology and geophysic (G&G), structure or facilities engineering. It has to be the culmination of optimum options in all sub-disciplines. Well design determines the number of wells to be drilled, platform location, platform count and many other areas in the FDP. Therefore, having a limited set of well design when implementing WDS may limit this opportunity to have the best option for the project.

Thirdly, the coordination and priorities in operations can be very challenging. Implementation of WDS in multiple projects, corporate wide, supply base wide or country wide, there must only be one control point. No matter what the implementation magnitude is, there are always issues that need to be handled with regards to coordination and priorities. Every operations, projects and companies believe their operation is the utmost important.

Furthermore, WDS may promote market monopoly where one supplier or contractor is awarded with the contract provision of equipment, material and services for a large number of wells and a long period of time through contract bundling [15]. The rest of the suppliers and contractors will lose their ground and will never be able to sustain with very minimal business for "unique wells" that are bided out separately when the "standardized wells" are awarded to the sole winner. The issue with market monopoly for the operators will be unavailability of a back-up party to rely on in case the incumbent contractor cannot perform as per the contract requirement for whatever reason. The operator will be left with no option or having to opt for options which are very expensive.

4. Mechanism to Make WDS Work

Firstly, the total number of wells must be substantial. This is because the basic principle of WDS cost saving is economy of scale. Therefore, a number of small projects' requirements may need to be combined to obtain a bigger volume. One company may also combine their requirements with another company. However, legal issues especially in dealing with share partners, risk and contract Terms and Conditions (T&C) from one company to another shall pose a great challenge in the process of contract synergy. This aspect can work for companies sharing the same supply base for their operations. In this case, a one-stop center for the requirements need to be established to handle the substantial number of wells from various parties [16].

Secondly, the well design must not have too many variations (limited unique design). Each model in the WDS needs a back-up set. The well design variation can probably be minimized to no more than 8 designs, for example. However, this has to be worked out based on the reservoir requirements of parties involved in the campaign.

Thirdly, all parties must be committed during the planning and implementation. Collaboration would be easier if all the parties involved are in the same company; i.e. multiple projects. Issues are unavoidable when the collaboration includes parties from different legal entities (different companies) [17]. This is why commitment to solve the issues together as a conglomerate that is

bounded by a memorandum of understanding (MoU) is utmost importance. MoU will be sufficient to define relationship boundaries for both parties. Issues during planning may revolve around T&C of the contract, willingness to reveal information and availability of information to be provided timely. Issues during implementation may revolve around influence toward the operations coordination, and cost allocation basis.

Fourth, all parties must have possibly the same stakeholders, such as board of directors, joint venture partners, host country, country's authorities and the public. Although this is not exactly necessary to make the concept work, it can increase the probability of success. Support and influence of stakeholders to the project would be tremendous. This is in terms of expectations, requirements and authority over policies. The significance of having the same stakeholders is to ensure that all the implementation efforts can be supported by the same parties. Different stakeholders on the other hand will have different interest in the projects thus influencing the requirements and priorities in a project.

Lastly, operations coordination must be efficient and impartial to all the parties involved. This point is similar to the influence toward operations coordination, but it stresses the point from a different perspective. WDS will require an operations coordination that is efficient. How do we ensure operations coordination efficiency? A body needs to be set up independent from all parties involved [18]. Operational and cost allocation guidelines need to be provided to operations coordination center. It will answer to the highest level of authority of the common stakeholder to minimize unfairness.

5. Conclusion

In conclusion, WDS is an operationally feasible concept to be implemented by any large project, corporate wide or inter-companies. The bigger the implementation scale, the bigger the savings could possibly be, but becomes more complex to implement and control. The benefits of implementing WDS is realized through economies of scale and elimination of multiple back-up equipment requirement. There were four main challenges discussed in this paper. They are in the forms of field unique requirements, limitation of the FDP options, coordination complexities, and potential issue of monopoly if not implemented with appropriate regulation and planning. Consequently, the paper also discussed the mechanisms that will make the WDS concept feasible to be implemented. There were five mechanisms discussed; total number of wells must be large, well design must not have too many variations, all parties must be committed during planning and implementation, all parties must have possibly the same stakeholders, and WDS operations coordination must be efficient and fair to all parties. There are undeniably many complexities, but with any great challenges, there will always be greater benefits to be acquired when the challenges were overcome.

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