

Brief Analysis of Cost per Meter Management in Drilling and Well Completion Operations in Bohai Oilfield

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Abstract: The development of domestic offshore petroleum engineering is faced with opportunities and challenges under the situation dominated by the seller across the complex international petroleum market. The cost of drilling and well completion accounts for more than half of the budget, also directly affect the feasibility of offshore oilfield development. Therefore, to effectively improve the management level of offshore drilling and well completion, "speed, quality, production and efficiency" are the main problems faced by the workers. The meaning of cost management, and influencing factors, and the current status of drilling cost control has been introduced in this paper. The aim will be to provide reference value for the subsequent development of offshore oil drilling and well completion and the cost management of related oil industry.

Keywords: Drilling and well completion, Project management, Cost per meter

1. Introduction

In the 1980s, several large oil fields with high proven reserves and higher quality of oils, such as Jinzhou 9-3, were successively discovered in Bohai Oilfield. However, the development was delayed at that time because of the long drilling and completion period, high development cost, and the failure of economic evaluation to reach the benefit target. These fields were developed effectively in 1995, when superior drilling and completion techniques were widely used. It can be seen that drilling and completion technique plays a vital role in the development of the entire oilfield, and it is a key point of drilling and completion project management to improve efficiency and reduce cost. At the same time, a survey of the oil price in the past 10 years shows that the price of international crude oil market fluctuates frequently. After the cold winter of 2015 and 2016, the oil price fell to a low point in the global COVID-19 epidemic in 2020. Some oil producing countries have reduced production, making the relationship between supply and demand of oil resources more tense. In such a difficult international oil environment, the production requirements of Bohai oilfield are not reduced but increased, which makes offshore drilling and well completion face a much tougher test. It has become a top priority to improve project management, improve drilling and completion efficiency, and reduce project cost. As an important measure of cost reduction and efficiency of drilling and well completion, the drilling cost per meter has naturally become the focus of attention.

2. Meaning and control objectives of the cost per meter

Cost per meter refers to drilling and well completion cost per meter of footage. The calculation formula of cost per meter is as follows:

$$\text{Cost per meter} = \text{drilling and well completion cost } C / \text{footage } F.$$

In the field of drilling and well completion, the footage has a great impact on the drilling cost. Therefore, in applications, the cost per meter is more specific to refer to the drilling cost per meter footage. That is, cost per meter = drilling cost DC/ footage F.

Cost control objectives in general enterprise can be summarized into the following three levels: Firstly, through cost control to cooperate with the strategic choice and implementation of the enterprise, to obtain cost advantages to help the enterprise to obtain competitive advantages; Secondly, make use of the linkage relationship among resources, cost, quality, quantity and price to cooperate with enterprises to

obtain the maximum profit as far as possible. Thirdly, cost reduction. For offshore oil drilling and well completion, in order to reasonably manage and control the cost, one of the most critical indicators is per meter cost. The most appropriate cost reduction target is to combine the development of the company and the oil price tendency. According to different types of projects, formulate feasible per meter cost management indicators, through the monitoring and control of cost per meter, so as to effectively reduce the cost of drilling and well completion, so that the oilfield development can achieve rapid growth in value, to maximize the company's interests, make the company get advantage in the fierce competition in the international oil market.

3. The contributing factors of the cost per meter

According to the calculation formula of cost per meter, it can be seen that cost per meter is mainly affected by drilling cost and footage. Footage = well depth- the depth start drilling. Relative to footage drilled, the cost of drilling becomes more complex.

Drilling cost in offshore drilling and completion can be divided into four major items: pre-drilling preparation, drilling service, drilling equipment and drilling indirect cost. Taking 2019 as an example, the proportion composition of the four major items in drilling cost is shown in Figure 1, and the proportion fluctuates slightly over the years.

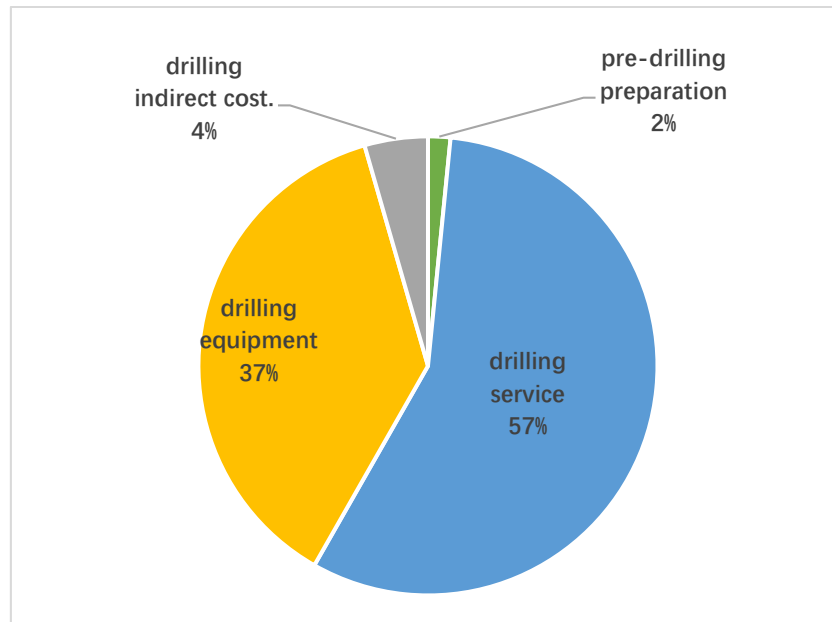


Figure 1 Proportion composition of drilling cost

These four major items are divided into more granular expense item, and their composition and proportion are shown in Figure 2.

According to the pie chart, the influencing factors of cost per meter according to different expense items can be summarized as follows:

Items affected by the construction period: drilling rig, supply ship, helicopter, fuel, cementing services, drilling fluid services, logging services, etc.

Items affected by well depth: drilling fluid materials, cementing materials, ceramic pipes and accessories, drill bits and nozzles, etc.

Items affected by well type and well structure: drilling fluid materials, cementing materials, casing and accessories, wellhead equipment, directional well, LWD, wire line logging, etc.

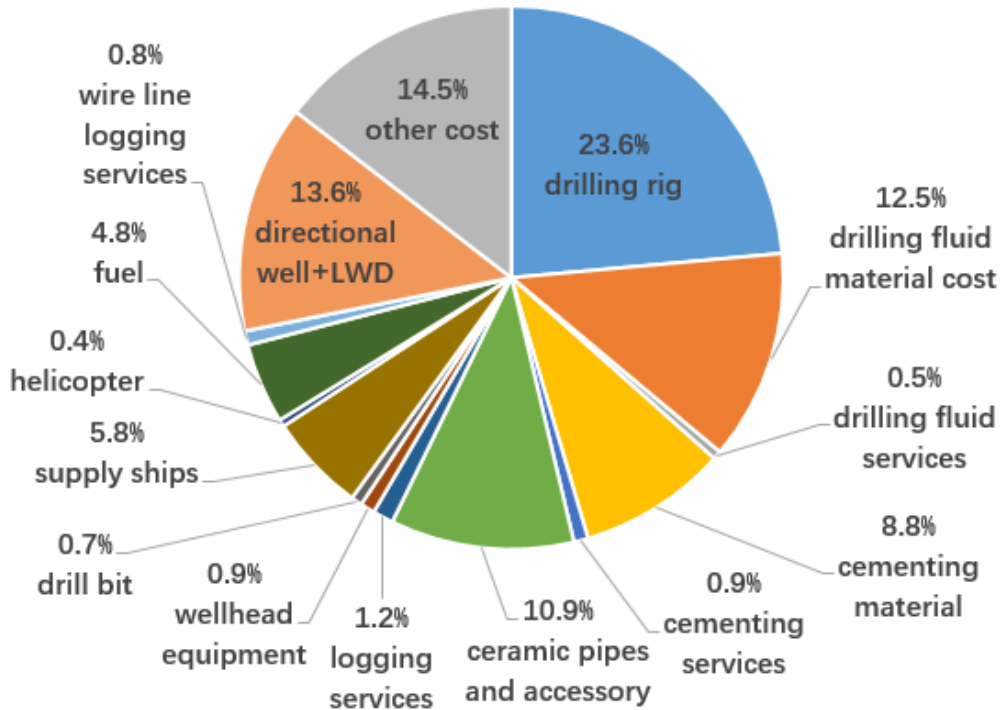


Table 2 Detailed drilling cost structure

Items affected by regional management: helicopters, fuel, supply ships, etc.

Items affected by tool capabilities and technology levels: directional wells, LWD, wire line logging, etc.

To sum up, drilling rig ability level, well depth, wellbore structure, management level and the application of new technology and so on are seriously affected the drilling cost, which in turn affects the cost per meter, so these factors also indirectly affect the oilfield development and the feasibility of the adjustment scheme.

4. Methods and effects of cost per meter control

Bohai Oilfield has been committed to drilling and well completion cost reduction and efficiency improvement work. The management and requirements of cost per meter are increasingly strengthened. According to the project period, cost per meter management methods can be summarized as follows:

4.1 Pre-operation. Using per meter cost to correct design cost, optimize bidding and procurement strategy.

Before drilling and completion operation begin, this is also known as the design phase. At this stage, following the instructions to locate the wells, according to the location position paper completes the targets, the optimal design, the reasonable optimization of wellbore structure, simplify logging projects, apply for a new type of drilling fluid system, try to reduce unnecessary trip work, to improve drilling efficiency and cost budget, according to previous annual cost per meter level to complete the planning cost budget, using cost per meter index to check and correct the basic design and construction design, complete the budget report. In addition, the bidding strategy and procurement strategy should be selected reasonably, and the construction team and core tools should be selected through bidding and tendering

to reduce the operation cost.

4.2 Precise decomposition of indicators in operation. Real-time feedback tracking; Improve the management level and adjust the plan in time

According to the international oil price, the company's overall policies and project cost, formulate scientific and reasonable target cost per meter. Effectively control and incentive the drilling cost, strengthening the drilling cost management. Determine reasonable cost quota through establishing cost per meter prediction model, provide reliable indexes for assessment of cost. With a clear overall target cost per meter, the target task should be accurately decomposed. According to different project types and different investment ratios, the target of cost per meter should be accurately confirmed, so that each project and each well have a clear goal.

During the drilling operation, the cost controllers of the project timely finish budgeting and settlement. In the management of the budget estimate, we should strictly follow the design requirements, correctly understand and apply the cost estimate. Tracking the actual cost timely, accurate and reasonable, compare and analyze with the budget estimate. During the settlement, cost controllers are required to be patient and meticulous, calculate the workload carefully, and be verified with supervisor on platform.

The cost controllers of each project will monitor and feedback the actual cost per meter in real-time. According to the established cost per meter index, real-time project cost tracking statistics, every well can be contrastively analyzed with the index of cost per meter, so as to grasp the degree of deviation in time, summarize and analyze the causes of deviation, and establish a direct and effective feedback mechanism so that the project manager can timely adjust the project plan strategy according to the analysis and comparison results from cost per meter.

From a managerial level: on-site operation arrangement, tool allocation and personnel division of labor all reflect the level of on-site operation management, thus affecting the operation efficiency and the completion of cost per meter even further. Completes the construction plan, including directional well tools used in each well logging plan, drilling process is to do a detailed plan. Completes the process arrangement, the overall arrangements for each service provider according to the construction plan, and reasonable control downhole tools such as logging tools and personnel service time, in guarantee under the condition of field operation, reduce the waiting of time, achieve seamless. This is an effectively way to reduce the cost of directional well services, LWD logging services, downhole tool services, and so on.

From the technical level: advanced drilling technology can improve drilling speed and well bore quality. Actively explore and apply advanced drilling technology, carry out drilling simulation, optimize drilling engineering design, forming a set of suitable drilling technology, these all play a positive role on improve drilling rate and reduce cost.

4.3 After the operation finished - summarize and analyze the cost per meter, and set up reward and punishment to evaluate the completion of project

When drilling and well completion has finished, the decomposed cost per meter index and the actual cost per meter were compared and analyzed in time to summarize the reasons for increase period or decrease period. A systematic and comprehensive assessment mechanism is developed to evaluated and compared the cost per meter of each project, and a supporting and feasible reward and punishment mechanism is established, so as to achieve clear reward and punishment, generally in the annual unit, effectively improve the consciousness of all staff to reduce cost and improve efficiency, mobilize the enthusiasm of all staff.

4.4 Other methods to control cost per meter

Optimize management. Optimize the organization structure reasonably, divide the management authority reasonably, and make sure that the indicators are uploaded and transmitted to each employee.

Technical innovate. Fully reflects the importance of technicians, stimulate the enthusiasm of the technical innovation, reasonable play the advantages of technology management, improve technicians' work enthusiasm, improve the their career promotion channel and salary, at the same time, quantitative different technology innovation awards and incentives, improve the mechanism of rewards and punishments. Achieved the goal of improve efficiency and reduce cost.

Logistics management. Either project owner or service provider, all need to strengthen their personnel

and equipment management, reduce the staff turnover rate, establishing and perfecting the mechanism of warehouse management system and equipment maintenance, reasonable allocate equipment tools, reduce the accident rate, strive for achieving the goal of cost control.

Contract management. As an important part of project management, contract is the basis of project settlement and has legal benefits. To improve efficiency and control cost, it is necessary to do a good job in contract management. To clear the business process of contract and make it classification, contract manager and cost controller should establish a fast and effective feedback channel, to create a shortcut for contract improvement. In addition, contract management should carry out systematic and digital transformation and establish a sound contract management system mechanism, so as to make contract management more efficient and achieve the purpose of reducing costs.

5. Conclusion

Through unremitting efforts and innovations in project management and cost control in recent years, the drilling efficiency has been greatly improved and the cost of offshore oil drilling and well completion has also been effectively controlled. In the process of controlling the cost per meter, we constantly seek for deficiencies and breakthroughs: in order to control the cost more efficiently, we established a "whole-process management mode". Cost controllers participate in the project management throughout the whole process, starting from the design stage, to provide data basis for the rationality of the cost and other indicators; Open the feedback channel between cost controllers and contract management, provide the practical basis for contract signing and the rationality of contract terms, provide the data basis for bidding and procurement; It also provides a theoretical basis for the selection of different service providers and tool optimization. Through the comparison and analysis of cost per meter index, find the space of cost reduction, and provide the calculation basis for the project leader's decision in time.

The cost per meter index, seemingly simple, but fully reflects the level of offshore drilling and well completion project management and the ability on cost control. The management and control of cost per meter index have a long way to go. In the future, Bohai oilfield drilling and well completion will drive cost control to digital transformation, in the era of the rapid development of science and technology of big data, the index of drilling and completion of various types of fees towards to the systematic, standardized development. Provide better service for the project is the new target of offshore drilling and well completion cost management.

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