Analysis of the efficiency of telemetric systems for drilling wells

L Z Zainagalina, L V Petrova and V A Petrov
Ufa State Petroleum Technological University, Branch of the University in the City of Oktyabrsky, 54a, Devonskaya St., Oktyabrsky, Republic of Bashkortostan, 452607, Russian Federation
E-mail: zlz11@mail.ru

Abstract. For efficient control of well drilling, it is necessary to know actual drilling conditions, parameters of the trajectory of previously drilled wells, to predict the trajectory of a new part of the well bottom, to know technological parameters in the bottom hole zone. Efficiency of the telemetry systems used for drilling wells was analyzed by calculating the economic efficiency for well drilling at the Taylakov field. Modern telemetric systems help avoid additional drilling costs and improve efficiency and reliability of well drilling.

1. Introduction
According to the Megion Drilling Operations Company, well drilling without telemetric systems causes the need for remedial works which increases the period of well construction and well construction costs. Wellbore adjustment is a time-consuming process which includes:
- measurement of inclinometric data by the geophysical crew;
- trip out of hole;
- layout changing;
- tool running;
- drilling of the 25 m additional bore with a diverter orientation;
- additional measurement of inclinometric data by the geophysical crew [1, 3].

These operations take from forty to seventy hours [2]. Drilling equipment (drill pipes, slewing systems, downhole motors) wear, unworked bits, energy consumption, work of the geophysical crew should be added to the time spent on well bore adjustment [6].

The analysis of the results of drilling wells without downhole telemetric systems shows that the design and actual profiles have significant differences [8, 9]. This affects the casing running, deteriorates the casing cementing quality due to various gutters and kinks which reduces the turnaround time of the well. The actual well profile is longer than the design one which causes excessive wear of drill pipes, increases the flow rate of drilling fluid, the length of casing pipes, consumption of cement, etc. [4, 5].

Accounting for all factors affecting the cost of well construction is a very time-consuming research task. The most significant factor affecting the cost parameter is geophysical surveys of wells [10, 11].

2. Materials and methods
The Taylakov field, which belongs to the Megion facility, has relatively uniform mining and geological conditions. It is located in a highly marshy zone. More than 70% of the entire area is occupied by swamp
forest and open swamps, especially in the northern and north-eastern parts. The territory of the field is located in the south of the West Siberian Plain. According to the geobotanical zoning, this region is a taiga zone of Nizhnevartovsk province.

Under these conditions, let us determine the economic effect from the use of telemetry compared with the use of periodic monitoring tools.

The purpose of drilling is optimal operation of the field [7]. The method used is a turbine drilling method. The drive is electric. The well depth is 2,743 m for the basic variant and 2,736 m for the new one. The cost of 1 brigade-hour in comparable conditions is 2504 RUB. The duration of the drilling operations per one well is 496 hours for the basic variant and 397 hours for the new one. The average consumption of bits per one well is 14.80 for the basic variant and 12 for the new one. The average number of measurements per one well is 10 for the basic variant and 3 for the new one. The price of bits MSZ-GNU R-3-26669 is 295.3 RUB; MZ-GV R-155-12624 - 215.9 RUB; HLG R-190-8159 - 215.9 RUB. The average cost of one measurement is 133538 RUB. The volume of implementation is 34 wells.

3. Results and discussion
The basic variant case is the drilling process using tools of regular monitoring; the new variant is the drilling process using telemetric tools.

After the calculation of the economic effect of telemetric systems based on the source data, results of the basic and new variants were compared. As can be seen from Figure 1, for the basic variant, the bulk of the costs is time-dependent costs (124300 RUB). The total amount of the costs for this method is 1404600 RUB.

The cost data diagram for the new variant is presented in Figure 2. The total changing operating costs are more than 1236400 RUB.

Thus, the use of telemetry tools is economically efficient. The savings per well are 1,68200 RUB. Operating cost savings for the entire implementation volume is more than 5,720,300 RUB. Cost reduction is about 60 RUB/m.

![Figure 1. Expense data for the basic variant.](image-url)
Let us calculate the cost of a single inclinometric survey. In both cases, the average duration of one measurement is 3 hours; the average duration of the duty of one inclinometric crew per one measurement is 1 hour. The average distance from the base to the bush is 120 km. The number of measurements for the basic variant is 10, for the new one, the number is 3. The wage rate for the work of one inclinometric crew is 1307 RUB per hour. The wage rate for the technological duty of one inclinometric crew is 494 RUB per hour. The movement cost for one inclinometric crew is 33 RUB per km. The cost of one inclinometric measurement is 953 RUB per operation.

The total changing inclinometric cost per well is 133538 RUB for the basic variant, and 40059 RUB for the new one (Figure 3). Savings amounted to more than 93,000 RUB. The time spent on measurements is different, since inclinometric measurement takes about 30 hours for the basic variant.

4. Conclusion
Thus, to improve the efficiency and reliability of well construction, it is necessary to apply a reliable and universal telemetric system. The system includes high-precision inclinometric sensors, technological sensors, logging tools which help reduce drilling costs. The use of the telemetric system at the Taylakov deposit improves economic efficiency: time-dependent costs decreased by 28%.
inclinometry costs decreased by 70%; total changing operating costs decreased by 11 %, and savings amounted to more than 5720300 RUB.

References

[1] Nie Z, Liu Z and Sun X 2018 A Multirelay Cooperation Method for Wireless Transmission of MWD and LWD Signals IEEE Transactions on Geoscience and Remote Sensing 56(3) pp 1229–37
[2] Khabibullin M Ya, Samigullina L Z and Zainagalina L Z 2018 Laboratory studies for the momentum of liquid optimal impact on hydrocarbon formation Advances in Engineering Research (AER) (Int. Conf. “Actual issues of mechanical engineering” (AIME 2018)) 157 pp 276–79
[3] Saikia K 2018 A proposed methodology of 3D geomodeling-while-geosteering for optimum horizontal well placement and enhanced geological risk management Indian J. Geo-Mar. Sci. 47(4) 826–30
[4] Goryunova M V and Yantsevich V V 2018 Determining the location of restriction in formation pressure management systems pipelines with wavelet analysis IOP C. Ser.: Earth Env. 194(8) 082015
[5] Yaskin S A, Mukhametshin V V, Andreev V E and Dubinskiy G S 2018 Forecasting the parameters of non-stationary water flooding of oil deposits IOP C. Ser.: Earth Env. 194(6) 062037
[6] Khuzina L B, Mukhametshin V Sh, Tyncherov K T and Shaikhtudinova A F 2018 On the choice of the oscillators’ installation site Int. J. of Civil Engineering and Technology 9(9) 1952–59
[7] Zainagalina L Z, Suleimanov R I, Gabdrakhimov M S and Khabibullin M Ya 2018 Determining oscillating system dynamic parameters of a near-bit junk pulper Advances in Engineering Research (AER) (Int. Conf. “Actual issues of mechanical engineering” (AIME 2018)) 157 pp 642–45
[8] Gillen M E, Moody B and Dymmock S 2018 New LWD technology provides high-resolution images in oil- and water-based muds for improved decision making in real time Proc. of the Annual Offshore Technology Conf. 4 pp 2617–26
[9] Liu Z, Nie Z, Sun X, Wen D and Tan J 2017 A low frequency forward looking antenna array for LWD and MWD Progress in Electromagnetics Research Symp. pp 151–54
[10] Bijnani P, Coscia M, Hammon K, Ashraf M and Ali Hassan H 2015 MWD/LWD challenges and solutions for drilling the longest al hosn gas well in an aggressive subsurface environment Society of Petroleum Engineers - Abu Dhabi Int. Petroleum Exhibition and Conf. (ADIPEC 2015)
[11] Tyncherov K T, Mukhametshin V Sh, Paderin M G, Selivanova M V, Shokurov I V and Almukhametova E M 2018 Thermoacoustic inductor for heavy oil extraction IOP Conf. Ser.: Mat. Sci. 327(4) 042111