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Determining the estimated machine time and efficiency of equipment at an oil and gas enterprise under conditions of information uncertainty

Określanie szacowanego czasu pracy maszyn i wydajności sprzętu w przedsiębiorstwie naftowo-gazowym w warunkach niepewności

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ABSTRACT: One of the main conditions for long-term forecasting of equipment requirements is to ensure the maximum level of equipment utilization, which characterizes production efficiency. In line with this condition, production in drilling departments must be organized to achieve an optimal volume that maximizes equipment productivity. In other words, it is necessary to determine the functional relationship between changes in the amount of equipment involved in the production process and its productivity. Following this, it is necessary to determine the optimal amount of equipment for the enterprise to maximize its productivity. The primary goal is to identify the negative and positive consequences of changes in the production scale. This article examines the solution to the above issues using the example of SOCAR (State Oil Company of the Azerbaijan Republic). To adequately address this problem, a procedure for determining the estimated machine time for each drilling equipment at the enterprise level is proposed, using the "Annual drilling calendar balance" report from the SOCAR enterprise, Azerbaijan. It is known that as the drilling depth of a well increases, so do the labor costs associated with drilling. To solve this problem, the research examines the functional dependency of the amount of drilling equipment on its productivity. This study led to the development of a mathematical-statistical model to predict productive time based on drilling depth. The scientific innovations proposed in this article are presented with calculations, based on the example of the SOCAR drilling enterprise, offering practical insights. The results of the study can be applied when justifying production plans and forecasting future equipment and spare parts requirements for drilling enterprises.

Key words: estimated machine time, equipment utilization rate, product added value.

STRESZCZENIE: Jednym z głównych warunków długoterminowego prognozowania zapotrzebowania na urządzenia wiertnicze jest zapewnienie maksymalnego poziomu ich wykorzystania, co pozwala określić wydajność produkcji. Zgodnie z tym warunkiem produkcja w działach wiertniczych musi być zorganizowana tak, aby osiągnąć optymalną wydajność, przy jednoczesnym zmaksymalizowaniu wydajności urządzeń. Innymi słowy, konieczne jest określenie funkcjonalnego związku między zmianami w ilości urządzeń wykorzystywanych w procesie produkcyjnym a ich produktywnością. Następnie należy określić optymalną ilość urządzeń dla danego przedsiębiorstwa, która pozwoli zmaksymalizować jego produktywność. Podstawowym celem jest zidentyfikowanie negatywnych i pozytywnych konsekwencji zmian w skali produkcji. W celu właściwego zajęcia się tym problemem zaproponowano procedurę określania szacunkowego czasu pracy maszyn dla poszczególnych urządzeń wiertniczych na poziomie przedsiębiorstwa, z wykorzystaniem raportu *Annual drilling calendar balance* sporządzonego przez przedsiębiorstwo SOCAR w Azerbejdżanie. Jak wiadomo, wraz ze wzrostem głębokości odwiertu rosną również powiązane koszty pracy. W związku z tym w badaniu przeanalizowano funkcjonalną zależność ilości urządzeń wiertniczych od ich efektywności. W rezultacie opracowano model matematyczno-statystyczny do przewidywania czasu efektywności urządzenia na podstawie głębokości wiercenia. Nowatorskie rozwiązania naukowe zaproponowane w tym artykule zostały przedstawione wraz z obliczeniami na przykładzie przedsiębiorstwa wiertniczego SOCAR, co przekłada się na wiedzę praktyczną. Wyniki badania można wykorzystać przy uzasadnianiu planów produkcyjnych i prognozowaniu przyszłego zapotrzebowania na urządzenia i części zamienne w przedsiębiorstwach wiertniczych.

Słowa kluczowe: szacowany czas pracy maszyny, wskaźnik wykorzystania urządzeń, wartość dodana produktu.

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Introduction

One of the important areas in the problem of managing the reliability of oilfield equipment is the improvement of methods of substantiating and calculating its normalized level. The value of the research work lies in its ability to address the issue of efficient utilization of fixed assets. This can be achieved by increasing production, enhancing the impact of the generated production potential, optimizing the equipment balance, reducing production costs, and increasing production profitability (Elevli and Elevli, 2010). The purpose of the study is to propose measures for improving the efficiency of the use of fixed assets of an enterprise. The methodological basis of the research work includes regulatory documents, publications of leading experts in periodicals, and textbooks by both domestic and foreign authors. It should be noted that the analysis of issues related to the management of fixed assets of an enterprise is an area extensively covered in the scientific literature.

The drilling process should be considered as a system that encompasses design, technology, and economics. The drilling efficiency is primarily determined by the parameters of the drilling rig, which is the leading and active element in this system. These parameters (design, technology, and economics) form a set of input and output variables for this system element. Given their significant number and varying degrees of influence of these parameters, the problem of optimizing them arises.

A review of the literature revealed that some authors consider the drilling process as a system that combines three elements: the bottom hole, drilling technology, and the drilling rig. These parameters form a set of input and output variables of a given system element. The leading and active element in this system is the drilling rig, the parameters of which largely determine drilling efficiency. Their number is significant and the degree of influence on efficiency varies. Taking this into account, the task of optimizing the number of drilling rigs is set (Shadrina, 2013).

Other authors explore the issues of determining the conditions and factors that influence the level of machine efficiency at the design stage, developing a methodology for assessing their impact and interaction (Sadykova, 2013).

Some previous studies have also focused on predicting the rate of penetration (ROP) at any given depth and the actual drilling time required to reach that depth (Hazbeh et al., 2021).

When developing a drilling program for new wells, it is advisable to use drilling data from previously drilled wells on the site. Literature contains models that suggest ROPs in future wells can be predicted by using the penetration rates, bit loads, rotation speeds, and formation properties of the pre-drilled wells (Håpnes, 2014).

Additionally, a review of the literature indicates that the theoretical and methodological aspects of technical and economic analysis of the efficiency of fixed assets in the oil and gas sector are insufficiently developed and require further research. This is particularly relevant for mechanism that manage the process of increasing the efficiency of these assets. Studying the procedure for calculating specific and general indicators of fixed assets utilization, as well as developing methods for their technical and economic analysis, is of great importance.

Model for determining the annual productivity of drilling equipment

The decline in oil prices on the global market requires oil exporting countries to carefully consider the efficiency of investment in the oil industry. As a result, a pressing issue has become the study of the production capacities accumulated over the years in oil-producing countries and the need for more efficient utilization of existing production capacities.

The production capacity of a drilling company is understood, first of all, as its ability to produce finished products or, in other words, the number of wells commissioned. The production capacity of drilling enterprises is the sum of the production capacities of drilling rigs operating under various production conditions.

Drilling wells for oil and gas production occurs in both offshore or onshore environments, at depths ranging from 1,000 to 6,500 m. For this reason, drilling rigs vary by type—floating, moving on the ground, or transportable parts—and differ in design, lifting capacity, and power.

Drilling enterprises also work on production and exploration wells under diverse conditions (sea, land), in different fields, and at different depths, using different methods. This diversity introduces information uncertainty, complicating calculations in production planning and often resulting in incorrect allocation of production plans across drilling departments. To improve the accuracy of planning tasks for drilling enterprises, it is necessary to take into account the design time frame for drilling wells, geological and technical drilling conditions (well depth, rock hardness, reservoir pressure, etc.), and the level of production organization (Mehtiyev and Tanriverdiyev, 2023). It is also essential to determine the type and number of drilling rigs correctly when planning tasks.

It should be noted that, depending on the specifics of production in drilling departments, field factors affecting the efficiency of using fixed production assets include drilling depth, rock hardness, the presence of zones that complicate drilling time, climatic conditions, etc. Among these factors drilling depth is especially significant. As drilling depth increases, more powerful equipment, high-strength drill pipes, stronger drill axles, etc. are required. On the other hand, as drilling depth increases, drilling speed tends to decrease, necessitating additional drilling crews and equipment.

Usually, when studying the influence of drilling depth on the utilization of fixed assets, the average increase in depth across drilling departments is considered. In our opinion, it would be more expedient to carry out this work at drilling intervals. Drilling speed and production fund indicators also significantly depend on well depth, all else being equal (Savash et al., 2019). Increased depth also complicates the organization of work of drilling departments and results in increased downtimes. With increasing depth, the time required for lifting and lowering operations and for repair works also increases, which reduces mechanical speed. Additionally, deeper wells increase demand for the active part of fixed assets, or more precisely for technical equipment.

Analysis of the time structure of equipment utilization makes it possible to determine the utilization level of calendar, routine and planned time, the causes of time loss, and also to identify backup sources for more complete equipment utilization.

Drilling time is recorded using the following time elements:

1. Productive time:
   - mechanical drilling;
   - opening and closing the instrument;
   - lifting and lowering the tool;
   - borehole wall expansion;
   - securing the borehole walls;
   - auxiliary works;
   - repair work.
2. Unproductive time:
   - accident relief work;
   - work to correct defective operations;
   - downtime due to organizational issues.

Drilling oil and gas wells is one of the most capital-intensive areas of the oil and gas industry. The main production assets include drilling rigs and equipment involved in technological operations. Their effective utilization, quantity, and technical level are key factors influencing the volume of work performed by a drilling enterprise (Batista et al., 2022).

The annual productivity of the existing drilling equipment of the enterprise, taking into account the labor intensity factor, can be calculated using the following empirical formula:

$$P_i(t) = Q_t K_c / N_t K_m K_{in} \quad (1)$$

where:

Q_t – production output of the *i*-th drilling department in year *t* [meters],

K_c – change in the average well depth in year t or the coefficient of equipment use intensity,

N_t – the actual st.-month indicator,

K_m – coefficient for equipment machine time utilization in year *t*,

K_{in} – determined by the ratio of productive drilling time to calendar drilling time, in year *t*.

We note that the multiplication of $N_t \cdot K_m \cdot K_{in}$ in formula (1) characterizes the machine-months corresponding to the actual working time of each piece of equipment. The coefficient of intensity of equipment utilization (K_c) in this formula represents the level of complexity of the drilling process with an increase in the depth of wells during the drilling process. The product $Q_t \cdot K_c$ (the brought value of the product) better characterizes the level of production.

The average change in depth, or labor intensity coefficient (K_c) is determined by the following rule (Musaev and Akhundov, 2015).

$$K_c = H_{av} / h_{av} \quad (2)$$

where:

H_{av} – average annual depth of wells drilled in the year under consideration (year *t*) [m],

h_{av} – minimum average annual depth of wells drilled during the period under review (2018–2023) [m].

The equipment usage intensity factor is determined as follows:

$$K_{in} = T_p / T_k \quad (3)$$

In this case, the calendar time (T_k) and productive time (T_p) of drilling should be taken from the annual reports of the drilling department. The productive time of a drilling rig is calculated by subtracting downtimes due to organizational issues, drilling accidents, and waste write-offs from its calendar month (Corrales et al., 2020).

Finally, the utilization rate of equipment machine time is determined by the following formula:

$$K_m = T_{mach} / T_p \quad (4)$$

where:

T_{mach} – estimated machine time of drilling equipment in year *t* [hours],

T_p – productive drilling time in year *t* [hours].

N_t in formula (1) – the actual “st.-month” indicator in the period under review is calculated according to the following rule:

$$N_t = T_k / 720 \quad (5)$$

Here T_k is the actual annual balance of calendar time in the period under consideration, in hours. Substituting the values from equations (3)–(5) into formula (1) yields, with the intensity of equipment use coefficient considered, the annual productivity of drilling equipment, which can be expressed by the following simplified formula:

$$P_t(t) = \frac{Q_t \cdot K_c}{\frac{T_k}{720} \cdot \frac{T_{mach}}{T_p} \cdot \frac{T_p}{T_k}} = 720 \frac{Q_i \cdot K_c}{T_{mach}} \tag{6}$$

Here, T_{mach}, the machine time of drilling equipment operating directly in the production process, can be determined by the following rule. A machine-month (st.-month) in drilling is a conventional unit of measurement for both the working and idle times of drilling rigs, equal to 720 machine-hours (or 30 machine-days).

Methodology for determining the estimated machine time of drilling equipment

It is known that the drilling process consists of several stages – technological operations. Some of these operations require all equipment, while others only use specific units (Carter-Journet et al., 2014). It should also be noted that the percentage of equipment participation in technological operations varies within the range $100 \geq T_{mach} \geq 0$. All drilling technological

Table 1. Participation of equipment in the sub-technological process [%]

Tabela 1. Udział urządzeń w procesie podtechnologicznym [%]

		Participation of sub-technological processes in the main technological process	Drawworks	Rotor	Power Swivel	Travelling system	Preventer	Drilling pump	Compressor
1	Mechanical drilling	100	100	100	100	100	–	100	20
2	Opening and closing the instrument	100	100	10	–	70	–	–	20
3	Lifting and lowering the tool	100	96	5	–	97	–	–	20
	– lifting an empty elevator	23	100	–	–	100	–	–	20
	– make-up of drill stand	10	100	–	–	100	–	–	20
	– candle descent	18	100	–	–	100	–	–	20
	– raising a candle	22	100	–	–	100	–	–	20
	– unscrewing the drill stand	5	100	100	–	100	–	–	20
	– installing a candle by the finger	5	10	–	–	50	–	–	20
	– lowering an empty elevator	17	100	–	–	100	–	–	20
4	Borehole wall expansion	100	100	91	90	100	–	90	20
	– barrel expansion	90	100	100	100	100	–	100	20
	– opening and closing the instrument	10	100	10	–	100	–	–	20
5	Securing the borehole walls	100	60	5	5	55	3	17	20
	– preparation for lowering the column	5	–	–	–	–	–	–	20
	– descent of the column	50	100	–	–	90	–	10	20
	– cementing the well	10	–	–	–	–	50	65	20
	– WCC (waiting time for cement hardening/setting)	25	–	–	–	–	–	–	20
	– lowering the drill string	5	100	–	–	90	–	–	20
	– opening the "shoe"	5	100	100	100	100	–	100	20
6	Auxiliary works	100	46	31	58	30	6	63	20
	– changing, assembling and disassembling drilling tools	13	80	45	–	–	–	–	20
	– descent-ascent operation	3	96	–	–	97	–	–	20
	– replacing the traveling rope	6	100	100	–	100	100	–	20
	– production of clay mud, chemical treatment of drilling mud during flushing	21	20	–	70	5	–	70	20
	– installation of equipment	2	5	–	–	–	–	–	20
	– geophysical studies	6	–	–	–	–	–	–	20
	– flushing	31	15	3	80	5	–	100	20
	– re-passing a drilled interval	18	100	100	100	100	–	100	20
7	Repair work	100	8	4	16	16	8	12	20
	– repair of the lifting part of drilling equipment	20	–	–	–	–	–	20	20
	– repair of mud pumps	80	10	5	20	20	–	10	20

processes and their sub-processes are summarized in Table 1 below, compiled based on the opinion of experts. The table shows the percentage participation of equipment in each process (from $100 \geq T_{mach} \geq 0$). The percentage participation in sub-technological processes of the main technological process is also provided.

For example:

Auxiliary work (100%) = change, assembly, and disassembly of drilling tools (13%) + hoisting operation (3%) + change of hoist rope (6%) + production of clay solution (21%) + installation of statutory equipment (2%) + field geophysical surveys (6%) + flushing (31%) + development (18%)

Using Table 1, it is possible to calculate the percentage participation of each equipment in the technological processes of the drilling process. For example, the total percentage of winch participation in auxiliary works will be as follows:

$$\text{Drawwork}_{\text{Auxiliary works}} = 13 \cdot 0.8 + 3 \cdot 0.96 + 6 \cdot 1 + 21 \cdot 0.2 + 2 \cdot 0.05 + 6 \cdot 0 + 31\ 0.15 + 18 \cdot 1 \approx 46$$

Using the same rule, the standard participation of equipment in drilling processes is calculated [in %], which is given in Table. 2.

Using Table 3 and the *Annual calendar drilling balance report* of the enterprise, it is possible to determine the estimated machine time of each drilling equipment at the enterprise level. It should be noted that calculations must be carried out on separate drilling equipment used at the drilling enterprise.

Solution of the problem

Let us carry out this calculation using the example of SOCAR (State Oil Company of the Azerbaijan Republic). Table 3 shows the calendar-time balance for 2017-2022 using the annual reports of the SOCAR drilling enterprise.

Table 2. Regulatory participation of equipment in technological processes
Tabela 2. Przewidywany udział urządzeń w procesach technologicznych

Drilling equipment	Technological processes [%]									
	mechanical drilling	opening and closing the instrument	lifting and lowering the tool	well expansion	securing the borehole walls	auxiliary works	repair work	work to eliminate complications	accident relief work	work to cancel defective work
Drawworks	60	60	96	60	60	46	8	51	51	51
Rotor	60	10	5	91	5	31	4	19	19	19
Power Swivel	60	–	–	90	5	58	16	34	34	34
Travelling system	60	70	97	60	55	30	16	43	43	43
Drilling pump	60	–	–	90	17	63	12	38	38	38
Compressor	20	20	20	20	20	20	20	20	20	20
Preventer	–	–	–	–	3	6	8	5	5	5

Table 3. Enterprise report *Annual calendar balance of the drilling process*
Tabela 3. Raport przedsiębiorstwa *Roczny bilans procesów wiercenia*

Year	Total calendar time	Productive time [hour]							Unproductive time [hour]			
		total	mechanical drilling	lifting and lowering the tool	securing the borehole walls	auxiliary works	repair work	work to elim. complicat.	total	accident relief work	work to cancel defective work	downtime due to organization
2018	50 673	37 499	12 269	4 123	4 597	13 024	3 486	0	13 174	0	0	13 174
2019	53 411	45 341	14 188	6 516	3 793	16 728	4 116	0	8 070	4 590	0	3 480
2020	96 079	83 847	24 750	11 064	12 071	28 568	6 520	874	12 232	5 778	0	6 454
2021	71 868	68 049	18 902	9 160	6 071	24 361	4 835	720	3 819	0	0	3 819
2022	19 761	18 690	6 595	1 296	5 693	4 282	823	0	1 071	0	0	1 071

For the enterprise in question (using Table 3), the estimated machine time for the drawworks in 2022 will be:

$$T_{draw} = 6595 + 1296 \cdot 0.96 + 5693 \cdot 0.60 + 4282 \cdot 0.47 + 823 \cdot 0.08 = 13333 \text{ hour}$$

Using the same rule as well as Tables 2 and 3, the estimated machine times for other drilling equipment were determined, with the results given in Table. 4.

Using Table 4 and formula (4), the coefficient of equipment machine time utilization is determined, which is given in Table 5.

Table 4. Estimated total machine times for equipment at the enterprise for 2017–2022

Tabela 4. Szacowany łączny czas pracy sprzętu maszynowego dla urządzeń wiertniczych w przedsiębiorstwie w latach 2017–2022

Drilling equipment	Years					
	2017	2018	2019	2020	2021	2022
Drawworks	33319	25385	33251	59510	45947	13333
Rotor	22028	16681	20927	36288	27611	8305
Drilling pump	28729	21673	27610	48110	36815	10360
Travelling system	30333	23261	30246	54595	41718	12400
Power Swivel	27475	20611	26300	45228	34554	9496
Compressor	9998	6899	9986	17925	13610	3738

Table 5. Coefficient of machine time utilization for drilling equipment in 2017–2022 by enterprise

Tabela 5. Współczynnik wykorzystania czasu pracy maszyn dla urządzeń wiertnicznych w latach 2017–2022 w przedsiębiorstwie

Drilling equipment	Years					
	2017	2018	2019	2020	2021	2022
Drawworks	0.698	0.677	0.733	0.710	0.675	0.713
Rotor	0.461	0.445	0.462	0.433	0.406	0.444
Drilling pump	0.602	0.578	0.609	0.574	0.541	0.554
Travelling system	0.636	0.620	0.667	0.651	0.613	0.663
Power Swivel	0.576	0.550	0.580	0.539	0.508	0.508
Compressor	0.209	0.185	0.220	0.213	0.200	0.200

The coefficient of utilization of machine time for drilling equipment varies depending on the type of equipment, its technical and technological indicators, working time and method of its operation (Lamjahdi et al., 2021). A higher machine time ratio of drilling equipment indicates that the equipment was used more efficiently to achieve the goal set in the drilling process and that its capabilities were well utilized in the production process. It is advisable to use this indicator when measuring the level of utilization of drilling equipment.

Using equation (2), we determine the coefficient of change in average depth (or labor intensity coefficient (K_c)). Using this coefficient, the brought value of the product ($Q_t \cdot K_c$) was calculated. The calculation results are shown in Table 6.

Table 6. Coefficient of change in average depth and the brought value of the product for the SOCAR drilling enterprise in 2017–2022

Tabela 6. Współczynnik zmiany średniej głębokości i wniesionej wartości produktu dla przedsiębiorstwa wiertniczego SOCAR w latach 2017–2022

Indicator name	Years					
	2017	2018	2019	2020	2021	2022
Volume of drilling work, Q_i [m]	32541	28025	30862	50558	47388	16736
Average depth of wells delivered to the customer [meters]	1215	1053	1484	1351	1401	797
Labor intensity coefficient, K_c	1.52	1.32	1.86	1.70	1.76	1.0
The brought value of the product, $Q_i \cdot K_c$ [m]	49462	36993	57403	85949	83403	16736

Using the indicators included in Tables 4 and 6, as well as formulas (6), it is possible to calculate the productivity of the drawworks for 2017–2022 at the SOCAR drilling enterprise. For example, the average monthly productivity for "drawworks" in 2022 was:

$$P_{draw}(2022) = 720 \cdot \frac{16736 \cdot 1.0}{13333} = 903.8 \text{ m / hour}$$

Using this rule, the productivity of the drawworks for the control under study was calculated, which is presented in Table 7. During the period under review, the ways of using new equipment, improving technologies, and organizing production and labor are reflected in changes in equipment productivity (Pintelon and Muchiri, 2008).

To determine the functional dependence of the number of drilling equipment on its productivity, we will place the indicators in Table 7 in a rectangular graphical system. As can

Table 7. Indicators of the number and productivity of drilling drawworks by year in 2017–2022

Tabela 7. Wskaźniki liczby i produktywności wyciągów wiertniczych wyciągowych dla poszczególnych lat w okresie 2017–2022

Drilling equipment	Years					
	2017	2018	2019	2020	2021	2022
Estimated annual number of winches during drilling (N)	70	52	69	125	95	26
Drawworks performance ($P_{draw}(t)$)	1069	1049	1243	1040	1306	904

be seen from the graph, the location of the points shows that the functional dependence we are looking for corresponds to a parabola. We use the least squares method to determine the parameters of this parabola. If we write the specified parameters into the function, then the function of the relationship between the number of drawworks and its productivity will be as follows:

$$Y = -0.08865x^2 + 15.412x + 536.8 \text{ here } x > 0 \quad (8)$$

The assigned "Calculated Values" align well with the actual Y values. This means that the specified functional relationship accurately represents the data. Figure 1 shows this function graphically.

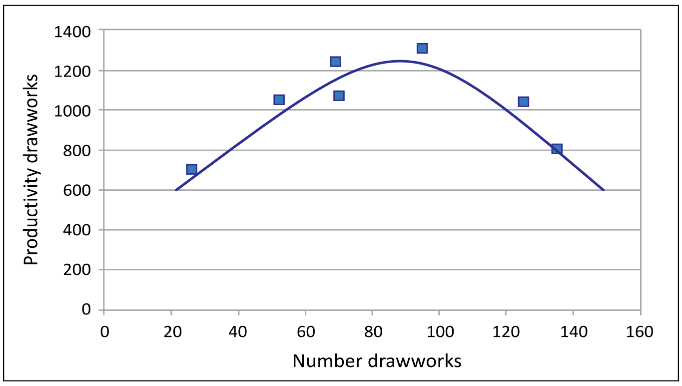

Figure 1. Functional relationship between the number and the productivity of drilling drawworks

Rysunek 1. Zależność funkcyjna między liczbą i wydajnością wyciągów wiertniczych

Since the function is parabolic, it has one local extremum (point S). The coordinates of this extremum are determined as follows:

$$Y_{eks} = -(b^2 - 4ac)/4a = 1207 \text{ m/st.-month}$$

$$X_{eks} = -b/2a = 87 \text{ st.-month}$$

where $X_{eks} = 87$ is the optimal estimated annual number of winches in production, at which its productivity reaches its maximum level ($Y_{eks} = 1207$). As can be seen in Figure 1, as the number of drawworks in production at the enterprise under consideration increases, its productivity first rises (BS), reaches a maximum point (S), and then begins to decrease.

Conclusions

The analysis showed that determining the need for oil engineering equipment in drilling and making economic decisions in this direction is largely related to the composition, structure, and improvement of equipment utilization. Proper use of drilling equipment affects productive time. The time balance analysis showed that a large proportion of non-productive time remains in drilling operations. It is known that as the depth of the well increases, so does labor intensity.

To address this issue, the research work studied the functional dependence of the number of drilling equipment on its productivity. As can be seen from the graph (Figure 1), the location of the points shows that the functional dependence we are looking for corresponds to a parabola.

As a result of increasing the amount of equipment at a drilling enterprise, a number of factors lead to an increase in its productivity, namely:

1. Conditions for full utilization of the enterprise's qualified personnel are established;
2. The available capabilities of logistics are fully utilized;
3. The existing capabilities of the subsidiary and auxiliary workshops of the drilling department are fully utilized;
4. The capacity of additional equipment serving production, etc. is fully utilized.

All these factors facilitate a gradual increase in drawworks productivity up to a certain number, resulting in maximum drawworks performance (point S). Beyond this point, an increase in the number of drawworks in mining operations leads to a decrease in its productivity (SD). This decline occurs because the potential capabilities of the enterprise are insufficient to support the existing number of drawworks. Thus, using this model, it is possible to determine the optimal amount of drilling equipment for drilling enterprises (based on the available production capabilities). In turn, it is advisable to apply this method when justifying production plans and forecasting the needs for drilling equipment and spare parts.

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