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# Ways of Performance Improvement in Petrochemical Enterprise

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## Abstract

The paper considers the problems of performance improvement in petrochemical enterprises. The possibilities of applying financial mathematics methods to assess the personnel efficiency are explored. The theoretical aspects of lean production which affect the growth of personnel efficiency are studied and practical measures for their implementation are developed. Economic calculations have been made and the change in sales revenue, net profit, net present value due to the introduction of elements of lean manufacturing in the petrochemical industry is assessed. Practical-oriented approaches to the differentiation of ways which determine the companies' performance and serve as the basis for management decisions are formulated.
**Keywords:** Economic efficiency; Analysis; Petrochemical industry; Lean production; Net profit; Net present value; Payback period.

## 1. Introduction

The current modern conditions of petrochemical companies' activities require new approaches to management because the efficiency of all resources is an important indicator of business competitiveness. The improvement of labour productivity and operating efficiency is one of priority tasks for the petrochemical enterprises. The ability of these companies to answer to market challenges depends on the fullfilment of this task.

The reasons of low labour productivity of work at the petrochemical enterprises at the level of a production process are the low oil recovery factor, mainly, caused by inadequacy of impact methods on pool, insufficient use of technology of hydraulic fracturing and inefficiency of drilling because of the low-quality used chisels, flushing solution and cement; and at the level of management is a lack of organizational improvements (Shishkina *et al.*, 2015; Zakharyan *et al.*, 2015). In this regard, the increasing number of the companies develop long-term strategies to increase the efficiency of work, take real measures for achievement goals, overcome pressure of external factors (Ike & Lee, 2014). The entities refuse obsolete management mechanisms, review the infrastructure and problem fields which slow down development, use the potential of digital technologies in management of production assets, that allow promptly to trace a situation and to make the weighed decisions (Sokolov and Sungatullina, 2015). All the efforts taken have significant impact on economic indicators of the entity's activities, determine its financial stability (Hartley and Medlock III, 2008; Yépez, 2017).

Thus, the implementation of new measures to improve performance will be followed by the analysis of profitability of new projects in connection with the increased company's general resources use effectiveness and in particular a manpower, and optimization of staff benefits ant. Besides that, a necessary condition is orientation on the basic principles of performance evaluation. It is consideration of technologies throughout all payback period; modeling of cash flows; and a multistaging of assessment at various stages of development and implementation of each measure (Sungatullina and Faizrahmanova, 2016).

## 2. Methods

In the context of the analysis of measure influence directed to improve the company's performance, the company profit growth assessment and executions of the normative times on reimbursement of measures expenses are significant. For efficiency analysis of measures with the long period of profit earning the following indicators can serve: Net Present Value (NPV); Profitability Index (PI); a Payback Period (PP) and the Discounted Payback Period (DPP).

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The estimation of the net present value can be on the basis of a formula:

$$NPV = \sum_{t=0}^{T} NCF_T (1+r)^{-1} \qquad (1)$$

where $NCF_T$ – Net Cash Flow;

r – discount rate;

T – duration of the project;

T – calculation step numbe

Profitability index can be defined by formula:

$$PI = \frac{NPV}{I_0} = \sum_{t=0}^{T} \frac{CF_t}{(1+r)^t} \qquad (2)$$

NPV – Net present value;

$I_0$ – initial investment;

$CF_t$ – cash flow;

r – discount rate;

T – duration of the project;

t – calculation step number.

The formula can be applied for estimation of the payback period reflecting the period of invested funds return and characterizing financial risk:

$$PP = T - \frac{\sum_{t=0}^{T} CF_t}{CF_{T+1}} \qquad (3)$$

where $\sum_{t=0}^{T} CF_t$ – cumulative net cash flows on the step previous to payback step;

$CF_{T+1}$ – cash flow of settlement period step, during which the moment of payback occurs;

T – duration of the project;

t – calculation step number.

When calculating a payback period (PP) it is necessary to remember that this indicator has a number of shortcomings: doesn't consider the discounted cost of cash; doesn't determine the size of cash flows after a payback point; value of an indicator at changeable cash flows is distorted. To even out the specified shortcomings it is possible to determine the discounted payback period by a formula:

$$DPP = T - \frac{\sum_{t=0}^{T} DCF_t}{DCF_{T+1}} \qquad (4)$$

где $\sum_{t=0}^{T} DCF_t$ – cumulative net discounted cash flows on the step previous to payback step;

$DCF_{T+1}$ – discounted cash flow of settlement period step, during which the moment of payback occurs;

T – duration of the project;

t – calculation step number.

Thus, the financial mathematics instruments allow to assess the size of cash which the company expects to receive from implementation of performance improving measures, to control profitability of these actions (Neizvestnaya and Mardanova, 2016; Shirai and Amano, 2017).

## 3. Results and Discussions

We research the methods of financial mathematics instruments use for efficiency analysis of implementation of performance improving measures on the example of one of the largest Russian petrochemical companies. The entity is the international and acknowledged vertically integrated holding in which industrial complex gas-and-oil production, petroleum refining and petrochemistry develop.

Results of studying of the best world practices of the oil companies show that the main measures to improve the personnel efficiency shall be aimed at efficiency of activities of each production site. In connection therewith, one of the basic directions in the researched oil company is the implementation of lean production instruments on trade objects allowing to formulate understanding that each worker can be directly involved in improvement of company activities. We consider the influence on the main indicators of company activities because of implementation of some elements of lean production during a year:

- tools of small-scale mechanization for decrease of labour content and enlargement of bypasses, and, therefore, improvement of personnel efficiency in oil extraction crews;

- the means of standardization and visualization directed to reducing unproductive time. It is the organizational economic factor exerting impact on a work gain in productivity.

Approximate calculation of the translation of all crews for oil and gas extraction of the petrochemical company structural division at the expense of small-scale mechanization shows that economy of costs will constitute 2 238 thousand rub. per year (without the cost accounting on equipment purchase). At the same time optimization of bypasses quantity releases three operators.

According to the second action development of eighty-five standard operational cards, the covering main transactions of the operator of oil and gas extraction, and also forming of stands for control of a well stock is supposed. Use of cards will increase informational content of workers that promotes reducing number of violations of industrial safety and labor protection for 9.3%, or on 0.12 violations per one object. Stands will allow to strengthen extent of wells control that will reduce the number of idle times of wells and will reduce oil losses.

The offered actions are sufficiently effective as the implementation of the first action will entail a personnel efficiency growth by 2,0706 thousand per person, the second action – by 2,0712 thousand per person. Besides, it is necessary to estimate how these actions will be reflected on the main economic indicators of structural division

activities of the petrochemical company. For this purpose, on the basis of the formulas used in financial mathematics we will calculate cost efficiency from improvement of personnel efficiency on each action (Djakupova, 2012)

Calculation results show the efficiency of implementation of this lean production element:
- annual economy of costs – 2 238 thousand rubles.
- a net profit in a year – 1 790 thousand rubles.
- the net present value (NPV) – 1 712 thousand rubles.
- the discounted payback period (DPP) – 0,3 months.
- profitability index (PI) – 5,0.

Let's make calculation of other action efficiency to improve efficiency of personnel - it is implementation of standardization and visualization means.

Let's determine costs for creation of standard operational cards and stands in the considered structural division of the petrochemical company:
1) the average monthly salary of one worker of industrial and production personnel – 37,410 thou. rub.;
2) the average size of the wage fund of this division in a year constitutes – 37,410 thou. rub. ×12 months =448,920 thou. rub.;
3) the average of the fulfilled working days in a year – 200 days;
4) the average duration of the working day – 8,2 hours;
5) the effective fund of working hours in a year constitutes – 200 days ×8,2 hour=1640 hours;
6) the hourly average salary of one worker of industrial and production personnel constitutes – 448,920 thou. rub. ×1000 / (1640 hours) =273 rub. per hour;
7) for creation of eighty-five standard operational cards it will be spent – 85×4×2=680 hour;
8) costs for creation of standard operational cards will constitute – 273×680=185,640 thou. rub.;
9) costs for forming of stands will constitute – 359,753 thou. rub.

Results of the executed calculation efficiency of implementation of this lean production instrument:
- sales proceeds in a year – 37 251 thou. rub.;
- a net profit in a year – 14 127 thou. rub.;
- the net present value – 13 025 thou. rub.;
- the discounted payback period – 0,3 months;
- profitability index – 1,754.

Summary assessment of performance indicators of actions for personnel efficiency improvement within lean production is presented in table 1.

**Table-1.** Summary assessment of indicators of efficiency measures to improve the personnel efficiency in petrochemical company structural division

| Indicator | The measure to improve the personnel efficiency within lean production | |
|---|---|---|
| | the implementation of small-scale mechanization and enlargement of bypasses tools | the implementation of standardization and visualization means |
| Costs change on implementation, ths. rub. | - | +545,4 |
| Change of annual saving costs, ths. rub. | +2238 | - |
| Change of proceeds of oil sales, ths. rub. | - | +37251 |
| Change of net profit, ths. rub. | +1790 | +14127 |
| Change of net present value (NPV), ths. rub. | +1712 | +13025 |
| Change of discounted payback period (DPP), months | +0,3 | +0,3 |
| Change of profitability index (PI) | +5,000 | +1,754 |

Comparison of performance indicators of actions for improvement of personnel efficiency shows that both actions give a notable net profit. Implementation of standardization and visualization means allows to increase significantly a net profit of petrochemical company structural division – by 14 127 thou. rub. Besides, in case of implementation of small-scale mechanization and enlargement of bypasses tools in one of structural division shops on oil and gas extraction, there are no costs for implementation and the index of profitability is 2.

The considered actions for improvement of personnel efficiency will have significant effect on the main indicators of the petrochemical company structural division activities, namely on increase in oil extraction, reducing idle times of wells. Comparison of the main technical and economic indicators before and after implementation of actions is given in table 2.

**Table-2.** Influence of actions for improvement of personnel efficiency on technical and economic indicators of the petrochemical company structural division

| Indicator | Unit | Before implementation | The measure to improve the personnel efficiency in the frame of lean production | | Change of indicators after implementation of measures |
| --- | --- | --- | --- | --- | --- |
| | | | the implementation of small-scale mechanization and enlargement of bypasses tools | the implementation of standardization and visualization means | |
| Change of labor productivity | mln. rub. per person | 20,983 | +21,024 | +21,039 | +21,080 |
| Change of oil production | ths. ton | 3333 | - | +5,219 | +5,219 |
| Change of number of staff | person | 1612 | -3 | - | - 3 |
| Change of proceeds of oil sales | mln. rub. | 33824, | +2,238 | +90,221 | +92,459 |
| Selling value of 1 ton of oil | rub. | 10149,6 | | | |

According to data of table 2 the greatest gain in productivity of work is observed in case of implementation of standardization and visualization means – for 0.27%. In case of implementation of small-scale mechanization and enlargement of bypasses tools the personnel efficiency will increase in one of crews of the oil and gas extraction shop of the petrochemical company structural division slightly below – for 0,19%. In total after implementation of both actions within lean production the growth in personnel efficiency will constitute 0.46%.

The considered actions will exert impact on the main technical and economic indicators of the petrochemical company structural division activities. So, oil production will increase only from implementation of standardization and visualization means as the number of idle times of wells will be reduced by 1.33% and losses of oil will decrease by 2.14% (14,3 tons per day or 5219,5 tons per year), and will constitute 3337,83 thou. tons. And the indicator of sales proceeds will increase from implementation of both actions. The total sales proceeds after implementation of actions for improvement of personnel efficiency will constitute 33917,1 million rubles (Chen and Hsieh, 2005).

# 4. Summary

The ways of increasing the efficiency of petrochemical companies, as studies show, should be oriented towards the evaluation of indicators characterizing the level of profitability of the project and an analysis of their impact on key performance indicators of the organization. Correctly chosen actions enable to reveal available reserves in the companies' activity of and to determine the ways of implementing the strategy at all stages of the enterprise's life cycle. This kind of interconnection is important for petrochemical enterprises, because the emerging changes in business, in business needs require the evolution of ways to increase staff efficiency to strengthen competitiveness and sustainable development (April Chang & Chun Huang, 2005).

Our research confirms the conclusions of the professionals. High labor productivity has a great importance for increase in production, sales proceeds and efficiency of financial and economic activities of the petrochemical companies.

# 5. Conclusions

Modern business conditions are aimed at applying various approaches to the forming of performance criteria, on the basis of which management decisions will be developed. One of that is comparison of activities results at different levels. At the first level the analysis of manpower use of the company in different aspects is performed: from the workers' point of view, from business and finance conditions, the company position in the external environment. At the second level the efficiency of receipt of total income and profit is evaluated as higher income level and profit provides companies financial stability. The specified approaches allow to differentiate implementable actions of the companies, to determine how analysis results will be transformed to real types of an action. It enables to attach a strategic importance to the success factors determining efficiency of companies functioning, to estimate extent of their influence and the developing tendencies in its change and importance.

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