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**IMPROVING IN THE MECHANISMS OF PROJECT COST MANAGEMENT:
GAS TURBINE MANUFACTURING ENTERPRISE**

The article deals with the improving mechanism of the cost management system of gas turbine manufacturing enterprise. The sources affect the effectiveness of project management are determined and their influence has been estimated. The authors propose the methods of project cost regulation. Here, the master schedule and milestone chart of brand new project of development and manufacturing of 32-35 MW engine at the Ukrainian Gas Turbine Research and Production Complex are shown.

Keywords: cost management, gas turbine manufacturing enterprise, project costs, time schedule of works, consolidated budget.

В статье рассмотрены механизмы совершенствования системы управления стоимостью проектов на примере газотурбостроительного предприятия. Определены факторы, влияющие на эффективность управления проектами, и осуществлена оценка их влияния. Показаны методы регулирования стоимости проекта в рамках его реализации. Приведен календарный план-график новой отечественной разработки научно-производственного комплекса газотурбостроения «Зоря»-«Машипроект» – двигателя мощностью 32-35 МВт.

Ключевые слова: управление стоимостью, газотурбостроительное предприятие, стоимость проекта, календарный план, консолидированный бюджет.

У статті пропонуються механізми вдосконалення системи управління вартістю проектів на прикладі газотурбобудівельного підприємства. Визначено фактори, які впливають на ефективність управління проектами, та здійснено оцінку їх впливу. Показані методи регулювання вартості проекту в рамках його реалізації. Наведено календарний план-графік нової вітчизняної розробки науково-виробничого комплексу газотурбобудування «Зоря»-«Машипроект» – двигуна потужністю 32-35 МВт.

Ключові слова: управління вартістю, газотурбобудівельне підприємство, вартість проекту, календарний план, консолідований бюджет.

Introduction. The management system of gas turbine manufacturing enterprise belongs to the matrix-type organizational structure. Its characteristic features are a high degree of uncertainty in planning and time implementation of the projects. The existing methods of project estimation do not always pro-

vide the timeliness and authenticity of information for decision-makers. Also, the financial indexes are reported out of time when the chance to affect them is lost. At the same time, operating efficiency of the separate departments involved in the project of development, manufacturing, and repairing of gas turbines typically is not estimated.

As the final result, the enterprise's management faces the signs of unmanageability, such as: a significant quantity of facilities is untimely commissioned and the cost of the project exceeds the planned one. In these conditions management of project and program is in need of improvements through the development and implementation of the effective management approaches. Cost management is a key element of management system of gas turbine manufacturing enterprise. It links management of recourses, duration of works, qua-lity, risk, procurement, etc.

The goal of the article is to improve the mechanisms of cost management of projects implemented by the gas turbine manufacturing enterprises to insure their competitive ability and investment potential.

Basic material. Zorya-Mashproekt Gas Turbine Research and Production Complex is one of the world's leading companies in the field of gas turbine development and production.

Now Zorya-Mashproekt is a union of powerful block of metalworking workshops, advanced metallurgical technology, high-accuracy assembling workshop, complex of numerous test stations, and highly professional design engineer teams.

During the period of 61 years the Enterprise has developed and mastered manufacturing of four generations of gas turbine engines rated from 2.5 to 110 MW and tens of gearboxes with power up to 70 MW. About 4000 industrial engines and thousands of gearboxes have been manufactured and shipped.

More than 500 vessels are equipped with Zorya Mashproekt's marine propulsion units.

More than 150 compressor stations from 20 countries are equipped with turbines and about 60 power plants are shipped to Russia, Ukraine, Kazakhstan, Republic of Belarus, Czech Republic, Canada, Azerbaijan, Iran, Turkmenistan, Uzbekistan and other countries.

Total power of gas turbines is more than 50 million kW. Full operating time of gas turbines is more than 90 million hours.

Recently, the Enterprise has shipped marine propulsion plants for Navy of India, Greece, Russia, China, Vietnam, USA, and other countries.

Over 30 years engines have been used as drivers for gas pumping units. From 2010 to 2011 we made a technological advance in power sector of industry.

Nikolaev's company has taken part in the international power plant construction project in Ghana (West Africa).

Under completion of contract signed with Mapna Company, Iran, we started the engines shipment.

A unique project was realized for European Silicone Company, Poland. Zorya-Mashproekt signed the contract with Sinopec Corporation (China).

Zorya-Mashproekt negotiated with Petro Bras, the largest oil and gas Company of Brazil.

Project cost management is an important process which is used to ensure that the project will be completed within the approved budget.

Thus, the development of project cost mechanisms based on the modern information processing technology is an issue for improving of management system of gas turbine manufacturing enterprise.

There are several cost estimation methods such as follows:

- expert assessment;
- analog procedure;
- parametric assessment;
- bottom-up estimating;
- project evaluation and review technique;
- quantitative analysis.

The PMBOK Guide presents the estimation methods of project cost which can be implemented at the knowledge-based gas turbine manufacturing enterprise.

The following methods are also employed for project cost estimation:

- net value (NV);
- net present value (NPV);
- internal rate of return (IRR);
- payback period (PP).

Today, the specialists involved in the gas turbine manufacturing projects specify the estimated costs as a union of calculation of the scheduled work for design, manufacturing and repair of gas turbine engine.

These calculations are conducted on the base of accounting sheets, typical work price lists, and other running standards. The estimated costs are a base for contract pricing which terms are specified by the work scope and technical capabilities of enterprise.

The accounting sheets set the work value according to the price list, and thus market value of turbine manufacturing work is formed.

A project cost regulation is the packages of measures or operations applied by the project team for project implementation within the terms and planned budget limits.

Features of manufacturing process of gas turbine manufacturing enterprise determine the factors affect both separate work costs and the project cost of gas turbine building. These factors can be divided into external and internal groups.

The external factors of cost changing do not depend on enterprise's activity otherwise the internal factors are governed by the features of production system.

Long-lasting cycles of project implementation for gas turbine manufacturing or repairing increase the risk of cost changing in the whole range of project elements (raw materials, supplies, constituent parts, involved outside funds, counterparty monitoring).

The changes in regulatory framework (rate of transportation and public utility services, level of taxes and fees) result in adjustments of project plan costs. If the customers break the payment schedule the enterprise's managers engage unplanned borrowed assets or internal financing.

Changing in resource cost of local markets of labor, raw materials, and money can also affect the project cost.

Upgrade of manufacturing equipment and assimilation of innovative technology lead to the decrease of labor costs that in turn pulls material consumption rates lower.

Besides, a large scope of unforeseen works arises while gas turbine is being repaired and they are not placed in the defect lists. The unforeseen works cause the baseline changing in work costs and scope. The rectification of raw materials of inadequate quality or poorly executed work increases the cost parameters of project.

Therefore, the adjustment of cost includes the following items:

- determination of project implementation stage conducted in accordance with the cost indicator (it is carried out by analysis of the actual costs and the estimated cost of performed works);
- analysis of factors that influences on the positive and negative deviations;
- preparation and analysis of baseline project adjustments;
- implementation of adjustments;
- forecasting parameters of work scope towards project completion.

Models and methods for the development of budget system elements, their consolidation into the budgets of different levels of hierarchy with provision for the production features of gas turbine manufacturing enterprise are the base of costs regulation mechanism.

At the level of project planning the cost estimating of all needed resources with provision for risks is a key technique. The authors have developed the model of cost management of gas turbine manufacturing project.

Analysis of project data provides an overall assessment of project progress at the current date. Besides, analysis allows making a reasonable forecast of the work cost at the next levels.

Completed work scope and actual cost of performed work are defined in the integrated system of accounting and the main sources of information are the basic accounting documents.

If agreed values of actual cost parameter deviate from the planned ones this requires changing in the baseline indicators and the preparation of regulatory actions is carried out.

Involving of the additional financial resources, as a part of regulatory actions, is applied when the majority of factors influence on the project implementation apart from the factors which decrease clearly the scope of the needed resources in comparison with the planned ones.

The project budget and project schedule are used as the source of information for planning of project expenses. Every time period of project has own cost of works and these works should be completed within schedule and budget. Figure 1 depicts the process of development and manufacturing of 32-35 MW gas turbine engine on the time schedule-basis.

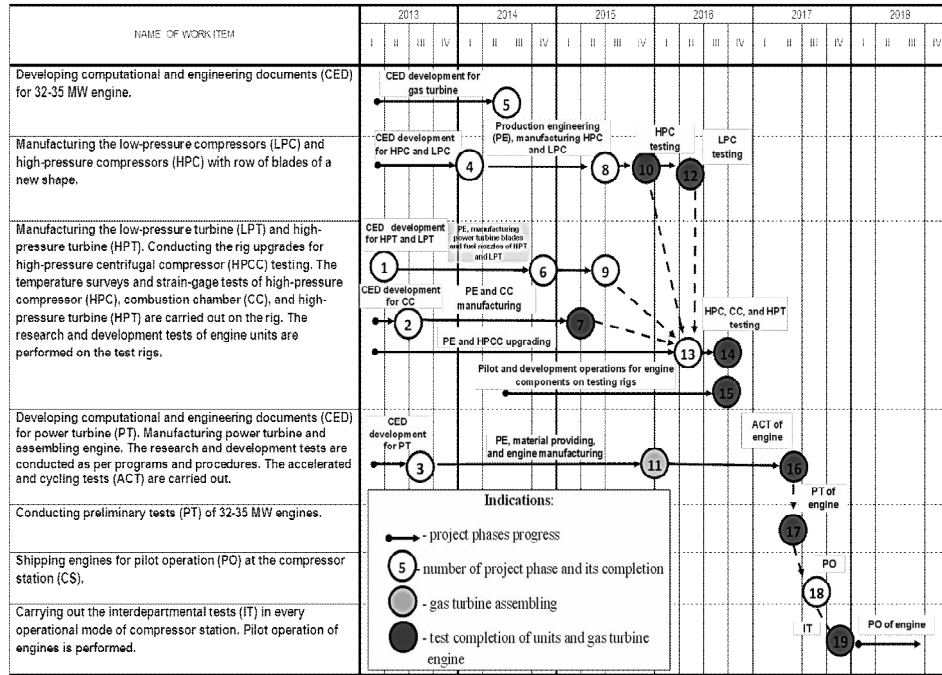


Fig. 1. Master schedule and milestone chart of 32-35 MW engine development and manufacturing at Zorya-Mashproekt

The master schedule consists from the following phases:

1. Developing computational and engineering documents (CED) for 32-35 MW engine.

2. Manufacturing the low-pressure (LPC) and high-pressure compressors (HPC) with the blade row of a new shape.

3. Manufacturing the low-pressure (LPT) and high-pressure turbines (HPT). Conducting the rig upgrades for high-pressure centrifugal compressor (HPCC) testing. The temperature surveys and strain-gage tests for high-pressure compressor (HPC), combustion chamber (CC), and high-pressure turbine (HPT) are carried out on the rig. The pilot and development works of engine units are performed on the test rigs.

4. Developing computational and engineering documents (CED) for power turbine (PT). Manufacturing power turbine and assembling engine. The research and development tests are conducted as per programs and procedures. The accelerated and cycling tests (ACT) are carried out.

5. Conducting preliminary tests (PT) of 32-35MW engines.

6. Shipping engines for pilot operation (PO) at the compressor station (CS).

7. Carrying out the interdepartmental tests (IT) in every operational mode of compressor station. Pilot operation of engines is performed.

The every phase has own budget or several budgets. The consolidated budget of the project for development and manufacturing 32-35 MW engine consists from the phase budgets. The contract cost of engine and cost estimating documentation result in the project cost estimation.

Conclusion. In the present study we proposed the model of cost management at the levels of departments and workshops of enterprise. The developed model is used as a foundation for the corresponded informational system.

Proposed mechanisms for cost management are the base for the development of the tools of project management gas turbine manufacturing enterprises.

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