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# Budget Financing Of Investment Projects At The High-Technology Industry Enterprises: Project Implementation Technology And Risk Mitigation

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***Abstract*: As a rule, large-scale investment projects in high-tech industries are implemented with the participation of the state. The procedure and terms of coordination of the budget financing volumes and forms take a considerable amount of time (sometimes up to two years), and its results, when approved, are not subject to review. During this time, the baseline data on the project undergo changes leading to an increase in its value, thereby increasing the risks of successful project implementation. Thus, the company needs to secure additional financing at its own expense in order to eliminate negative consequences by increasing the project value. This situation can be resolved by using a redundancy mechanism that allows an enterprise to gradually accumulate funds to cover the increasing project costs. The availability of the reserve fund increases the sustainability of the project in terms of the dynamic external environment and leads to the mitigation of risks in its implementation.***

***Index Terms*: budget financing, investment project, reservation of funds, risk management.***

## I. INTRODUCTION

Analysis of the state of high-technology industry enterprises shows that their development is hampered by slow improvement in the structure of production and export, and a fairly high physical and moral depreciation of fixed production assets due to the low investment and innovation activity. These problems may be solved by a sustainable investment policy implemented in the form of capital investments, which will increase the production efficiency [1].

As is commonly known, in such enterprises, many large investment projects (IP) are financed by budgetary funds, which entails greater responsibility for the use thereof. Consequently, there is the need for the most complete and reliable assessment of the IP, which should include careful marketing, strategic management, and forecasting of the industry's capabilities in the long term in an uncertain environment based on the principles of a systems approach and program planning. This will allow the enterprise avoiding many mistakes in the IP implementation, and increasing the efficiency of implementation thereof.

The procedure for preparing IPs financed from the budget, currently in force, has several shortcomings, one of which is the long preparation period (more than two years from the decision to prepare and implement budget investments).

Another issue in the preparation of project documentation and the IP implementation is the project value, which is embedded in the project documentation in rubles, based on specific commercial proposals at the very beginning of approval thereof, and is not subject to change. This means that all possible risks are not taken into account at the approval stage, thereby leading to an increase in the investment project value by the time of implementation thereof by about 20 %, which must be financed at the expense of the company's funds. Of course, this is reflected in the project effectiveness, leading to the need to identify sources of additional funding. Thus, the issue of improving both the procedure for the project data approval and the refinement of the methodological guidelines to assess and mitigate the risks of such investment projects becomes urgent [2].

The IP risk level is the difference between the most probable and pessimistic value of the NPV criterion of investments. If the project instability is identified, it is recommended to make adjustments to the organizational and economic mechanism for implementation thereof as follows [3]:

–To change the size or terms of provision of budget funds;

–To provide for the creation of the necessary cash reserves from the deductions to a special fund;

–Where necessary, to provide for the transactions hedging or indexation of the prices for the goods and services supplied; and

To provide for the insurance of the project participants for certain insurance events.

## II. METHODS

### A. Block Diagram

In general, all methods of the investment projects risk management can be divided into dynamic (active) and static (passive) ones.

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Risks can be managed dynamically at the stage of the investment project implementation. Hedging involves the use of futures and forward contracts, as well as CALL and PUT options. Financial engineering allows managing the economic environment risks based on currency and interest rate swaps. However, static risk management methods are of the greatest practical interest, since they can be applied at the project development stage. Project risks can be minimized with the greatest efficiency by reserving money to cover cash deficiencies in case of unforeseen expenses and losses. Most often, the reservation is considered as a one-time action designed to reduce the consequences of a possible adverse event during the entire project implementation period, or the execution of any works [4]-[7].

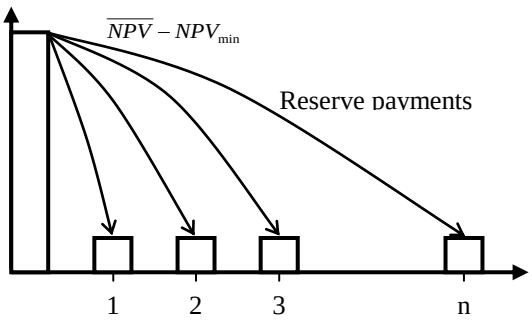


**Fig. 1. Calculation Of Reserve Payments**

"Insurance" expenses or "reserve" payments can be calculated based on the difference between the pessimistic NPV and the base NPV of the project. For this purpose, the absolute measure of risk is presented in the form of the current value of ordinary rent with monthly "reserve" payments.

It is possible to record this as follows:

$$Reserve\ costs = \frac{\left(\overline{NPV} - NPV_{min}\right)\frac{r}{12}\left(1+\frac{r}{12}\right)^{n}}{\left(1+\frac{r}{12}\right)^{n} - 1} \quad (1)$$

where $n$ is the number of IP months;

$r$ is the rate of contributions to the reserve fund.

Reserve payments are made at the expense of own funds of the project-initiating enterprise.

Upon investments, the losses from the risks may turn out to be lower than those planned in the reserve payments, in which case the borrowed funds of an enterprise can be repaid ahead of the schedule to increase the efficiency of financial activity by reducing the interest payments.

### B. Algorithm

When using the proposed method of ensuring IP sustainability, it is recommended:

– To use moderately pessimistic forecasts of the project's technical and economic parameters, prices, tax rates, currency exchange rates and other parameters of the project's economic environment;

– To increase the discount rate by the risk adjustment amount.

When these conditions are met, the investment project is considered sustainable in general if it has sufficiently high values of integral performance indicators.

## III. RESULTS

Let us consider the use of this technique based on the following example.

The investment project object is an infrastructure facility that provides operating media for all production and test units of the enterprise: low, high and ultra-high-pressure gases (8 ÷ 700 kgf/cm$^2$) with the required parameters for consumption, purity and humidity (air, nitrogen), technical water and fine-cleaned water.

The main part of the engineering equipment located in the production premises of the facility is obsolete, physically worn out, extremely unrepairable, does not provide passport productivity, stable quality of working environments, and is a risk factor from the point of view of industrial safety.

The infrastructure facility providing operating media was not reconstructed. Technical re-equipment was reduced to single replacements of obsolete, physically worn and extremely nonrepairable compressor and energy systems.

The main scope of the investment project is the modernization of the existing facility to ensure the generation, storage, and transportation of operating media of a guaranteed quality and volume for the implementation of the tasks set by Customers at a modern technical level, with the necessary quantitative indicators and at a stated time.

The estimated value of the investment project is RUB 323.77 mln based on the prices of 2018 (including the budget of RUB 186.1 mln).

The reconstructed and technically redeveloped area is 4,490 sq.m., and the construction volume is 26,750 m$^3$.

The investment project provides for the following technological structure of CAPEX:

Construction and installation works – RUB 103.97 mln;

Purchase of equipment – RUB 148.1 mln; and

Other expenses – RUB 71.7 mln.

The project provides for the replacement of obsolete, physically worn and extremely nonrepairable equipment and the purchase of new modern equipment.

The unit cost of one square meter of the reconstructed and technically re-equipped area is RUB 0.075 mln/m$^2$.

The estimated timing of the investment project is 2020 – 2030.

For the project under consideration, the lifetime is determined based on the useful life of the purchased equipment, therefore, cash flows should be planned for 10 years. Depreciation is charged on a straight-line basis since the use of the linear method is stated in the company's accounting policies for tax purposes. The investment schedule is presented in Table I.

**Table I. Characteristics Of The Investment Project Financing**

| Item No. | Cost direction | U.M. | Volume of financing: total/*own funds*/***budgetary funds*** | | |
|---|---|---|---|---|---|
| | | | **2020** | **2021** | **2022** |
| 1 | Volume of investments (total), including: | RUB. mln | 108.52 | 91.90 | 123.35 |
| | | | *48.12* | *36.1* | *53.45* |
| | | | ***60.4*** | ***55.8*** | ***69.9*** |

The investment project implementation results in the

reduction of material and labor costs. Savings amounts make up the revenue of the investment project. Project cash flows and investment performance indicators are shown in Table II. The calculation is provided without taking into account the inflation factor.

The real discount rate is 9.32 %; the expected annual rate of inflation according to the forecasts of the Ministry of Economic Development will remain at 4.3 %.

The feature of budget financing is that the amounts of funds received from the state budget, approved at the initial stage of the analysis, are not subject to further adjustment. Accounting for the inflation factor in the cash flows of the project leads to a significant decrease in the efficiency thereof. Net present value falls from RUB 18,196.98 mln to RUB 11,367 mln. This is because all revenues and expenses of the project, except for the funds from the budget, are subject to inflationary adjustment. The discount rate is accepted at the level of 14 %. The calculation is provided in Table III.

Further IP risk analysis implies consideration of pessimistic and optimistic scenarios. In the pessimistic scenario, project costs may increase not only due to inflation but also due to other disturbing factors. Let us suppose that the maximum investment can grow by 4 %. In this case, the project's net present value becomes negative and amounts to RUB -467 mln.

**Table II. Project Efficiency Without Taking Inflation Into Account**

| Year | | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual discount rate (% | 9.30 % | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Cash flow from investment activity | RUB mln | -108,520 | -91,901 | -123,350 | | | | | | | | |
| Cash flow from operating activity | RUB mln | 17,190.00 | 24,182.00 | 35,647.00 | 18,570.00 | 18,379.00 | 15,941.00 | 15,635.00 | 15,641.00 | 15,360.00 | 15,375.00 | 13,639.00 |
| Earmark funds | RUB mln | 60,400.00 | 55,800.00 | 69,900.00 | | | | | | | | |
| Net cash flow | RUB mln | -30,930.00 | -11,919.00 | -17,803.00 | 18,570.00 | 18,379.00 | 15,941.00 | 15,635.00 | 15,641.00 | 15,360.00 | 15,375.00 | 13,639.00 |
| Cumulative cash flow | RUB mln | -30,930.00 | -42,849.00 | -60,652.00 | -42,082.00 | -23,703.00 | -7,762.00 | 7,873.00 | 23,514.00 | 38,874.00 | 54,249.00 | 67,888.00 |
| Discounted cash flow | RUB mln | | -30,930.00 | -10,904.85 | -14,902.29 | 14,221.70 | 12,877.79 | 10,219.15 | 9,170.16 | 8,393.12 | 7,541.02 | 6,906.11 |
| Discounted cumulative cash flow | RUB mln | -30,930.00 | -41,834.85 | -56,737.13 | -42,515.44 | -29,637.65 | -19,418.50 | -10,248.34 | -1,855.22 | 5,685.80 | 12,591.91 | 12,591.91 |
| Simple payback period (years) | 5.5 | | | | | | | | | | | |
| Net present value - NPV (RUB mln) | 18,196.98 | | | | | | | | | | | |
| Internal rate of return -IRR (%) | 15.55 % | | | | | | | | | | | |
| Discounted payback period (years) | 7.22 | | | | | | | | | | | |

**Table III. Project Efficiency Taking Inflation Into Account**

| Year | | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual discount rate (%) | 14 % | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Annual inflation (%) | 4.30 % | | | | | | | | | | | |
| Cash flow from investment activity | RUB mln | -108,520.00 | -95,852.74 | -134,186.17 | | | | | | | | |
| Cash flow from operating activity | RUB mln | 17,190.00 | 25,221.83 | 38,778.55 | 21,070.01 | 21,749.99 | 19,676.01 | 20,128.14 | 21,001.71 | 21,511.25 | 22,458.15 | 20,779.05 |
| Earmark funds | RUB mln | 60,400.00 | 55,800.00 | 69,900.00 | | | | | | | | |
| Net cash flow | RUB mln | -30,930.00 | -14,830.92 | -25,507.62 | 21,070.01 | 21,749.99 | 19,676.01 | 20,128.14 | 21,001.71 | 21,511.25 | 22,458.15 | 20,779.05 |
| Cumulative cash flow | RUB mln | -30,930.00 | -45,760.92 | -71,268.54 | -50,198.52 | -28,448.53 | -8,772.52 | 11,355.63 | 32,357.34 | 53,868.59 | 76,326.73 | 97,105.78 |
| Discounted cash flow | RUB mln | -30,930.00 | -13,009.58 | -19,627.29 | 14,221.66 | 12,877.74 | 10,219.10 | 9,170.11 | 8,393.07 | 7,540.96 | 6,906.06 | 5,605.02 |
| Discounted cumulative cash flow | RUB mln | -30,930.00 | -43,939.58 | -63,566.86 | -49,345.20 | -36,467.46 | -26,248.36 | -17,078.24 | -8,685.18 | -1,144.21 | 5,761.85 | 11,366.86 |
| Simple payback period (years) | 5.4 | | | | | | | | | | | |
| Net present value - NPV (RUB mln) | 11,366.86 | | | | | | | | | | | |
| Internal rate of return -IRR (%) | 17.85 % | | | | | | | | | | | |
| Discounted payback period (years) | 8.16 | | | | | | | | | | | |

The optimistic scenario is based on the fact that the project costs will fall by 2 %, and the revenues will grow by 3 %. In this case, the net present value of the project will be RUB 21,606 mln.

The quantitative indicators of the risk of an investment project indicate that the project is quite risky. The losses on the project may amount to RUB 467 mln. Calculation of risk indicators is given in Table IV.

**Table IV. Project Risk Indicators Before The Formation Of The Reserve Fund**

| Scenario | Units of measurement | NPV | Probability |
|---|---|---|---|
| Pessimistic | RUB mln | -467 | 0.3 |
| Most probable | RUB mln | 11,367 | 0.5 |
| Optimistic | RUB mln | 21,606 | 0.2 |
| Mathematical expectation (ENPV) | RUB mln | 9,864.6 | 9,864.6 |
| Standard deviation σ | RUB mln | 15,711.8 | |
| Variation coefficient CV | | 1.5927 | |

In order to mitigate the risk of the project, a reserve fund must be formed, the value of which is calculated by the formula (1). The fund in this project is RUB 11,834 mln. Formation of the fund involves annual additional costs of RUB 1,925.93 mln. The calculations assume that the rate on deposits is 10 % per annum.

The calculation of risk indicators in the reserve fund formation at the expense of the annual reserve of RUB 1,925.93 mln are presented in Table V.

**Table V. Project Risk Indicators At The Formation Of The Reserve Fund**

| Scenario | Units of measurement | NPV | Probability |
|---|---|---|---|
| Pessimistic | RUB mln | 1,321 | 0.3 |
| Most probable | RUB mln | 11,367 | 0.5 |
| Optimistic | RUB mln | 21,606 | 0.2 |
| Mathematical expectation (ENPV) | RUB mln | 10,401 | 10,401 |
| Standard deviation σ | RUB mln | 14,454.5 | |
| Variation coefficient CV | | 1.3897 | |

Even in the worst-case scenario (pessimistic), the NPV of the project remains positive and amounts to RUB 1,321 mln. The expected value of the net income for the project is increased, and the risk indicators Ϭ and CV are mitigated.

## IV. CONCLUSION

Thus, risk analysis and further insurance thereof by reserving money allow avoiding losses in implementing an investment project, covering cash deficiencies without resorting to additional lending at an increased interest rate, and increasing the expected project income from RUB 9,864.6 to 10,401 mln. At the same time, the reliability of the estimated IP business-plan significantly increases. The proposed model based on the consideration of a moderately pessimistic development scenario allows optimizing cash flows taking into account the economic environment risks and assessing the real effectiveness of an investment project.

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