Specifics of Project Management on Industrial Innovation

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Abstract: The paper offers a scientific and methodological approach to assessing the efficiency of innovative projects which develops and supplements the theoretical bases of innovative projects analysis through the accounting of recursive dependence of investments on such factors of innovative process as (1) the constructive complexity of the product, (2) the number of stages of the innovative process and (3) the innovative capacity of the enterprise. It is also proposed to enter an adjustment factor (multiplier) to reflect the causal connection between the net present value of innovative projects and the abovementioned factors of innovative process and to improve the accuracy of calculation of cash flows under the project linking the assessments with the certain stages of the project and the corporate capacity. This will reduce the overall integral risk of project implementation for potential investors. The author's concept and the system of models for planning the production and innovations allow revealing quantitative correlation between investments, innovations, and sources of financing and can be used for a reasoned strategic decision making by enterprises implementing innovative development model.

1 INTRODUCTION

Global industrial development demonstrates the strengthening role of innovative production in mature economies. Innovations become the key factor of competitive capacity [4]. Taking into account the increasing backlog of our industry from many other countries we need an intensive and scientifically grounded systemic modernization of the national economy. The economic growth through oil and gas industry is at the limit, and the oil prices no longer determine the dynamics of GDP growth.

The transition of Russian economy to the innovative path of development occurs under the lack of theoretical elaboration and the violation of principles of systemic approach. In particular, the program documents do not provide a clear description of the mechanism and concept of «material media» of innovative industrial transformations. They address side issues like intellectual property rights, venture funds, the support for young scientists and some others which are important but do not help solving the core problem of organization of mass knowledge-intensive production [3][9].

One of the vital problems in managing a modern corporation is the construction of its economics in the line of innovative production. The science lacks the methodological substantiation of the concept of building the innovative economy. Therefore, there is a need of formation of theoretical and methodological foundations for the organization and management of modern innovation-oriented corporations in Russia.

Methodological aspects of this problem are reflected in the works on instrumental methods of research, i.e., on the assessment of innovative potential, the economic and mathematical modelling of innovation planning [1][2][5][6]. Still, there is no clear understanding that large industrial companies are the core of development strategies. Not enough attention is paid to the problem of efficiency of innovations from the point of coordination of production and innovation processes in an industrial enterprise. Methods of corporate modelling require clarification and development to become the efficient planning tools.

2 METHODOLOGY

Production program is the most important element of corporate planning. At that, this task allows rather clear formalization and application of programming tools of decision-making. A production program stipulates optimum availability of resources and calculates all the technical, economic, and financial indicators and parameters. However, production planning is much more complicated for an enterprise which competitive capacity is based on innovations and constant launch of new products. The authors take as a premise that (1) production plans should include the planning of innovations and investments in innovations; (2) assessment of investment efficiency requires a simultaneous and coordinated forecast of cash flows from all activities; and (3) the production planning shall be a long-term prospective forecast.

The research of production structures with innovative potential that allows covering all the stages of innovation process on the basis of constant renewal of products and receiving the rent during a long period of time methodologically relies on the introduced notion of innovation-oriented corporation. This notion summarizes and systemizes those variants of defining the enterprises oriented on innovations which are most popular in scientific literature.

3 CORPORATION AND THE ECONOMIC MECHANISM OF ITS SUSTAINABLE DEVELOPMENT

At the end of XX - beginning of XXI century, the leading industrial corporations underwent a large-scale reconstruction following the new paradigm of organization of business and competition: a modern enterprise is a multilayer structure that integrates in time and space the flows of resources which evolve at a different speed. At that, the category of «resource» is significantly expanding and is supplemented with the notions of «key competences», «dynamic abilities», and «routines» [8][10].

Such corporations successfully combine the tactical and strategical aspects of their activity. What is the foundation for the economics of a leading western or Japanese company? It definitely possesses enough assets, the technology relevant to the industry development level, the R&D facilities, the market share and cost structure that ensure balanced production of goods and innovations with a pre-set standard return on assets.

Our hypothesis is that such an innovation-oriented corporation shall follow certain functional relations between key parameters such as equity, output and sales, production and innovation costs, return on investment (ROI), and etc. Speaking about innovations, we have to understand how they are financed, how the strategic stability is ensured, and how the balance between the initial costs and return is reached.

Our study and research are focused on the following concept: speaking about innovations, we see the main outcome in the form of cash income. ROI is the return on capital: intellectual, technical, and managerial. How this capital shall work in a corporation?

A competitive production of a modern corporation consists of the processes of production (operations) and innovations. Operational process means solving of current tasks of production and sales of products. It is the source of financial resources for all forms of investments including innovations. The process of innovations solves the prospective tasks for future production (transfer of competition from the sphere of production to the sphere of innovations). The processes of operations and innovations have a sequential and parallel logic of interaction and can be formally presented as a set of life cycles. Consequently, a modern corporation has certain proportions between the processes of operations and innovations which shall be reflected in the production plan.

A company invests in both processes, operations and innovations, but it looks like the added value is generated only by the capital invested in operations. In fact, in innovation-oriented companies the investments in innovation provide added value with a certain time delay. Taking into account the probabilistic nature of this process, we have to mention that this is the most complicated task of corporate planning of innovations.

4 MODEL OF PLANNING OF NEW PRODUCTS IN CONDITIONS OF CONSTANT INVESTMENT IN INNOVATIONS

We offer a concept of Operations and Innovations Program (OIP) as a unified and balanced in the selected time interval plan of production and sales of

products and innovative works on the preparation of production of promising products substituting phase out products. The main task of such a program is in the synthesis of models of innovative and production processes in a way ensuring rational combination of limited resources for production of goods and innovations with an increase or, at least, the maintenance of competitive capacity in the strategic perspective.

For this purpose, such planning shall resolve the following tasks:

- Preparation of an optimum production plan taking into account the demand, the available resources, and the development strategies;
- Definition of suitable investment funding strategies and the assessment of return in the form of rent and profit;
- Definition of time of the launch of new products and the withdrawal from production of the old ones;
- Balancing of operations and innovations in the program through the calculation of financial indicators, forecasting of balance and preparation of data for the start of the next iteration in the planning interval.

This model includes forecasting blocks of the operational plan, the choice of innovation process implementation strategy and the assessment of investment efficiency. Purpose of the model: determining the optimum structure of production oriented on market demand, the assessment of investment funding strategies including the assessment of innovative potential and stage of RTD funding. It is also used to forecast the payback of a new product, calculate the income and rent using such data as forecasted live cycles of each product, the financial and economic characteristics of the enterprise and some others. The balance of model calculations between the operational and innovational parts of the OIP is ensured by the Higgins model [7] which shows how the assets and a number of other financial indicators shall change under changing sales and costs.

The demand for products is forecasted by N application of Monte-Carlo method to the life cycle interval, with the subsequent averaging. At that, marketing department shall define the forecasted demand for a new product within developed market development strategy. This demand will represent exogenous parameters of the simulation.

The “Functions Costs-Sales” block sets the sales (based of forecasted demand), costs and profit functional parameters for each product while the integral characteristics may be obtained from corporate reports. These functions are the basis for criteria, constraints on costs, output, and capacity of the optimization model.

The optimization model is formed automatically. The results are first processed by the “Calculation of financial indicator” block, then – by the “Calculation of innovation and investment indicators” block to obtain NPV, payback period, NPV adjustment, and rent assessment, define the final parameters, and deliver the variants of OIP.

When modelling the OIP (Fig. 1), each planning stage shall deliver a separate optimization model with its own parameters and constraints defined by the current state of corporate resources at the moment *t*.

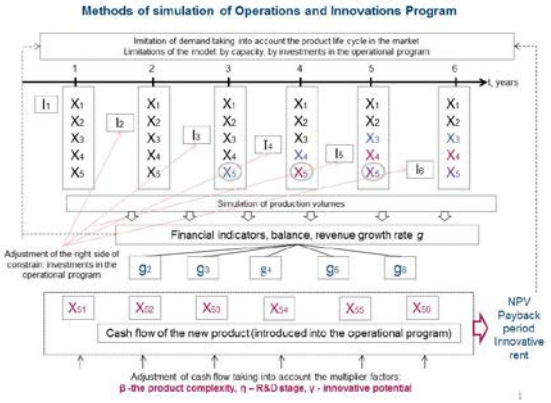

Figure 1: OIP simulation approach.

Balance sheet indicators are simulated using the optimization model. Financial indicators are calculated using balance sheet calculations for each forecasting year.

The block of calculation of investment characteristics solves the following tasks: the assessment of R&D investment efficiency, the calculation of NPV, the adjustment of NPV taking into account the current innovative potential (using of expressions (1) and (4)), the consideration of changes in the innovative potential depending on investments, the calculation of rent from production and sales of a new product.

Innovative potential assessed through processing the results of questioning the experts is not a constant value. This potential is a dynamic parameter which varies depending on the volume and intensity of investments in innovations. According to our methodology, the increase in innovative potential reduces the adjustment factor and the payback period of an innovative project for launching a new product. The development and future production of a new product suggest the receipt of Schumpeterian (business) rents what should be taken into account in

the simulation by changing the price of the new product. Price of a new product depends on the competitive influence on the market. The rent to be received from production and sales of the new product is calculated for the strategies defined by the marketing department.

Our methodological statements allow adjusting the volume of investments in innovations taking into account the payback periods and the balanced growth rates.

5 ASSESSMENT OF THE VOLUME OF INVESTMENTS IN OIP INNOVATIVE PROJECT

The prepared OIP model addresses rather important theoretical and practical issues related to the dependence of the volume of investments on the characteristics of the innovation process and the level of corporate innovative potential. Technological parameters and the innovative potential in general have a definite but not a direct influence on the efficiency of innovative projects. An accurate assessment of investments, efficiency and payback period of innovative project based on NPV requires a methodical approach to the investment analysis of innovative projects which would take into account the technological and organizational characteristics of the corporation.

More accurate definition of investments in innovations and the assessment of ROI require clarifying the basic NPV concept from the point of dependence of the result from the complexity of the product, the depth of the innovative process and the innovative potential of the enterprise by including these characteristics in the NPV calculation formula.

The analysis of scientific literature on the issue and assessment of efficiency of innovative projects shows that the existing methods do not take into account a number of essential factors that will be mentioned below.

Total expenses on innovations in an industrial corporation include expenses on purchasing the scientific equipment, apparatus, software, wages of scientists and engineers, patent and informational support, outsourcing of works and financing of certain projects. Expected income of a classical investment project mainly depends on the amount of investments, rate of return (ROR) and risk, while an innovative project has a complex systemic dependence mainly from technical and economic, or technological factors.

Formally, the forecasted investments in an innovative project I_n depend on a certain set of parameters and factors:

$$I_n \leq \Psi\left(c_{nj*}, x_{nj*}, \delta, \beta, \eta, \gamma, T_n\right) \quad (1)$$

where c_{nj*} is the expected price of a developed innovation product $j*$ substituting the "old" product j; x_{nj*} is the expected total output of the new products; δ is the planned ROR including the risks and the required ROR defined by the corporate management; $\Psi$is the type of function; β is the structural complexity of the product which may be assessed by an expert or analytically in comparison to an analogue; η is the depth of scientific study (the development of theory, survey, technology) which reflects the level of spending on R&D stages; γ is the integral criterion of scientific and production potential which reflects the availability of key competences, routines, the level of equipment of laboratories, and the similar depth of penetration of the industry. I.e., the corporation as an average representative of the industry has its history, a stable market share, the innovations, and etc.; T_n is the payback period defined for a fixed level of investment.

We offer the procedures for assessing the technological parameters and innovative potential. Such parameters as the structural complexity of the product, the depth of innovative process, the innovative potential of the enterprise can be assessed by questioning the qualified experts in the fields of science and production.

Our concept is based on the following assumptions:

- A corporation with a high innovative potential, competences and abilities will require less investment in R&D to create the same product than a corporation with a smaller potential. In the current term, it will spend less on preproduction and research equipment and training as it has more qualified staff, a developed scientific and production base, an information base and essential reserves in many directions of development. The corporate experience also has a great meaning.
- In the absence of potential ($\gamma \rightarrow 0$), the costs of innovations are very large; and vice versa, the higher is the potential, the lower is the cost of innovations.
- A corporation can become innovative at any stage: the basic research, the applied research, or can get a patent and start developing a concept product and the design. From the strategic point of view, its decision-makers have to decide on their intentions: do they want to start the research at an early stage with

higher I_n, to create key competences and routines for this area and to gain additional income (rent), or they want to save I_n but to lose the rent as the competitors will also be able to deliver this product.

Some properties of exponential function allow building models of accounting and analysis of investments in innovations, especially, through defining the α argument by regression analysis on the basis of the available dynamic ranks.

Let's see how the parameters of innovative potential affect NPV. We have defined that the higher is the potential γ, the less initial capital is required, and vice versa. Also, the deeper is the innovative process η, the more funds are required for its implementation. The same refers to the product complexity: the more complex is the product (the greater the value of the coefficient β), the more investment is needed.

Complex influence of these factors characterizing the innovative project and the enterprise itself can be accounted for by introducing a special multiplier (adjustment factor), for example, by using an exponential function,

$$\sigma = e^{\frac{b\beta\eta}{\gamma}} \quad (2)$$

where *b* is the coefficient taking into account the cost forecasting accuracy in development of complex products.

The parameter *b* can reflect the degree of inaccuracy of the planned investment decisions and can be defined by an expert. I.e., if 6 out of 10 planned investment decisions with the pre-set parameters in average have significant deviations of actual parameters from the planned ones, than *b* is equal to 0.4. The *b* value shall be defined by experts from corporate planning department as an adjustable parameter.

The properties of expression (2) depend on the following restrictions of the function indicator σ:

$$0 \le \beta \le 1;\ 0 \le \eta \le 1;\ \gamma d \le \gamma \le 1.$$

1. σ = 1, if β = 0 v η = 0; σ > 1; 1 if β ≠ 0 v η ≠ 0. Here, "v" means logical operator "or". But *b* can be equal to 0, so the planned system absolutely precisely defines the efficiency of investments as $-\sigma = e^0 = 1$. Therefore, the correcting coefficient has no influence on the investment project efficiency.
2. $\sigma \to \infty$, at $\gamma \to 0$. So, a decrease of innovative potential γ results in a significant growth of σ.
3. As the coefficients of complexity and depth are in the range of $0 \le \beta\eta \le 1$, the variable $\frac{b\beta\eta}{\gamma}$ has the maximum value at γ = γd, βη =1, that is, when the product has the highest complexity and the lowest level of preparedness, and the potential γ is at the extremely low level. As σ has the minimum value of 1 under the provided restrictions on dimension parameters, the values of β and η (characteristics of a certain innovative project) at various values of γ with the adjustment factor *b* are needed to calculate the usual *NPV* (without adjustment).
4. The parameter *b* is used to define the multiplier σ for a certain enterprise considering its technical and organizational characteristics and the statistics of investments in different projects.

Innovative project investment strategies will be integrally assessed using the adjusted NPV calculation procedure. We have used the innovative potential of the enterprise, the product complexity, the depth of R&D and the multiplier to obtain an equation for assessing the amount of initial investments in an innovative project depending on the characteristics of the innovative process:

1. ρ_{nj*} is the return on current costs on production x_{nj*}, and is the sum of the return on costs Rc_{nj*} and the additional yield from the Schumpeterian rent Ren_{j*} :
$$\rho_{nj*} = Rc_{nj*} + Ren_{nj*} \quad (3)$$
2. The product price is the production of yield and costs S_{nt} in the period *t*:
$$c_{nj*} = S_{nt} + \rho_{nj*}S_{nt} = (1 + \rho_{nj*})S_{nt} \quad (4)$$
With the adjustment, the NPV calculation formula will look as follows:
$$NPV = -I_n^п + \sum_{t=1}^{T} \frac{(1-\tau)(Rc_{nj*}\,S_{nj*}\,x_{njt*} + Ren_{nj*}\,S_{nj*}\,x_{njt*} - S_{cnsj*})}{(1+\delta)^t} \quad (5)$$

Let us transform the formula (5) into the equation for the case when $NPV = 0$ to receive the equation for assessing the amount of initial investments in an innovative project depending on the characteristics of the innovative process:

$$NPV = -I_n^п e^{\frac{b\beta\eta}{\gamma}} + \sum_{t=T1+1}^{T} \frac{(1-\tau)(Rc_{nj*}\,S_{nj*}\,x_{njt*} + Ren_{nj*}\,S_{nj*}\,x_{njt*} - S_{cnsj*})}{(1+\delta)^t} \quad (6)$$

where *T1* is the time spent on R&D, τ is the income tax rate.

Here, the production $Rc_{nj*}S_{nj*}x_{njt*}$ represents the operating income, and $Ren_{nj*}S_{nj*}x_{njt*}$ is the rental income from the competitive advantage of the corporation. In competitive environment, the corporations follow up with promising products and the yield gradually decreases to reach the industry average.

So the amount of investments in complete development of an innovative product including the

launch of its production is within the interval bounded from below by the planned output, and from the top – by the adjusted amount of investments taking into account the structural complexity of the product, the number of stages of scientific development, and the scientific and production potential of the enterprise. The top bound of the interval mostly depends on the innovative potential which structure depends on the technological level, the human capital, the R&D, and etc. The higher is the innovative potential, the shorter is the interval; than the forecast of the actual investments in innovations is more accurate.

Preparation of raw data, calculation of such parameters as the innovative potential, the depth of the innovative process, the forecasted values of demand, prices and costs of the products, and formation of strategies of launching the new product are followed by the assessment of strategies of the OIP models and the selection of optimum variant by certain criteria.

6 CONCLUSION

We have shown the causal relationship of net present value innovative projects with the factors: the structural complexity of the product, the number of stages of the innovation process, innovative potential of the enterprise. To assess the factors of the innovative project, expert-analytical method.

We proposed to reflect this relationship a adjustment factor (multiplier). The introduction of a multiplier allows for more to correctly calculate the cash flows of the project, reducing the integral risk of the project to potential investors.

In fact, we formulated the theoretical position that the actual value of the investment in innovation lies in the interval, the lower boundary of which is a target value, and upper boundary adjusted by the coefficient (multiplier) the amount of investment.

This interval defines the problem of choosing the optimal investment strategy. The upper limit of the interval depends on the innovative potential: the higher the level of innovative capacity, the interval is narrowed, which improves the accuracy of the forecast investment. It develops and refines the theoretical framework of the estimation of efficiency of investments.

Further studies are interesting from the point of view of key problems of organization of innovative processes in the companies – the unresolvable dilemma of the insider. Why many private companies are reluctant to develop and invest on some limits? This will increase transparency, which will lead to the loss of control over a stable stream of income.

Therefore, the focus on domestic funding sources is a survival strategy, is futile from the point of view of overcoming the problems and difficulties faced by the Russian economy. The expansion and understanding of this phenomenon needs more research, content analysis, and the development of new models and tools.

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