MODELING OF ECONOMIC EFFECTS OF COMMERCIALIZATION OF HIGH-TECH DEVELOPMENTS AT SMALL INNOVATIVE ENTERPRISES OF POLYMER PROFILE

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ABSTRACT

On the basis of the approximating polynomial, a three-factor model for managing the sustainability of an innovative chemical project is presented in the context of economic uncertainty. Economic uncertainty in the chemical sector can be caused by intra- and external economic and political, investment, innovative, opportunistic, commercial, raw materials, industry and other factors. In the developed model, isoline levels show simultaneously a better ratio of the three economic characteristics of the innovation project across the entire range of the planning matrix, and also provide the ability to predict the net present value and return on the project's capital. Since the end of the 20th century, in the international business environment, it has been thought that a company can gain an advantage in its industry, outrunning competitors, offering superior products or being a price leader. It was accepted as a fact that a company can compete only in two of these three areas. Historically, the product life cycle began when the company (usually the market leader) first introduced its new offerings to the market. Then competitors offered similar products of higher quality, then companies appeared on the market offering similar quality at a more attractive price. Japanese manufacturers such as Toyota and Sony have shown that companies can compete in all three strategies simultaneously and become industry leaders. Traditional business has realized that "faster", "better", "cheaper" are not the only variables that consumers weigh when making purchasing decisions. To dominate the industry, organizations must constantly create innovation and remain flexible, able to confidently pursue strategic initiatives, including alliances, acquisitions, outsourcing and global expansion. Companies also need funds to consolidate their business during economic downturns, using cost-effective new tools for integrating business processes. To achieve high results, the executive management must first have control processes and accurate information to make informed decisions to adjust and restructure the strategic course. After making decisions, projects to optimize business processes require the company to study and use opportunities to reduce costs, cycle time, improve the level of service or product quality.

Keywords: modeling of economic effects, commercialization, science-intensive technologies, small innovative enterprises, polymer profile.

1. INTRODUCTION

Initiatives to optimize business processes depend on the competitive environment with which the organization is confronted in its field of activity. For example, customer service management processes are very important in financial services and government sectors, where the focus is on interaction with the client. User-friendly applications for access to information, financial management and purchase of financial products are important functions for financial service providers such as banks, insurance companies and brokerage houses. Conversely, the main priorities facing many companies in the chemical sector are focused on supply chain programs and consumer demand, self-service and access to information.

In the chemical sector, the optimization of the company's economic efficiency should determine the options for managing business processes with formalized information available on how to convert the feedstock to the final product. Optimization of business processes can eliminate uncertainties and establish the boundaries of the project. It identifies the main areas for improving the process, such as improving product quality, improving customer service and / or reducing costs, etc. In addition, optimization can find the necessary resources, including experts on specific issues, to identify the existing strengths of the process, the weaknesses, opportunities and threats. It is important to distinguish processes from projects. The project is a series of activities and tasks with a given goal, start and end date, resources. The project spends money, labor and equipment for a specified period of time and determines what will be done, in what time frame and how to ensure the desired results. Project tasks are unique, as a rule, they are not repeated and, after the project is planned, changes to the plan are eliminated to ensure compliance with the schedule. While business processes strive for efficiency, flexibility and satisfaction of needs, projects seek to meet the set goal in a timely manner and within the budget. Thus, project optimization is short-term work, in which the organization begins to identify the project inefficiency, determines how to solve this problem and ensure that the improvements reach the desired results without adversely affecting current operations.

2. METHODS

In order to optimize the degrees of ownership of the economic factors of the innovative chemical project, which make up the best value of net present value and return on capital, a simplex lattice structure was used. Simplex optimization for three-component models with visualization of results in the form of an line map, with support for plans 2, 3, 3.5 and 4 orders, is written in Delphi 5.0. For the approximating polynomial, the formula is adopted. Experiments are carried out for all lattice points 3: 3, after which responses are determined. Figure 1 shows their marks.

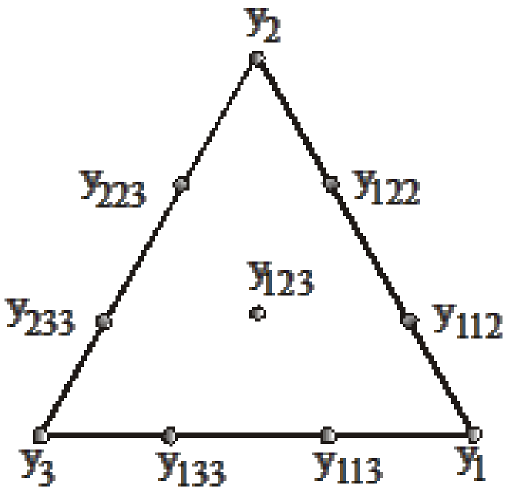

Figure 1 – Notation of responses at points of a simplex lattice. Source: compiled by the authors.

The number of indices for responses and the degree of a polynomial must be equal. The degree to which innovative chemical projects belong to the best investment portfolio shows the number of indices. Table 1 presents the responses and the plan based on the simplex 3: 3.

Table 1 – Response and plan based on the simplex 3: 3. Source: compiled by the authors.

№№	GRID NODES			VALUES	№№	GRID NODES			VALUES
	x_1	x_2	x_3			x_1	x_2	x_3	
1	1	0	0	y_1	6	0	1/3	2/3	y_1
2	0	1	0	y_2	7	2/3	1/3	0	y_2
3	0	0	1	y_3	8	2/3	0	1/3	y_3
4	1/3	2/3	0	y_{122}	9	0	2/3	1/3	y_{122}
5	1/3	0	2/3	y_{133}	10	1/3	1/3	1/3	y_{133}

Taking into account that the simplex lattices are filled, a substitution was used to determine the coefficients of the polynomial. This means that the coordinates of the points are alternately placed one after the other in the polynomial in order to derive formulas for calculation.

3. RESULTS AND DISCUSSION

Simplex optimization and fuzzy logic in project management makes it possible to minimize the possibility of a shortage of investment or, on the contrary, an excess of them, which will not give the required interest at the discount rate. With this approach, it becomes possible not only to quantify the magnitude of the risk, but also to continuously regulate its acceptable level to the investor. In addition to basic operations on fuzzy sets in the management of innovative projects, special operations such as "concentration" and "stretching" are of great importance. The "concentrating" operation is performed by raising the degree of membership in a square, which is graphically reflected as a function compression along the abscissa axis and is denoted by the term "very". The "stretching" operation is performed by finding the square root of the degree of membership, which is graphically reflected as an extension of the membership function along the abscissa axis and is denoted by the term "more or less". The venture business market is extremely volatile. In the case of an excess of projects satisfying the requirements of the investor (in terms of NPV, IRR, payback period, etc.), special operations make it possible to select projects with a "very" high probability of their future performance being declared. If the standing support of projects is presented in an insufficient number of investors, there is always the possibility of selecting projects with a "more or less" high probability of their future performance being declared (Figure 2).

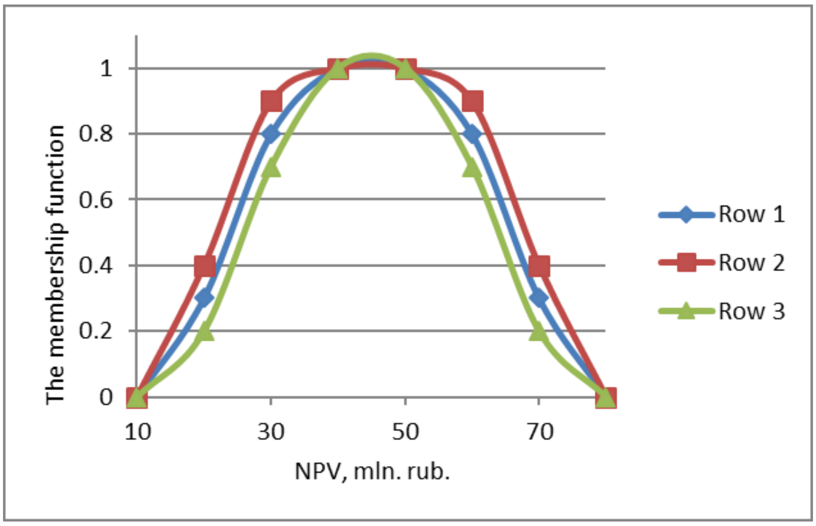

Figure 2 – An example of the membership function of the projected high, according to the investor, NPV (series 1), "more or less" high NPV (series 2) and "very" high NPV (row 3) innovation project. Source: compiled by the authors.

The most probable, according to figure 2, is predicted NPV in the amount of 40 - 50 million rubles. The left uncertainty interval is NPV from 10 to 40 million rubles, and the right uncertainty interval amounts to NPV from 50 to 80 million rubles (row 1).

The "stretching" operation (row 2) allows selecting projects with a "more or less" high NPV value, when the left and right uncertainty intervals (from 10 to 40 million rubles and from 50 to 80 million rubles, respectively) are wider than the original project. The "concentrating" operation (row 3) allows selecting projects with a "very" high NPV value, when these uncertainty ranges (from 10 to 40 million rubles and from 50 to 80 million rubles, respectively) become narrower than the original project.

This approach has been very relevant in the economy and management of innovative chemical projects, which face significant difficulties in the transfer from laboratory to production. This is explained by the multicomponent nature of chemical systems and the synthesis conditions. Executive management should be equipped with tools to make informed decisions to make adjustments to the organizational course with a high degree of maneuverability. The developed documents, including process maps, input and output data, resource assignments, scheduling, etc., formally define the scope of the action from initiation to delivery and serve as the roadmap for the process.

Let's make a model of the best ratio of factors (criteria) x1 - the price of the product, x2 - the discount rate, and x3 - the discounted payback period of the project for the net present value of NPV and the profitability of the capital of the innovative chemical project.

The net present value shows the amount of profit from the implementation of the innovative project, taking into account the return to the investor of the investment and the discount rate. The NPV portfolio of innovative projects is the sum of the NPV of each project that make up this portfolio. Taking into account the weighting coefficients of each project in the portfolio, the total value is found by the additive convolution method. Such a possibility allows us to consider the net present value (NPV) as the main method for assessing the economic efficiency of an innovative project, such as the profitability index (PI), the internal rate of return (IRR) and the modified internal rate of return (MIRR), the discounted payback period (DPP).

$$NPV = \sum_{k=1}^{n} \frac{P_k}{(1+r)^k} - \sum_{j=1}^{m} \frac{IC_j}{(1+i)^j},$$

где: P_k – annual income, n – number of years of income, r – ставка дисконтирования, IC_j – annual investment, m – number of years of investment, i – projected inflation rate.

With this analysis in a fuzzy environment, it is necessary to take into account that an increase in the price of a product simultaneously leads to a decrease in sales; reduction of the discount rate - to a decrease in the volume of investment, and, consequently, to a decrease in production volumes. The increase in the discounted payback period of the project entails an increase in its risk level due to various factors (intra- and external economic and political, investment, innovative, conjuncture, commercial, raw materials, industry, etc.). As a result, the fuzzy value of NPV and the return on capital will shift to the left.

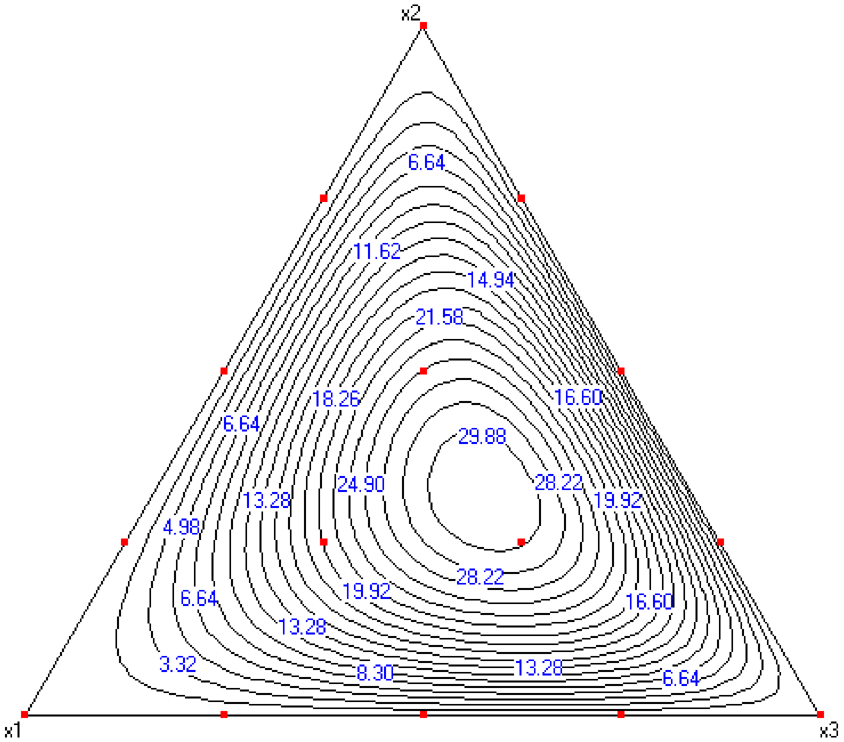

Figure 3 – Simplex optimization of the best NPV (million rubles) value of the innovative chemical project "Copolymer +" in conditions of product price uncertainty (x1), discount rate (x2) and discounted payback period (x3). Source: compiled by the authors.

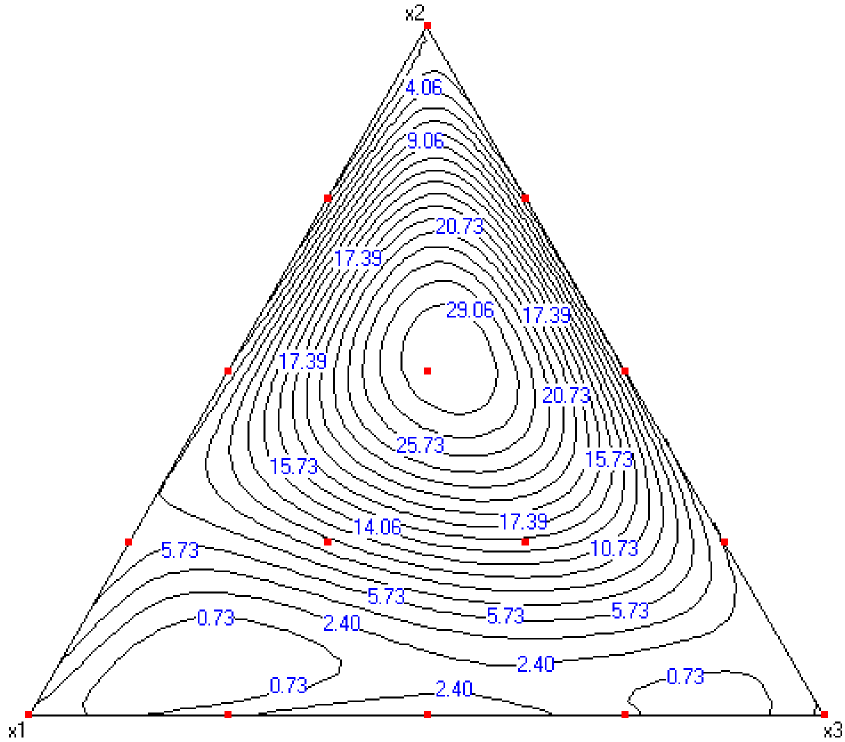

Figure 4 – Simplex optimization of the best NPV (million rubles) value of the innovative chemical project "Polycarbonate Analogs" in conditions of product price uncertainty (x1), discount rate (x2) and discounted payback period (x3). Source: compiled by the authors.

So, we build a model of the correspondence of the degrees of ownership of the product price (x1), the discount rate (x2) and the discounted payback period of the project (x3) to the maximum NPV values using the example of innovative chemical projects "Copolymer +" and "Polycarbonate analogues".

The return on capital is another key criterion for strategic investing in innovative projects. The impact on it of the product price uncertainty (x1), the discount rate (x2) and the discounted payback period of the project (x3) for both projects ("Copolymer +" and "Polycarbonate Analogues") affects the same way as net present value 5, figure 6).

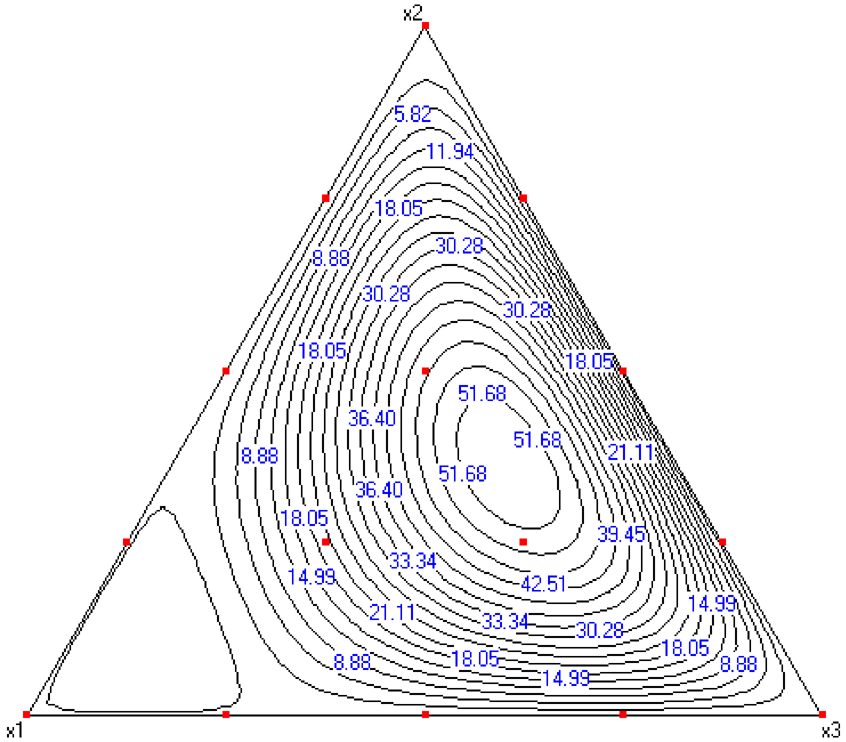

Figure 5 – Simplex optimization of the best value of the return on capital (%) of the innovative chemical project "Copolymer +" under conditions of uncertain product price (x1), discount rate (x2) and discounted payback period (x3). Source: compiled by the authors.

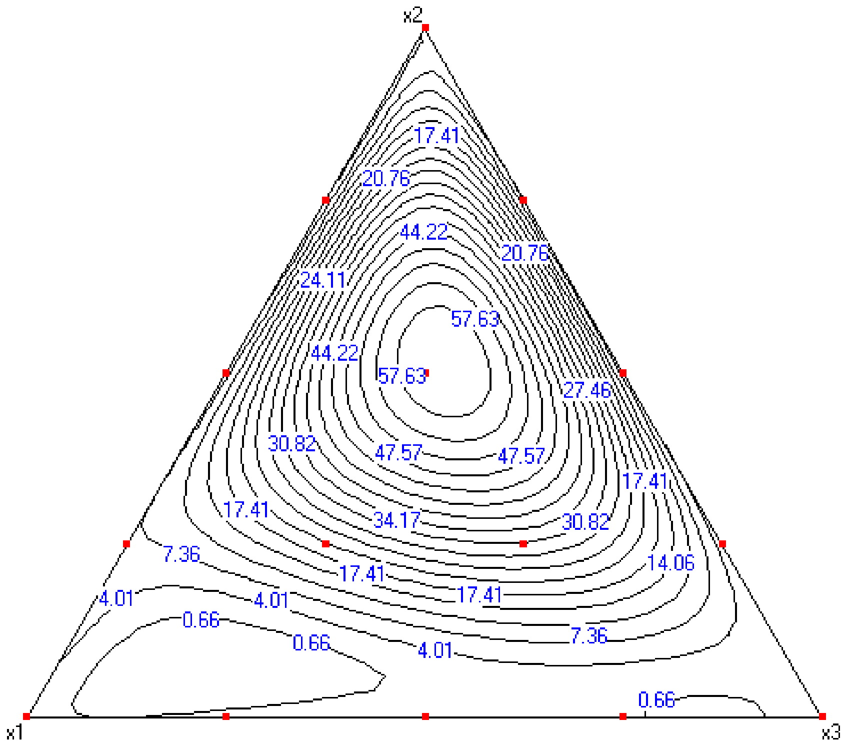

Figure 6 – Simplex optimization of the best value of the return on capital (%) of the innovative chemical project Polycarbonate Analogues under the uncertainty of the

product price (x1), the discount rate (x2) and the discounted payback period of the project (x3). Source: compiled by the authors.

4. SUMMARY

Simplex optimization of net present value and profitability of capital on the example of innovative chemical projects allowed the uncertainties of the product price (x1), the discount rate (x2) and the discounted payback period of the project (x3). Thus, the largest values of NPV (29.88 million rubles) and profitability of capital (51.68%) for the project "Copolymer +" showed a good match between themselves and are defined in the area of 0.25 / x1; 0.3 / x2; 0.45 / x3. The presented method showed the same good agreement of the best values (NPV 30.06 million rubles) and the return on capital (57.63%) under the uncertainty of the product price (x1), the discount rate (x2) and the discounted payback period (x3) , the ratio of which was: 0.2 / x1; 0.55 / x2; 0.25 / x3. The presented model is expressed as fuzzy sets {A = the best value of NPV} and {A = the best value of return on capital} in case of possibility of influence on product price (x1), discount rate (x2) and discounted payback period (x3), as well as like any other fuzzy sets in the case of a change of these factors independent of the innovative entrepreneur. Thus, on the basis of simplex optimization, organizations can achieve sustainable and effective improvement of management processes. The ability to simultaneously monitor diverse project factors provides the structure and discipline necessary to identify opportunities for improving the process, developing progressive solutions and guiding the organization through strategic change. The use of integrated optimization technologies in management allows innovative projects to be efficient, flexible and highly competitive.

5. CONCLUSIONS

Project management in an innovative economy based on simplex optimization and fuzzy logic provides a number of advantages in economic efficiency compared to traditional approaches. Innovative analysts have the opportunity to summarize fuzzy sets of profit, costs or risks of individual projects. This makes it possible to build highly reliable forecasts for the whole portfolio of projects.

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