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MANAGEMENT OF INNOVATIONS IN THE PETROCHEMICAL SECTOR ON THE BASIS OF ECONOMIC AND MATHEMATICAL MODELING METHODS

Igor L. Beilin, Vadim V. Khomenko*

Dept. of Economics and Finance, Institute of Management, Kazan Federal University, RUSSIA

ABSTRACT

The chemical industry is one of the most important basic branches of the modern economy. Its products (70 thousand items) are widely used for the production of various consumer goods, as well as in large volumes - in other sectors of the economy, such as agriculture, manufacturing, construction and services. The chemical industry itself consumes more than 25% of its own production of chemicals. Among the most important consumers of its products are automobile, textile, clothing, metallurgy, etc. The products of the chemical industry can be divided into four categories: basic chemicals (they account for approximately 35-37% of the global production of the industry), so-called life-support products – life science (30%), special chemicals (20-25%) and consumer goods (about 10% %). "Commodity" chemicals include polymers, large-tonnage petrochemicals, basic industrial chemical products, inorganic chemicals and mineral fertilizers. Over the past twenty years, this segment of the chemical industry has developed at a relatively low rate - 50-70% of the average annual global GDP. Polymers (including all types of plastics and chemical fibers) play a major role here, accounting for 33% of the total sales of basic chemicals. At the current stage in Russia, no more than 50% of entrepreneurs invest in the modernization of production technologies, 30% are establishing new products, and only 20% are investing in research into the development of brand new products.

INTRODUCTION

The main markets for plastics are packaging, housing construction, container manufacturing, pipes, transportation, children's toys and games. Among the polymers, the largest share belongs to polyethylene (PE), used for the production of packaging, packaging, containers and pipes, film, various containers, technical fibers. Another important polymer is polyvinyl chloride (PVC), which is used in the production of building pipes, finishing and thermal insulation materials, and to a lesser extent in the production of packaging and transport. Polypropylene (PP), in addition to the above mentioned markets, is used in the production of fabric and carpet coatings. Polystyrene (PS) is also used in the production of toys, car parts, radio industry.

According to forecasts, the innovative way of development of the domestic economy by the end of 2020 will determine the receipt of:

1) The share of enterprises that implement IT technology to 40-50%;
2) Increasing the proportion of technically new chemical products to 25-35%;
3) An increase in the amount of research and development costs to 2.5-3% of GDP.

The development of chemical products is the most important criterion for the country's technical development. It is related to demand and requires the appropriate development of high competitiveness of chemical products and the rate of its growth and development. Therefore, the goal of developing chemical products in Russia during the period under review is to ensure the necessary release, quality and assortment of chemical products corresponding to the demand of domestic and world markets, on the basis of the technical re-equipment of existing and creation of new productions on a modern technical basis.

Analytical review

In the prevailing conditions of the country's development, the chemical industry does not have a corresponding production and technological base. As a result, the Russian Federation occupies only about 1.0 percent of the world's output of chemical products (the industry share in GDP is 1.9 percent). In total, about 5.0 kg / year of chemical products are produced per capita in Russia, with an average of 34 kg / year in the world. Consumption of certain types of chemical products per capita, 8-10 times lower than in Germany, France, England. Lagging in competitive advantages is due, first of all, to weak innovation activity and low efficiency of the investment process at chemical enterprises.

This situation is due to the efficiency of exports of low-processed goods over the past 20 years, in the face of a sharp decline in domestic demand [1-2]. The current conjuncture in the world market does not stimulate exporters to improve the quality of products and the development of chemical enterprises [3-5]. In addition, an important factor constraining the development of the industry is the inconsistency of the structure of the chemical industry of the Russian Federation to the chemical complexes of other countries [6-7]. In spite of

*Corresponding Author
Email:
mega.sppa@mail.ru

this, there are opportunities in the chemical industry for the creation of a developed industry, including: the availability of energy-raw materials, water and other natural resources; growing capacity of the domestic market; availability of appropriate production and scientific and technical perspiration.

The Russian government has presented a new program for the development of the chemical complex in Russia. According to it, it is planned to increase the output of chemical products by 2.2 times, to raise the level of quality of chemical products to the world level due to the organization of production of new high-tech chemical products with high added value [8-9]. It is forecasted to achieve a share of innovative technologies in chemical products to 30-50% of the world level; import substitution for the growth of the role of the domestic market in the chemical complex of the country. The sustainable development of the chemical industry causes the formation of a number of necessary internal and external conditions [10-12].

RESULTS

At the modern level of the development of the science of management and economics, the apparatus of economic-mathematical methods is very diverse. The choice of the most effective method depends on a large number of various factors. For example, on the volume and type of data, their degree of reliability, their variability in time and depending on the influence of external and internal environment [13-20]. Thus, to analyze the possibilities of managing the economic efficiency of an innovative small chemical project, it seemed to the author that it was most important to involve methods of simplex optimization and cluster analysis. Simplex optimization for three-component models with visualization of results in the form of an isoline map, with support for plans 2, 3, 3.5 and 4 orders, is written in Delphi 5.0. As the approximating polynomial, the third-order Sheffe model was taken. The polynomial of the third degree in the general case has the form:

$$\widetilde{y} = b_0 + \sum_{1 \leq i \leq q} b_i x_i + \sum_{1 \leq i \leq j \leq k \leq q} b_{ijk} x_i x_j x_k$$

To evaluate the coefficients of the approximating polynomial at all points of the plan corresponding to the sites of the {3,3} lattice, experiments are performed and the responses of the system "y" are determined. Using the simplex optimization method, the influence on the net discounted income (NPV) and profitability of the assets of the small innovative chemical project [20-24] of the price of the future product, the discount rate and the payback period [Fig. 1,2].
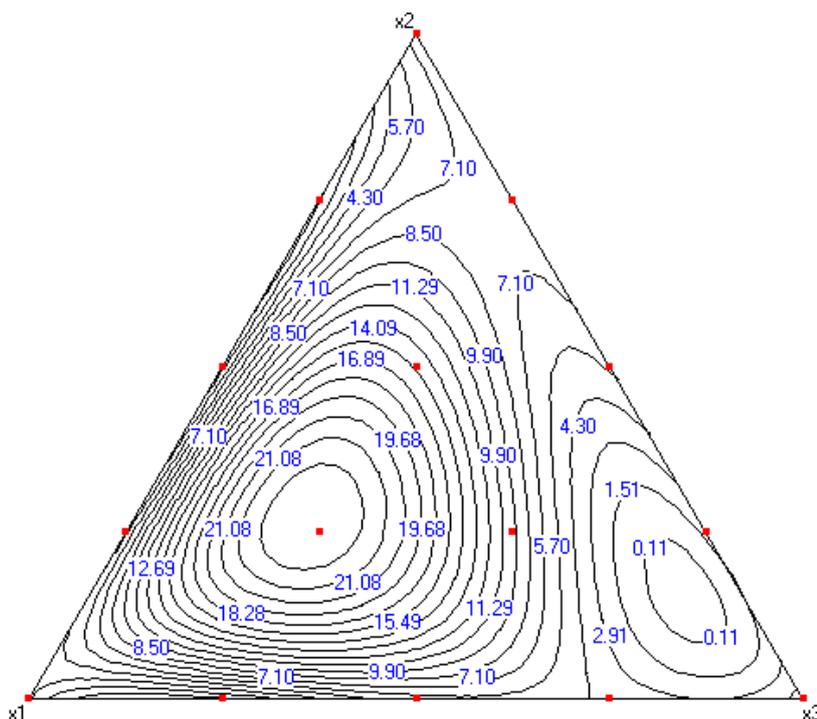
Fig. 1: Optimum price of the future product (x1), discount rate (x2) and payback period (x3) of the small innovative chemical project for the net discounted income indicator (million rubles).
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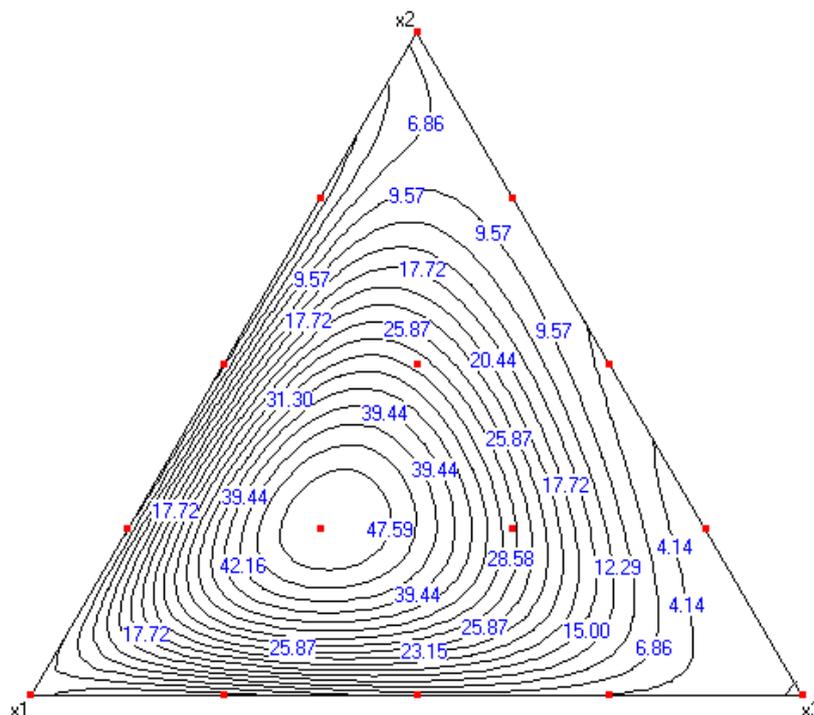
Fig. 2: Optimum price of the future product (x1), discount rate (x2) and payback period (x3) of the small innovative chemical project for the asset return ratio (%).

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Cluster analysis is one of the newest mathematical and statistical methods that have become popular due to the development of computer technologies and formalized calculation programs. Its purpose is to classify, in other words - a typological grouping of aggregates of mass phenomena based on a set of characteristics [25-29]. A measure of proximity, the degree of similarity of objects is conveniently represented as a reciprocal of the distance between objects. In the case of quantitative characteristics, the Euclidean distance is most often calculated:

$$d_{ik} = \left(\sum_{j=1}^{m} \left(x_{ij} - x_{kj} \right)^2 \right)^{\frac{1}{2}}$$

Another way to determine the metric, the so-called distance of urban neighborhoods or the Manhattan distance:

$$d_{ik}^* = \sum_{j=1}^{m} \left| x_{ij} - x_{kj} \right|$$

In the conditions of an innovative economy, when the supply of innovative projects is large enough, but their risks are also great, there is a need to explore the possibilities for their classification. The following is the result of a cluster analysis of ten small innovative chemical objects by the criterion of the internal rate of return (IRR) using the methods of the "Nearest Neighbor" [Fig. 3] and "Far Neighbor" [Fig. 4].
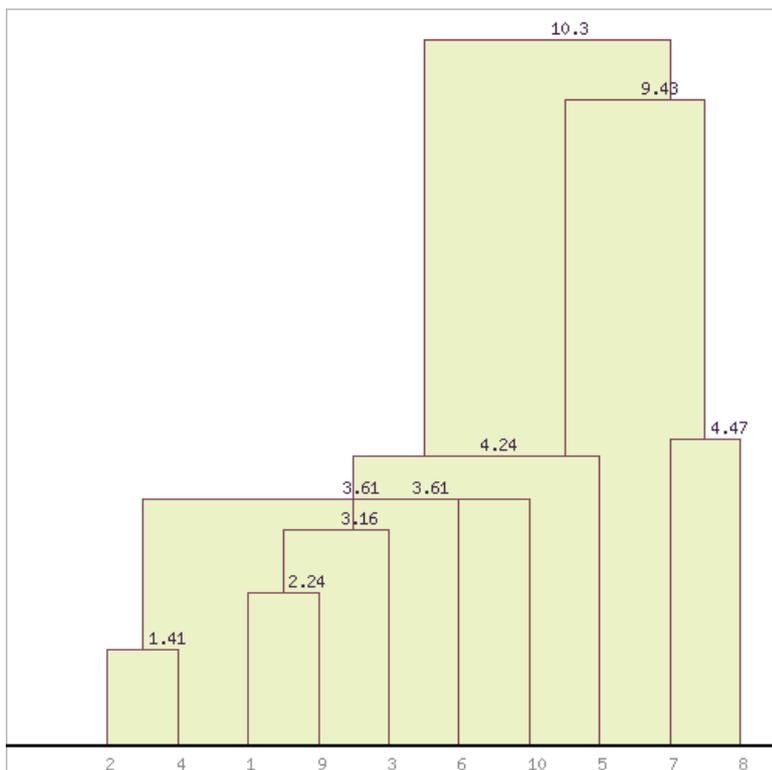
Fig. 3: The result of the cluster analysis of ten small innovative chemical objects by the criterion of the internal rate of return (IRR) to the methods of the "Nearest Neighbor".

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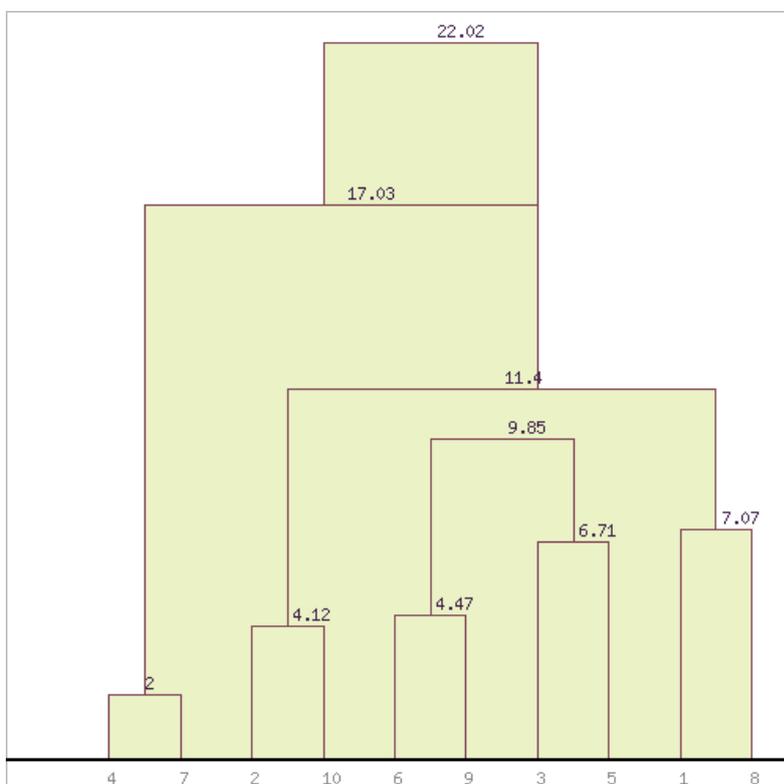
Fig. 4: The result of a cluster analysis of ten small innovative chemical objects by the criterion of the internal rate of return (IRR) to the methods of the "Far Neighbor"

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CONCLUSION

If at the first stage of the scenario for the development of chemical enterprises it was planned, basically, reconstruction of existing capacities and only insignificant commissioning of new production facilities, then at the second stage - innovative it is planned to introduce new capacities and create competitive production facilities for the production of chemical products. It is planned to introduce new technologies in all auxiliary chemical industries. This will give an opportunity to increase the proportion of high redistribution in the structure of products to 15-20%. It is predicted that the cost of production of chemical enterprises in comparable prices will grow by 2.64 times, and the volume of production of chemical products in 2.83 times.

The probability of the success of technological development largely depends both on external conditions (market conditions, etc.), and on the adaptation of chemical enterprises to trends in domestic and world markets. Solving the problems of the development of chemical enterprises is impossible without increasing their investment attractiveness by reducing the risks and growth rates of chemical products by at least 5% per year. Therefore, state support for the development of chemical enterprises and corporations is necessary on the basis of increasing their efficiency and deeper processing of raw materials and materials through the use of technologies of economic and mathematical modeling.

CONFLICT OF INTEREST
There is no conflict of interest.

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