Portfolio Analysis of Economic Decisions in the Enterprise

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Abstract: Selection of effective solutions in the enterprise is largely provided by the rational organization of interaction of the enterprise with contractors: raw material suppliers, customers (buyers) of finished goods, government agencies, financial institutions and other organizations. The paper discusses the ways of organizing of such an interaction based on the methods of vector optimization and the theory of portfolio investment which goes back to the works of G. Markowitz.

Keywords: Optimization Methods; Applications in Economics, Management and Environmental Science.

1. INTRODUCTION

Selection of effective solutions in the enterprise is largely provided by the rational organization of interaction of the enterprise with contractors: raw material suppliers, customers (buyers) of finished goods, government agencies, financial institutions and other organizations. Methods of effective work with contractors are multifaceted, they are studied in different areas of economic theory and include issues of customer relationship management, marketing, management, logistics and others (e.g., Nikonov 2011, Nikonov and Medvedeva 2012).

Economic-mathematical modeling is one of the tools for improving the interaction between the enterprise and its contractors as well as the selection of partners or services.

A wide range of problems, related to the interaction with the external environment of the enterprise, includes the problems of formation of orders, selection of products and services, the formation of a group (portfolio) of providers and consumers by such a way that the composition of the portfolio would be optimal on several criteria. Such criteria may be the income from selling of goods or services, the reliability of contractors and their work experience, the financial and economic characteristics of the partner companies. A particular case of the problem formulation is the optimization of risk-return ratio which is focused on the fact that the income from the activity must be as large as possible while the risk of the loss or shortfall in profits as little as possible.

When composing the optimal portfolio, firstly it is needed to evaluate and choose the best of individual counterparties and a whole group of counterparties, reducing the overall risk, and secondly, substantially get rid of the elements of subjectivity inherent to other approaches which are based upon expert assessments.

2. THEORY OF PORTFOLIO INVESTMENTS FOR THE FORMATION OF PORTFOLIOS OF NON-FINANCIAL OBJECTS

The theory of portfolio investments, working in its classic version with a portfolio of securities (Markowitz 1952), provides listed properties for the said portfolios. Therefore, to adapt and develop a portfolio approach to a class of non-financial objects is a perspective and relevant direction.

The modern theory of portfolio investments (Elton and Gruber 1970) allows extending its methods and approaches to the problem of formation and management of a portfolio of components, which are different in nature from the traditional tools of the stock market (e.g., Medvedev 2012). The methods of portfolio analysis and vector optimization of economic decisions in the enterprise associated with the formation of portfolios of non-financial objects, based on this theory, allow developing the methodological tools for generating efficient portfolios of non-financial objects to improve the efficiency of interaction of enterprises with their contractors (e.g., Nikonov and Medvedev 2008). These approaches allow us not only to offer an economic-mathematical model of the efficient portfolio of suppliers for minimization the cost and risk of the enterprise, but also generalize the results to an arbitrary number of counterparties with two or more performance criteria (e.g., Nikonov and Medvedev 2011).

The aim of the study was the development of theoretical and methodological clauses and the application of tools of portfolio analysis and vector optimization for use in making decisions on formation and restructuring of efficient portfolios of non-financial objects.

During the research, the following problems were solved:

1. The theoretical and methodological approach was developed for portfolio analysis and choice of vector optimization methods of economic decision-making in an enterprise. Approach allows applying the methods of the modern theory of portfolio investments to generate efficient

portfolios of economic instruments, which are different in nature from the capital market instruments, namely the portfolios of counterparties, orders, products and services.

The basic principles (criteria of applicability) were formulated implementation of which allows application the theory of portfolio investments for new classes of objects, for which it was not used previously, thereby significantly expanding the scope of modern financial and economic theory. These principles substantially reflect the properties of securities, but they are also suitable and to other objects, what provides applicability of constructions of the classical theory in the considered case.

2. The methodological tools were developed for portfolio analysis and decision support when developing of a portfolio of non-financial objects for the case of two or more performance criteria (the characteristics of the counterparties, orders, products and services). The tools allow constructing efficient portfolios of non-financial objects and provide elimination of the elements of subjectivity, which are present in other approaches.

3. A mathematical model for the finding of effective economic decisions on the formation of portfolios contractors (suppliers) of an enterprise based on the methods of vector optimization was developed. The model allows determining an option to ensure minimum cost and possibly lower risk associated with the interaction of the enterprise with business partners (suppliers).

3. RESULTS OF THE STUDY

The case of the orders portfolio selection for a company, which transports and delivers natural gas, is given as an example of practical application of the developed algorithm.

As performance criteria the following indicators were selected:

1) cost of the service; 2) experience in the field for the preceding year; 3) presence of necessary personnel; 4) amount of working capital; 5) size of fixed assets; 6) revenue from product sales for the preceding year; 7) after-tax profit for the previous year; 8) business reputation.

Next, the normalized values of the criteria lying between 0 and 1 were calculated. This normalization was done to provide possibility of the indicators comparison.

Then, Pareto optimal solutions were found for all eight indicators simultaneously, individual indicators and convolutions of individual indicators. On Fig.1 the counterparties (squares) are shown for which it doesn't exist better values of work experience and cost of services simultaneously. Other possible enterprises are depicted as rhombuses.
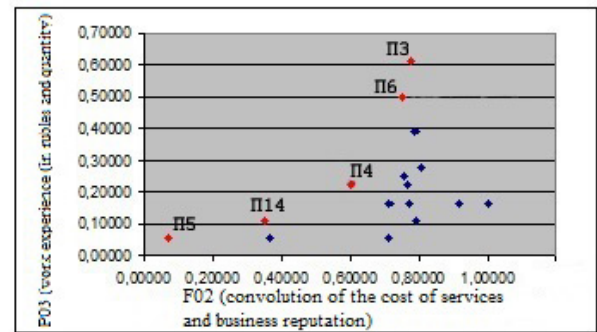

Fig. 1. Dependence of the convolution of work experience (in rubles and quantity) and convolution on the cost of services and business reputation

Approbation of the model for solving the problem of selection of raw materials suppliers was carried out on data of a particular company which works with six suppliers. Baseline data represent the volume of supply of each provider, planned and actual delivery dates and number of days of delay in delivery.

The expected cost and risk for existing pool of suppliers were found. Fig. 2 is showing that the current situation is not optimal.
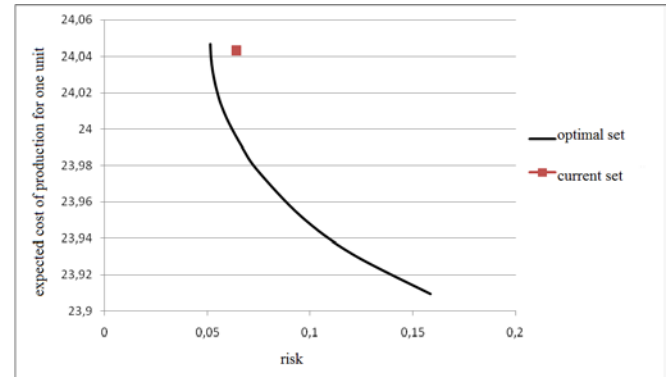

Fig. 2. Dependence of the expected cost of risk

When changing the proportion of suppliers in the existing portfolio, we can reduce the risk or the expected cost. Fig. 3-4 are showing a comparison of the current and optimal portfolio of suppliers.

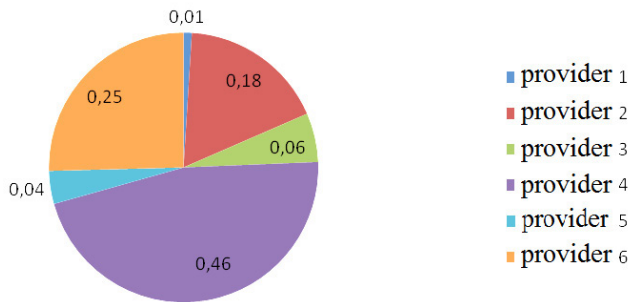**Expected cost: 24,0465**
Risk: 0,0641

Fig. 3. Structure of the current portfolio of suppliers

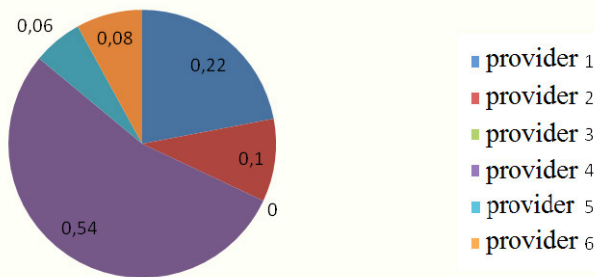**Expected cost: 24,0465**
Risk: 0,0514

Fig. 4. Structure of the optimal portfolio of suppliers

Fig. 5 is showing the results obtained with given necessary restrictions on the supply.
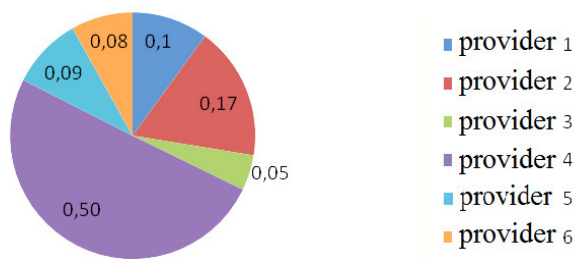
Expected cost: 24,0465
Risk: 0,0543

Fig. 5. The structure of the optimal portfolio of suppliers subject to the restrictions

The resulting risk is greater than the risk of an optimal portfolio without restrictions, but less than the risk of the existing portfolio. Thus, the developed model can take into account various external factors when working with suppliers.

4. CONCLUSION

The proposed approach allows increasing the efficiency of enterprise management and interaction with contractors, as well as intensifying the work on optimization of the nomenclature of products and services and minimization the risks. The approach will also contribute to informed decision making when selecting counterparties and portfolios of products and services.

In a whole, the application of the proposed approaches and methods will contribute to achieving the strategic objectives of enterprises and organizations on increasing their competitiveness. The results of the study may be used for industrial and trading companies, financial and credit organizations.

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