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# *Experience of Using Real Options in the Practice of the Enterprise's Innovation Activity: A case study*

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***Abstract* - The relevance of the study is connected with the need to expand the tools for managing portfolios of innovative projects in organizations. The traditional set of management technologies of a modern company does not provide adequate flexibility and adaptability in making management decisions in a rapidly changing open external environment. The aim of the study was to study the practice of applying real options in managing a portfolio of innovative projects of a high-tech company for the period 2013-2018. The basic research methods were "case-study" and interviews, also used the methods of analytical data processing and forecasting. Positive actual and predicted effects from the exercise of real options are noted. In particular, other parameters remaining unchanged, the portfolio of projects with embedded and realized options goes beyond the zone of negative values of the aggregate net cash flow after the planned period. However, the current indicator of the total cash flow is significantly higher than planned. At the same time, the situational nature of the implementation of functions of real options and the impossibility of modeling positive effects in the long term, which complicates the use of this tool in the framework of strategic project portfolio management, is noted.**

***Keywords - real options, innovation projects portfolio, innovation project***

## I. INTRODUCTION

In terms of the new industrialization, the innovative activities of enterprises, especially those related to high-tech and knowledge-intensive activities, take on special significance. The traditional format of innovation is the implementation of innovative projects, the totality of which is called a portfolio of innovative projects. Project portfolio management is focused on achieving the organization's strategic goals. It includes the selection, prioritization and balancing of projects among themselves in such a way as to maximize the achievement of the strategic goals of the company. It is about achieving cumulative and synergistic effects from the implementation of a set of projects. At the same time, a portfolio of projects is what allows an organization to show flexibility and adaptability in interaction with the external environment. The speed of reconfiguration of a project portfolio is incomparably higher than the speed of reconfiguration of a company's business processes. The organization's susceptibility to changes in the external environment depends on the extent to which these changes are absorbed by the project portfolio. In this regard, the actual question is how exactly the project portfolio shows flexibility and adaptability under external influences. In this article, on the example of a separate company, the practice of using real options in the implementation of projects as a way to quickly respond to changes in the external environment is investigated.

1. ***Theoretical background.*** The classic idea of innovations as introduced innovations [1] allows defining an innovative project as a project, the content of which is applied research and/or development, their practical use in production or implementation [2,3]. The implementation of innovative projects is accompanied by a high degree of uncertainty, formed by technological, market, organizational, resource factors [4]. In addition, the entire set of innovative projects has resource constraints due to the boundaries of the parent organization. These circumstances predetermine the difficulties associated with a reliable assessment of innovative projects. The scientific community has developed a fairly stable understanding of the limited use of traditional financial measures of the project's effectiveness — net present value (NPV), profitability index (ROI), internal rate of return (IRR), and others [5,6,7]. Moreover, the development of a new product that does not have a substitute on the market is associated with unpredictable demand and, as a result, the inability to forecast cash flow indicators [8]. When a product innovation relies on a new technology or a combination of technologies, it is difficult to predict the value of a product [9]. Accelerating scientific and technological progress makes innovative projects difficult, ambiguous and unpredictable, and traditional criteria for evaluation and analysis incorrect [10, 11].

The real options method has gained immense popularity among the scientific and expert community as a method that expands the possibilities of traditional financial evaluation of innovative projects when selecting them for a project portfolio [12-17].

The development of the method originates in the work on the assessment of natural resources [18], a free section of urban land [19], time as a strategic resource [20].

At present, there are two perspectives of the use of real options – as a method of specifying the evaluation of innovative projects and as a way to create managerial flexibility in the implementation of projects with a high degree of uncertainty. The first is based on the use of an adapted Black-Scholes model [21] for calculating the value of an option as an opportunity to make a decision to start investing at the most appropriate time for this [22,23], while the traditional method of estimating discounted cash flow implies the immediate launch of the project . In addition to the option of waiting, there are options for zooming in, out of the project, replication, switching [24, 25]. Therefore, if a project has options, its value increases due to the value of the option. It can be assumed that the method of real options allows for a more holistic assessment of the project. This provision is particularly relevant for innovative projects, where the value of the analysis of the variability of management decisions increases with an increase in the degree of uncertainty. It should be noted that the method has several limitations in practical use, due to the assumptions of the original theoretical model. For example, the underlying asset is represented on the open market, its price is unchanged, and the option is exercised instantly, which is quite realizable when it comes to financial instruments, and is limitedly applicable if a tangible or intangible asset is represented as the underlying asset [25].

The second view of using the real options method involves deliberate embedding of various types of options into a project with the aim of interacting with uncertainty. At the same time, a real option is an opportunity to change the course of the project [24], thereby reacting flexibly to the opportunities and threats of an unpredictable environment. Real options are classified into three large groups – 1) options for changing the scale; 2) options for waiting; 3) flexibility options. The first group of options is related to the possibilities of deciding whether to expand or reduce the scope of project implementation, depending on market conditions. The second group is with the possibility of changing the parameters of the project. The third one is with the ability to postpone the decision to invest until more accurate information appears [16]. The use of a real option provides a discrete formation of new project conditions, which gives flexibility and variability in decision making under uncertainty [17, 26, 27]. At the same time, these opportunities generate additional costs for the project, increased stress for the project team or staff of the company associated with the need to constantly adapt to the new conditions of the project, the destruction of the company's strategic focus [28, 29]. Therefore, the method of real options, although widely known in the field of theoretical studies as a progressive management technology, has a rather limited application in practice.

## II. RESEARCH

In this study, the goal was set to study the experience of applying the method of real options in the practice of innovative activity of an enterprise. “Case study” was chosen as the research method. This method is traditional for research, when for obtaining meaningful results, the involvement of company personnel is required in order to clarify and comment on data that is not open and obtained by computational methods [30]. In conducting the study, we used the tools of economic-mathematical modeling and socio-metric methods (interviewing, questioning). Representatives of the top management of the company, representatives of financial services, marketing divisions and R&D departments and the project office were invited to conduct interviews and surveys.

The investigated company is by type of economic activity to high-tech industries. It was founded over 50 years ago. Financial performance indicators indicate a slight, but steady growth of the company. The share of the occupied market for civilian products is 8-15%, for heavy manufacturing products – more than 40%. Indicators of innovation activity: 1) the share of personnel engaged in research and development, – 12.5% of engineering and technical personnel; 2) the volume of investments in research and development – more than 40% of the total volume of investments; 3) the volume of innovative products – not more than 20% in the total output of the enterprise. It should be emphasized that the management of the company uses an expanded range of management technologies at both strategic and operational levels. In particular, when selecting projects for implementation, the use of the real options method is regulated. The corporate guidelines for evaluating, analyzing and monitoring projects, managing changes, suspending and terminating projects have been introduced. A project office has been established at the enterprise, carrying out methodological support of projects. In general, it is possible to assess the corporate project management system of the enterprise under study as well-developed.

The study identified a portfolio of projects of the company, the start time of which was in 2013 and September 2018 in various stages of implementation or completion. The study was conducted on the constant project composition of the portfolio. This is one of the assumptions made in order to assess the consequences of the decisions taken on the suspension or early closure of the project (Table 1). In order to meet the requirements of presenting information relating to a trade secret, the table lists the titles reflecting the main content of the project.

TABLE I. PROJECT TITLES AND STATUSES OF THE STUDIED COMPANY FOR SEPTEMBER 2018

| No. | Project / Planned Implementation Period | Status (reason) |
|---|---|---|
| 1. | Automation of the main production line (2013-2015) | Completed (performed) |
| 2. | Increase in market share for main products (2013-2017) | Implementation (the activity increase has been agreed) |
| 3. | Development of a new small-scale production of import-substituting products (2013) | Postponed (the market is monopolized) |
| 4. | Development and implementation of a new process for the main | Suspended (clarification of technological parameters) |

| | | |
|---|---|---|
| | products (2013-2019) | |
| 5. | Search R&D 1 (2013) | Completed (performed) |
| 6. | Search R&D 2 (2013-2016) | Completed prior to the scheduled time (loss of relevance) |
| 7. | Market launch of a new product (2013 - 2018) | Postponed indefinitely (a substitute appeared on the market) |
| 8. | Reduction of non-core assets (2013) | Completed prior to the scheduled time (completed) |
| 9. | Increase in the profitability of auxiliary production (2013-2015) | Completed (performed) |

Drawn up by the author

Projects 1-4 are identified as investment, and they are aimed at improving the current production and market activities of the company. Projects 5-7 are innovative in nature, their goal is to ensure the technological and product leadership of the company. Projects 8-9 are organizational, do not require investments and are aimed at optimizing the costs of the enterprise.

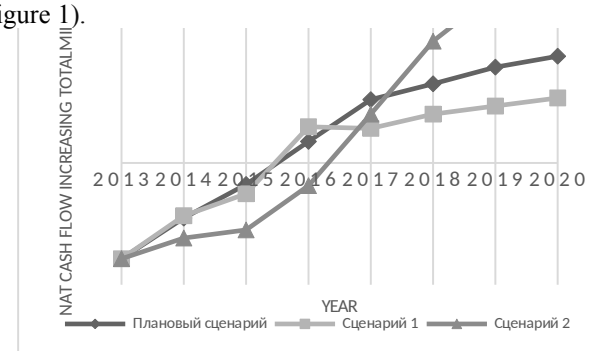
In projects 2, 3, 5-7, real options were identified and/ or embedded. Their valuation was made using the modified Black-Scholes formula, where the exercise price of an option were the costs for the implementation of actions on the underlying asset (scaling, replication, switching, stopping and waiting), the waiting period was set for various types of projects for the company in the range of 5 years, the risk-free rate was set in accordance with the current rate on interbank loans (recommendations from Thomson Reuters), deviations are calculated based on the calculation of the probabilities of the simulated model project scenario. If there are several options in the project, the total value was set not for the total, but for the maximum of the estimated values, since often the execution of one of the options excludes the execution of the other (for example, the execution of the replication option excludes the execution of the exit option). In the course of project implementation, options for all projects were exercised (Table 2).

TABLE II. OPTIONS IN the STUDIED PROJECTS

| Project No. | Project / Planned Implementation Period | Status (reason) |
|---|---|---|
| 2 | Increase in market share for main products (2013-2017) | 1) Scaling ***(performed)***<br>2) Waiting (fulfilled)<br>3) Withdrawal from the project (not performed) |
| 3 | Development of a new small-scale production of import-substituting products (2013) | 1) Replication (not performed)<br>2) Waiting (***performed***)<br>3) Withdrawal from the project (not performed)<br>4) Scaling (not performed)<br>5) Switching (***performed***) |
| 5 | Search R&D 1 (2013-2014) | 1) Replication (not performed)<br>2) Waiting (not performed)<br>3) Withdrawal from the project (not performed)<br>4) Scaling ***(performed)*** |
| 6 | Search R&D 2 (2013-2017) | 1) Replication (not performed)<br>2) Waiting (not performed)<br>3) Withdrawal from the project (***performed***)<br>4) Scaling (not performed) |
| 7 | Market launch of a new product (2016) | 1) Replication (not performed)<br>2) Waiting (***performed***)<br>3) Withdrawal from the project (not performed)<br>4) Scaling (not performed) |

Drawn up by the author

For all of the studied projects, the planned financial indicators — net present value (Net present Value, NPV) and present value of real options (Discount Real Option, DRO) were analyzed, and the current NPV and DRO values were calculated taking into account the information available for making forecasts. It should be noted that for research and development projects, the NPV value was negative, but the assessment of the scaling options identified led to a positive conclusion and their inclusion in the project portfolio. The net cash flows for the cumulative portfolio of projects for the period from 2013 to 2020 were constructed for three scenarios: 1) planned, 2) excluding exercised options (Scenario 1), 3) taking into account real exercised options (Scenario 2). Scenario 1 is a model of cumulative net cash flow, as if none of the built-in options were exercised. During the period from 2019 to 2020 predicted data are justified (Figure 1).




Planned scenario Scenario 1 Scenario 2

Drawn up by the author

Fig. 1 Net cash flow of the company's project portfolio for the three scenarios

It should be emphasized that obtaining correct and reliable data in such studies requires active interaction with company employees who are able to clarify and comment on a number of non-open indicators. We conducted interviews with the head of the project office, the head of the R&D department and the leading analyst of the company's financial department to confirm and clarify a number of calculated data.

## III. DISCUSSION.

An analysis of the results obtained during the study allows us to state a number of important points.

Firstly, the exercise of the options embedded in the projects led to a later exit of the portfolio from the negative zone of the aggregate net cash flow. This is due to additional

costs for the implementation of actions to exercise the option on projects No. 2 and No. 5. At the same time, the termination of financing for project No. 6 (the exit option was exercised) somewhat eased the financial burden of the portfolio. A leading analyst of the financial department noted that *"a change in the resource burden on the project portfolio through the exercise of options carries additional risks, changing the discount rate. Therefore, project cash flow forecasting will have an iterative character. And this makes it difficult to apply traditional static methods for evaluating the effectiveness of projects"*. Therefore, we are dealing with the need for multidimensional dynamic modeling of the portfolio's cash flow, which in the short run simplifies the task of substantiating managerial decisions, and in the long run, significantly complicates the strategic planning process.

Secondly, as of Q2 2018, the actual cash flow of the portfolio (Scenario 2) was 1.53 times higher than the planned scenario and 2.5 times higher than the indicator of model scenario No. 1. This situation became possible due to the timely scaling of the results of project No. 5 and the switching of project No. 3 to the development of the production of other products. According to the Head of the R & D Department, *"the speed of decision making on launching search R&D results (Project No. 5) into production and redesigning project No. 3 made it possible to take a significant share of the relevant market, the primary task now is to fix the result."* Therefore, the exercise of real options has significantly increased the total cash flow of the project portfolio. However, according to the head of the project office of the company, *"project management processes with embedded options are difficult to streamline; this is rather situational management than a formalized structured process. It is hardly possible to talk about the creation of a universal algorithm that allows you to provide the same performance in the future"*.

## IV. CONCLUSION.

The study results show the success of the use of real options in the implementation of a portfolio of innovative projects. Real options can be considered as a way for the company to interact with the uncertainty of the external environment. This is especially relevant for innovative projects of high-tech companies, where the technology update rate is very high. However, the situational nature of the use of real options, coupled with rapidly changing criteria for environmental conditions, does not allow us to create a universal model for managing a portfolio of innovative projects using real options. It is advisable to focus future developments in this direction – creating a multidimensional model that meets the requirements of the basic unification of the processes of embedding and executing real options when managing a portfolio of innovative projects.

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