

UDC 334

**COMPUTER MODELLING OF INVESTMENT RISKS
КОМПЬЮТЕРНОЕ МОДЕЛИРОВАНИЕ
ИНВЕСТИЦИОННЫХ РИСКОВ**

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Ключевые слова: инвестиционный анализ, стартап-проект, ключевые параметры инвестиционного проекта, критерии эффективности, чувствительность стартапа, риски стартапа, алгоритм, программные средства, компьютерная модель, методы программирования, язык макропрограммирования VBA.

Abstract. The article discusses methods for analyzing the risks of investment projects; a computer model has been developed for calculating and assessing the risks of an investment project by the method of sensitivity analysis of performance criteria and the method of scenarios. For this purpose, on the basis of VBA programming technologies and macro programming technologies in the MS Excel spreadsheet processor environment, a software application has been designed. The methodology was tested on the example of a startup project.

Аннотация. В статье рассмотрены методы анализа рисков инвестиционных проектов; разработана компьютерная модель расчета и оценки рисков инвестиционного проекта методом анализа чувствительности критериев эффективности и методом сценариев. Для этой цели на базе технологий программирования на языке VBA и технологий макропрограммирования в среде табличного процессора (ТП) MS Excel спроектировано программное приложение. Проведена апробация методики на примере стартап-проекта.

In the context of the current state of the external environment – a downturn in business activity and stagnation of many economies of the world due to the Covid-19 pandemic, the development of a startup movement stimulates the innovative inclusive growth of the country. Startups are embedded in global value chains, in regional clusters, thereby promoting employment and creating new jobs [4]. The business model of a startup is based on the creation of an innovative product, therefore, in order to provide new accelerators for the growth of the economy of the Republic of Belarus, it is advisable to stimulate the development of innovative entrepreneurship and start-up movement. Support for the start-up movement in Belarus is one of the most important

tools for the development of innovative entrepreneurship. A feature of startups is a low level of business survival. Thus, according to the Startup Genome Report, 92 % of launched startups and 74 % of Internet startups are closed due to premature scaling and an increase in the company's staff.

At the same time, simple methods and algorithms for assessing the effectiveness of a startup project in the MS Excel environment and assessing the risks (sensitivity) of the project for making business decisions by startups have not yet been sufficiently developed.

The purpose of the study is to develop methods and tools for modeling and assessing the effectiveness and risks (sensitivity) of a startup project in the MS Excel environment.

Tasks:

- to develop a methodology for assessing the effectiveness of a startup in the MS Excel environment and to test it;
- develop an algorithm for assessing the sensitivity of a startup project and recommendations for its use in making business decisions.
- develop a computer model for assessing the effectiveness and risks of a startup project.

In accordance with the methodology of business planning [3, 4], an algorithm for evaluating the effectiveness of a startup (software application) is proposed, which includes the following stages of implementation.

Stage 1. Selecting indicators for evaluating the effectiveness of a startup. Indicators for assessing the effectiveness of a business project are determined in accordance with the regulatory document on business planning – Resolution of the Ministry of Economy of the Republic of Belarus dated August 31, 2005 No. 158 "On approval of the rules for developing business plans for investment projects" [2]:

1. net present value (NPV);
2. index of return on investment (ROI);
3. dynamic payback period (current);
4. internal rate of return (IRR);
5. the sensitivity of the startup project.

Stage 2. Determination of the initial data. Based on the data of the financial plan for each individual startup, the following indicators are calculated:

1. the size of the initial investment in a startup (one-time costs for the acquisition and installation of fixed assets; for registration and registration of a business, obtaining licenses, marketing, etc.);
2. calculation horizon (defined as the payback period plus 1 year) [2];
3. discount rate (taken at the level of the National Bank's refinancing rate or the actual interest rate on long-term bank loans. A risk adjustment from 5 to 25 % may be added) [2];
4. current costs of production and sale of a product by years of project implementation (costs are calculated by cost elements) [2].

Stage 3. Calculation of baseline values of startup performance indicators. The calculation is carried out in the MS Excel environment based on the developed software application.

To simulate the calculation of each of the four indicators of the investment project, the corresponding modules have been developed, placed on separate sheets of the MS Excel workbook and ensuring the execution of input operations, as well as the calculation of the corresponding indicator of the startup's efficiency and the formulation of conclusions based on the results. The mechanism for filling tables with data and calculating efficiency criteria is automated by means of a system for end-to-end addressing of cells with elements of macro programming. To implement the calculations, formulas have been compiled using built-in functions: financial, statistical, logical and mathematical categories. To navigate between application modules, controls and a system of hyperlinks have been developed.

Stage 4. Modeling and risk assessment of a startup project.

To simulate and analyze the risks (sensitivity) of start-up projects, a computer model has been developed, implemented using the MS Excel software application. When developing the application, VBA programming technologies and macro programming capabilities were used. The computer model is based on an algorithm compiled by the authors, which includes the following actions.

1. Calculation of efficiency indicators: net present value (NPV), profitability index (IR), dynamic payback period (Current) when the following factors change:

- increase in the cost of production and sale of products (works, services);
- increasing the volume of initial investment in a startup;
- decrease in sales volumes (proceeds from sales).

2. Analysis of sensitivity indicators characterizing the sensitivity of the project for each of the factors.

3. Development of three types of startup scenarios – probable (the base one with a probability of 0.5), the worst one – "pessimistic" (with a probability of 0.25), and the best one – "optimistic" (with a probability of 0.25), with a corridor of changes in key parameters $\pm 5\%$ [1].

4. Investigation of the influence of a set of key project indicators on the value of the efficiency criterion for each of the scenarios based on the analysis of probabilistic estimates of its deviations.

Templates of tables with formulas in cells to automate the calculation of the sensitivity of startup project performance criteria to changes in the baseline indicators of the project are presented in the Sensitivity Analysis module in the application developed by the authors. When you enter into the template tables different variants of the values of the initial data – the size of the initial investment, cash flows – using the formulas and built-in functions of the "Financial" category, the values of the main performance indicators of the investment startup project are calculated. By varying the initial values of the above factors (initial investment, sales volume and production costs), it is possible to interactively simulate and evaluate the values of the net present value, the profitability index and the dynamic payback period of the startup in question.

Analysis of probabilistic estimates of deviations of key indicators of a startup allows not only to determine the break-even point of a project, but also to assess the viability of a startup in principle.

The application was tested on the example of a start-up project for organizing a virtual eco-farm "i-FerMir", developed under the supervision of Prof. Yasheva G.A, Doctor of Economics.

Thus, the methodology for analyzing and assessing the risks (sensitivity) of a startup, implemented with the help of a computer model developed by the authors in the environment of the MS Excel software application, allows in an interactive mode not only to simulate various scenarios for the implementation of the project, but also to determine the critical values of factors and, thereby, contribute to developing effective business solutions. Thus, in order to prevent the critical importance of changing factors, a startup can adjust their business strategy.

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