

Economics of knowledge-intensive and high-tech enterprises and industries.  
Management in organizational systems  
Экономика наукоемких и высокотехнологичных предприятий и производств.  
Управление в организационных системах

UDC 330.354

<https://doi.org/10.32362/2500-316X-2022-10-2-75-86>

## RESEARCH ARTICLE

## Features of assessing the investment attractiveness of high-tech projects

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### Abstract

**Objectives.** The creation of high-tech projects is one of the main stages of the transition to an innovative economy. This can further be explained by the intensive development of globalization processes in the economic system of Russia. High-tech projects have lower profitability when compared to venture projects, but a higher probability of commercial success. In Russia, there are currently six areas of support programs for high-tech projects. Moreover, there are a large number of operators supporting high-tech projects actively working in the Russian market. The acceleration of the technological development requires an intensification of innovation policy and a revision of the portfolio of its acting instruments. In turn, this makes the matter of analyzing their significance and relevance for participants in innovation processes more pertinent. The purpose of this work is to identify features of the investment process in the Russian Federation, and determine criteria for selecting priority high-tech projects and methods of evaluating high-tech projects, in the aim of making informed investment decisions.

**Methods.** Models for assessing the investment attractiveness of high-tech projects were constructed using economic and mathematical modeling methods, in particular, nonlinear and dynamic programming methods.

**Results.** The general principles and approaches to methods of evaluating the efficiency were analyzed. A model of the priorities of high-tech projects was presented. Models which take into account cash flows after the expiration of the payback period were also considered (by means of the nonlinear programming of calculation of the discounted payback period of investment costs and the modernized discounted payback period of investment costs). An algorithm for assessing the investment attractiveness of high-tech projects was demonstrated.

**Conclusions.** To date, there has been no single algorithm for assessing the investment attractiveness of high-tech projects. However, the integrated application of the methods and models proposed in this work will allow investors to make informed investment decisions despite the complexity of project financing in innovative developments.

**Keywords:** high-tech projects, innovative projects, government support, evaluation of the financial and economic efficiency of the project, evaluation methods, project financing

• Submitted: 01.03.2021 • Revised: 15.10.2021 • Accepted: 28.02.2022

**For citation:** Mandych I.A., Bykova A.V., Gaiman O.B. Features of assessing the investment attractiveness of high-tech projects. *Russ. Technol. J.* 2022;10(2):75–86. <https://doi.org/10.32362/2500-316X-2022-10-2-75-86>

**Financial disclosure:** The authors have no a financial or property interest in any material or method mentioned.

The authors declare no conflicts of interest.

НАУЧНАЯ СТАТЬЯ

## Особенности оценки инвестиционной привлекательности высокотехнологичных проектов

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### Резюме

**Цели.** Создание высокотехнологичных проектов является одним из главных этапов перехода к инновационной экономике, что объясняется интенсивным развитием процессов глобализации в экономической системе нашей страны. Высокотехнологичные проекты обладают меньшей доходностью по сравнению с венчурными проектами и более высокой вероятностью коммерческого успеха. На данный момент в России есть шесть направлений программ поддержки высокотехнологичных проектов. Кроме того, на российском рынке активно работает большое количество операторов поддержки таких проектов. Ускорение технологического развития требует активизации инновационной политики и пересмотра «портфеля» ее действующих инструментов. Это, в свою очередь, актуализирует задачу анализа их значимости и востребованности для участников инновационных процессов. Целью статьи является выявление особенностей процесса инвестирования в РФ, определение критериев отбора приоритетных высокотехнологичных проектов и методов их оценки для принятия взвешенных инвестиционных решений.

**Методы.** При построении моделей оценки инвестиционной привлекательности высокотехнологичных проектов использованы экономико-математические методы моделирования, а именно методы нелинейного и динамического программирования.

**Результаты.** В рамках статьи проанализированы общие принципы и подходы к методам оценки эффективности проекта. Представлены модель приоритетов высокотехнологичных проектов и модели (нелинейного программирования расчета дисконтированного срока окупаемости инвестиционных затрат и модернизированного дисконтированного срока окупаемости инвестиционных затрат), позволяющие учесть денежные потоки после истечения срока окупаемости. Показан алгоритм оценки инвестиционной привлекательности высокотехнологичных проектов.

**Выводы.** На сегодняшний день не существует единого алгоритма оценки инвестиционной привлекательности высокотехнологичных проектов. Тем не менее, комплексное применение предложенных методов и моделей позволит инвесторам, несмотря на сложность проектного финансирования инновационных разработок, принимать обоснованные инвестиционные решения.

**Ключевые слова:** высокотехнологичные проекты, инновационные проекты, государственная поддержка, оценка финансово-экономической эффективности проекта, методы оценки, финансирование проекта

• Поступила: 01.03.2021 • Доработана: 15.10.2021 • Принята к опубликованию: 28.02.2022

**Для цитирования:** Мандыч И.А., Быкова А.В., Гейман О.Б. Особенности оценки инвестиционной привлекательности высокотехнологичных проектов. *Russ. Technol. J.* 2022;10(2):75–86. <https://doi.org/10.32362/2500-316X-2022-10-2-75-86>

**Прозрачность финансовой деятельности:** Авторы не имеют финансовой заинтересованности в представленных материалах или методах.

Авторы заявляют об отсутствии конфликта интересов.

### INTRODUCTION

The creation of high-tech projects is one of the main stages in the transition to an innovative economy. This is explained by the intensive development of globalization processes in the economic system of Russia. High-tech projects have a lower profitability compared to venture projects, but a higher probability of commercial success.

At the present time, there are a large number of operators supporting high-tech projects actively working in Russia (Fig. 1). The acceleration of technological development requires an intensification of innovation policy and revision of the portfolio of its acting instruments. In turn, this makes the matter of analyzing their significance and relevance for participants in innovation processes more pertinent.

The purpose of this work is to identify features of the investment process in the Russian Federation, and to determine criteria for selecting priority high-tech projects and methods of evaluating high-tech projects in the aim of making informed investment decisions.

The study aims to analyze the general principles and approaches to methods of evaluating project efficiency. A model of priorities of high-tech projects was presented. Models which take into account cash flows after the expiration of the payback period were also considered, as well as an algorithm for assessing the investment attractiveness of high-tech projects.

### **INVESTIGATION OF FEATURES OF THE INVESTMENT PROCESS IN RUSSIA**

In order to resolve current problems, it should be noted that an important component in high-tech projects is novel science-intensive technologies. The key industries which ensure the sustainable growth of the economic system of Russia are now those sectors of economy which use science-intensive technologies [1]. The commitment of the economic system to innovation is one of the driving forces of the social and economic development and the improvement of the competitiveness of the national economy.

Attracting Russian investment in the domestic economy has become a task of primary importance [2]. Support programs for high-tech projects include<sup>1</sup>:

- support for small innovative enterprises,
- support for pilot projects of implementation of domestic digital solutions,
- support for projects of implementation of domestic IT solutions,
- support for projects of development and improvement of domestic software,
- support for industrial developments,
- concessional lending to companies.

The “Digital Technologies” Federal Project of the “Digital Economy” National Program<sup>2</sup> includes an integrated system of measures for the state support of projects for the development and implementation of domestic digital products, services, and platform solutions. The “Measures for the Support of Digital

Initiatives” Portal<sup>3</sup> was created especially for the information support of enterprises in the implementation of this Program.

The Industry Development Fund (IDP) proposes 10 concessional project financing programs with loans amounting to RUR 5 to 750 mln, at an interest rate of 1 to 5%. In 2015–2019, IDP financed 27 Republican projects to an amount of more than RUR 6 bn.

Since 2016, in Russia under the auspices of the Ministry of Economic Development of the Russian Federation, there is a project entitled “Support for the Leading Private High-Tech Companies” (“National Champions”)<sup>4</sup> which creates conditions necessary for the leading private domestic export-oriented high-tech companies. This project assists the formation of Russia-based transnational companies.

In order to participate in the project, companies are selected from the database of winners of the TekhUspekh (Tech Success) Rating.<sup>5</sup> The annual revenue of a company in the project ranges from RUR 400 mln to RUR 20 bn. The companies specialize in such segments as pharmaceuticals, medical equipment production, machine building, electronics and instrument manufacturing, novel materials, information technologies and telecommunications, chemical industry, and industrial automation.<sup>6</sup>

Not all the projects, however, provide the expected results, and, on the whole, Russian enterprises are insufficiently involved in the innovation process. Only those companies operating in high tech segments of the processing industry are active in innovation, even though high-tech companies that should be interested in state support. State support was used only by 46% of all the respondents and about 48% of innovative companies.

Figure 2 presents the percentages of state-supported high-tech enterprises.

Those companies most interested in state support are machine and equipment manufacturers (transport machine building). They are the main recipients of subsidies of state and federal target innovation

<sup>3</sup> Support Measures for Digital Initiatives. URL: <https://e-digital.tatar/>. Accessed December 5, 2020 (in Russ.).

<sup>4</sup> National Champions. Priority Project of the Ministry of Economic Development of the Russian Federation “Support for the Leading Private High-Tech Companies.” URL: <http://national-champions.ru/>. Accessed December 7, 2020 (in Russ.).

<sup>5</sup> TekhUspekh. National Rating of Russian Fast-Growing Technology Companies. URL: <http://ratingtechup.ru/>. Accessed December 7, 2020 (in Russ.).

<sup>6</sup> Support for the Leading Private High-Tech Companies. URL: [https://www.economy.gov.ru/material/departments/d01/razvitiye\\_sistemy\\_gosudarstvennoy\\_podderzhki\\_innovatsiy\\_v\\_subektah\\_nacionalnye\\_chempiony/](https://www.economy.gov.ru/material/departments/d01/razvitiye_sistemy_gosudarstvennoy_podderzhki_innovatsiy_v_subektah_nacionalnye_chempiony/). Accessed December 7, 2020 (in Russ.).

<sup>1</sup> Navigator of Support Measures. Federal Project “Digital Technologies” of National Program “Digital Economy.” URL: <https://digital.ac.gov.ru/support/>. Accessed December 1, 2020 (in Russ.).

<sup>2</sup> Passport of National Program “Digital Economy of Russian Federation.” URL: <http://static.government.ru/media/files/urKHm0gTPPnzJlaKw3M5cNLo6gczMkPF.pdf>. Accessed December 5, 2020 (in Russ.).

Name of event	Program operator (contest organizer), source of financing, and type of event
Refinancing of present credits for capital investment of investment projects in monotowns	Monotown Development Foundation (loan), Federal Corporation for the Development of Small and Medium Enterprises (FCDSME) (guarantee), Guarantee Fund (guarantee), Government of the Russian Federation (compensation of difference between interest rates). Concessional loan is provided to small, medium-sized, and large business unrelated to activities of town-forming enterprises (TFEs) at annual interest rate of 0 or 5%
Subsidy (co-financing of expenditures) for creation and development of industrial parks	Ministry of Economic Development (MED) of Russia within the National Project "Development of SME and Entrepreneurship". <sup>1</sup> RF Government Regulation no. 2489 of December 25, 2021, <sup>2</sup> and no. 316 of April 15, 2014. <sup>3</sup> MED Order no. 125 of March 14, 2019, <sup>4</sup> and no. 67 of February 14, 2018. <sup>5</sup> Subsidy (target budget co-financing) is provided by MED of RF.
Co-financing of municipal expenditures on retrofit of utility, road, and civil engineering infrastructure of accredited industrial parks and industrial estates	Ministry of the Economy of RT. Subsidy (target budget co-financing) is provided to municipality
Subsidy of interest rates on target credits to small and medium-sized enterprises (SME) in priority industries and residents of industrial estates (industrial parks)	Entrepreneurship Support Fund of RT. Compensation of part of interest rate (to 15 p.p.) on credits for SME in priority industries and residents of industrial estates (industrial parks)
Priority research and development tax exemption	Tax Code of RF. Deduction of research and development expenses multiplied by 1.5 from taxable profit
RAZVITIE-SOPR Contest for development of socially oriented projects	FGBU Foundation for Assistance to Small Innovative Enterprises in Science and Technology. R&D grant up to RUR 10 mln for socially oriented projects
Concessional loans for social entrepreneurs from Entrepreneurship Support Fund of Republic of Tatarstan (RT)	Entrepreneurship Support Fund of RT (Ministry of the Economy of RT). Concessional microloan up to RUR5 mln at interest rate of 5% is provided to social entrepreneurs
Tax exemptions for residents of priority social and economic development areas (PSEDA) in the Russian Federation (Naberezhnye Chelny, Mendeleevsk)	Ministry of the Economy of RT, Municipal Executive Committee. Profit, property, and land tax relief and other benefits for PSEDA residents (including support for IT companies as PSEDA residents)
Concessional (0% or 5%) loans for business in monotowns	VEB.RF–Monotown Development Foundation (loan), FCDSME (guarantee). Concessional loan is provided to small, medium-sized, and large business unrelated to activities of TFEs at annual interest rate of 0% or 5%
Concessional loans for SME from Federal Corporation for Development of Small and Medium-Sized Business	FCDSME and MED. FCDSME concessional loan is provided in priority industries at annual interest rate of 8.5% (through partner banks) with subsidization (compensation) of shortfall in income of banks; business in priority industries, 9.6%; and other SME, 10.6% (through partner banks)

Fig. 1. Programs of state support for high-tech projects (Sheet 1)

<sup>1</sup> Passport of National Project "Small and Medium-Sized Enterprises and Support for Individual Entrepreneurial Initiative." URL: <http://static.government.ru/media/files/qH8voRLuhAVW SJhIS8XYbZBsAves8A5t.pdf>. Accessed January 26, 2022 (in Russ.).

<sup>2</sup> Regulation of the Government of the Russian Federation No. 2489 of December 25, 2021, "On the Amendments to the State Program of the Russian Federation 'Economic Development and Innovative Economy' and the Annulment of Certain Acts and Individual Provisions of Certain Acts of the Government of the Russian Federation." URL: <http://publication.pravo.gov.ru/Document/View/0001202112300075>. Accessed January 26, 2022 (in Russ.).

<sup>3</sup> Regulation of the Government of the Russian Federation No. 316 of April 15, 2014, "On the Approval of the State Program of the Russian Federation 'Economic Development and Innovative Economy,'" <https://base.garant.ru/70644224/>. Accessed January 26, 2022 (in Russ.).

<sup>4</sup> Order of the Ministry of Economic Development of the Russian Federation No. 125 of March 14, 2019, "On the Approval of the Requirements for the Implementation of Measures by the Subjects of the Russian Federation the Budgets of Which Are Granted Subsidies for the State Support for Small and Medium-Sized Enterprises in the Subjects of the Russian Federation in Order to Reach Goals, Metrics, and Results of Federal Projects Being Parts of the National Project 'Small and Medium-Sized Enterprises and Support for Individual Entrepreneurial Initiative,'" and the Requirements for Organizations Forming the Infrastructure of the Support for Small and Medium-Sized Enterprises." URL: [https://www.economy.gov.ru/material/file/f01d6c61e7595ef12bc1e93f156a95ec/prikaz\\_125\\_14032019.pdf](https://www.economy.gov.ru/material/file/f01d6c61e7595ef12bc1e93f156a95ec/prikaz_125_14032019.pdf). Accessed January 26, 2022 (in Russ.).

<sup>5</sup> Order of the Ministry of Economic Development of the Russian Federation No. 67 of February 14, 2018, "On the Approval of the Requirements for the Implementation of Measures by the Subjects of the Russian Federation the Budgets of Which Are Granted Subsidies for the State Support for Small and Medium-Sized Enterprises, Including Peasant (Farm) Enterprises, and Also for the Implementation of Support Measures for Youth Entrepreneurship, and the Requirements for Organizations Forming the Infrastructure of the Support for Small and Medium-Sized Enterprises." URL: <https://normativ.kontur.ru/document?moduleId=1&documentId=356380>. Accessed January 26, 2022 (in Russ.).

**Fig. 1.** Programs of state support for high-tech projects (*Sheet 2*)



Share of companies that have used at least one measure for support	Pharmaceutics		Computers, instrument manufacturing, and telecommunications		Chemicals		Electrical equipment		Transport machine building (except aviation)		Aerospace		Other machine building	
	51.3		42.8		40.1		30.5		65.8		51.4		49.3	
Measures of state support of innovation activity	1	<div><div></div></div> 13.2	<div><div></div></div> 10.8	<div><div></div></div> 12.5	<div><div></div></div> 4.9	<div><div></div></div> 6.0	<div><div></div></div> 17.1	<div><div></div></div> 13.2						
	2	<div><div></div></div> 13.2	<div><div></div></div> 6.5	<div><div></div></div> 12.5	<div><div></div></div> 6.0	<div><div></div></div> 13.6	<div><div></div></div> 23.7	<div><div></div></div> 7.4						
	3	<div><div></div></div> 24.7	<div><div></div></div> 9.5	<div><div></div></div> 27.1	<div><div></div></div> 17.1	<div><div></div></div> 44.2	<div><div></div></div> 21.2	<div><div></div></div> 21.4						
	4	<div><div></div></div> 21.7	<div><div></div></div> 10.2	<div><div></div></div> 17.0	<div><div></div></div> 11.7	<div><div></div></div> 16.3	<div><div></div></div> 22.6	<div><div></div></div> 16.3						
	5	<div><div></div></div> 9.5	<div><div></div></div> 8.6	<div><div></div></div> 17.4	<div><div></div></div> 8.8	<div><div></div></div> 20.5	<div><div></div></div> 10.8	<div><div></div></div> 13.1						
	6	<div><div></div></div> 9.2	<div><div></div></div> 0.0	<div><div></div></div> 5.1	<div><div></div></div> 1.7	<div><div></div></div> 0.0	<div><div></div></div> 5.2	<div><div></div></div> 7.9						
	7	<div><div></div></div> 7.6	<div><div></div></div> 2.6	<div><div></div></div> 10.6	<div><div></div></div> 6.0	<div><div></div></div> 14.1	<div><div></div></div> 17.0	<div><div></div></div> 6.8						
	8	<div><div></div></div> 12.2	<div><div></div></div> 4.7	<div><div></div></div> 15.2	<div><div></div></div> 6.5	<div><div></div></div> 30.4	<div><div></div></div> 11.7	<div><div></div></div> 9.6						
	9	<div><div></div></div> 8.9	<div><div></div></div> 3.9	<div><div></div></div> 10.0	<div><div></div></div> 1.9	<div><div></div></div> 15.0	<div><div></div></div> 16.4	<div><div></div></div> 8.4						
	10	<div><div></div></div> 16.8	<div><div></div></div> 7.2	<div><div></div></div> 14.7	<div><div></div></div> 1.3	<div><div></div></div> 12.3	<div><div></div></div> 3.2	<div><div></div></div> 9.8						
	11	<div><div></div></div> 13.2	<div><div></div></div> 3.4	<div><div></div></div> 13.6	<div><div></div></div> 4.1	<div><div></div></div> 33.4	<div><div></div></div> 9.8	<div><div></div></div> 14.7						
	12	<div><div></div></div> 4.6	<div><div></div></div> 3.0	<div><div></div></div> 8.0	<div><div></div></div> 3.6	<div><div></div></div> 14.3	<div><div></div></div> 9.8	<div><div></div></div> 6.0						
	13	<div><div></div></div> 3.9	<div><div></div></div> 0.8	<div><div></div></div> 5.5	<div><div></div></div> 1.9	<div><div></div></div> 0.0	<div><div></div></div> 11.8	<div><div></div></div> 5.4						
	14	<div><div></div></div> 6.6	<div><div></div></div> 2.1	<div><div></div></div> 10.0	<div><div></div></div> 5.1	<div><div></div></div> 8.4	<div><div></div></div> 27.2	<div><div></div></div> 9.1						
	15	<div><div></div></div> 0.0	<div><div></div></div> 4.7	<div><div></div></div> 10.0	<div><div></div></div> 1.9	<div><div></div></div> 0.0	<div><div></div></div> 5.3	<div><div></div></div> 6.5						
	16	<div><div></div></div> 8.9	<div><div></div></div> 9.6	<div><div></div></div> 8.1	<div><div></div></div> 1.3	<div><div></div></div> 4.9	<div><div></div></div> 10.9	<div><div></div></div> 11.0						
	17	<div><div></div></div> 21.0	<div><div></div></div> 9.5	<div><div></div></div> 21.4	<div><div></div></div> 11.0	<div><div></div></div> 32.7	<div><div></div></div> 27.9	<div><div></div></div> 18.0						
	18	<div><div></div></div> 9.9	<div><div></div></div> 8.7	<div><div></div></div> 17.7	<div><div></div></div> 6.3	<div><div></div></div> 10.8	<div><div></div></div> 18.5	<div><div></div></div> 8.7						

Fig. 2. Percentages of state-supported enterprises in 2019

ИСТОЧНИК: Demand for Instruments of State Innovation Policy from Enterprises of High-Tech Industries, URL: <https://issek.hse.ru/news/293711880.html>. Accessed July 4, 2021 (in Russ.).

programs and concessional loans from the Industry Development Fund. Those least interested are manufacturers of electrical equipment, computers, instruments, and telecommunications.

In order to more efficiently support technological startups and develop high-tech industries, an active innovation policy vector was formulated in 2020 through the revision of the portfolio of acting instruments<sup>7</sup>. Another new instrument facilitating the development of high technologies is corporate venture fund (CVF). The classical process of new product development in large companies has become increasingly lengthier and more risky. Therefore, wider use is made of alternative methods to implement innovation through external investment obligations in technology alliances. CVF is a unique instrument in comparison with independent venture funds (IVFs) because it typically strives to reach the strategic, rather than financial, objectives of the parent company. These objectives are directly or indirectly aimed at increasing sales and profits of its ongoing business by accessing new technologies, resources, and markets, rather than the startup which was invested.

High-tech projects are characterized by a high added value of project products. This is due to using

breakthrough technologies and other achievements of science and technology.<sup>8</sup>

High-tech projects are developed using the latest achievements and results of research and design in priority industries. The development of such projects is costly and requires significant investment. They are also high risk because these projects are characterized by high uncertainty at each lifecycle stage.

Increasingly larger investment in high-tech industries is a trend of recent decades and they end to control the qualitative growth of economy. New technologies have become a driver of growth of national economies and determine a country's ability to hold its competitive position in the global market [3]. Investment in high-tech projects is a complex and, at the same time, very promising activity. They can be highly significant for society and the country as a whole [4].

When choosing high-tech project are factors which affect priorities are very important. These factors can be used to create a model of priorities. The complexity of given factors can be represented using a classification based on financed projects and projects awaiting financing. Such a classification is quite general and it would be more more expedient to use a ranking of

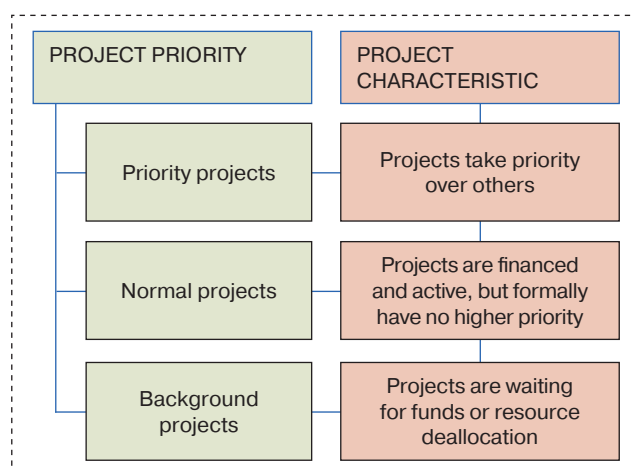
<sup>7</sup> Demand for Instruments of State Innovation Policy from Enterprises of High-Tech Industries, URL: <https://issek.hse.ru/news/293711880.html>. Accessed July 4, 2021 (in Russ.).

<sup>8</sup> Decree of the President of the Russian Federation No. 642 of December 1, 2016, "On the Strategy of the Science and Technology Development of the Russian Federation." URL: <http://government.ru/docs/all/109256/>. Accessed January 26, 2022 (in Russ.).

projects in terms of priority, normal, and background projects (Fig. 3).

Project priority criteria are illustrated by impetuously accelerated trends:

1. Promotion of import substitution.
2. Access to foreign markets—export of Russian technologies and business models.
3. Sharp increase in the number of remote workers. This factor has prompted the development of teamwork services, videoconferencing, cloud storage and cybersecurity, and production of computers and electronic and optical products.
4. Increase in the importance of the development of public health infrastructure projects because of the development of the medical rehabilitation market in the post-pandemic period.
5. Technological solutions purpose-built for state needs (GosTekh). The drivers of the implementation of innovation in the state sector are such factors as the digitalization of state services and digitalization of business processes in government agencies.



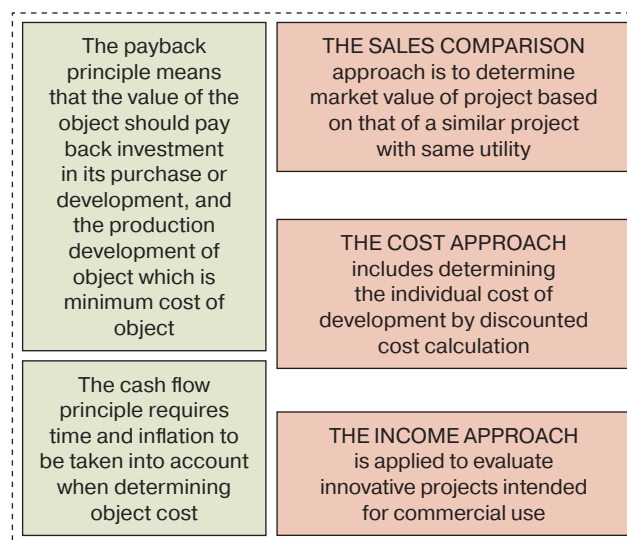
**Fig. 3.** High-tech project priority model

More complex priority models can be constructed using various mathematical methods [5]. However, there is a contradiction: funds, which are earmarked for finding promising investment projects are not keen on widely disseminating information about themselves, since they consider that investment should be applied by project developers. Meanwhile, project developers very often consider investors unavailable and, therefore, do not apply to them for support measures.

The main financial instruments of state and private financing programs are grants, subsidies, subsidized loans and credits, investment loans, subsidized leasing, government research contracts, syndicated transactions, and convertible loans and venture capital funding.

## INVESTIGATION OF METHODS AND MODELS OF EVALUATING THE EFFICIENCY OF HIGH-TECH PROJECTS

Figure 4 presents the general principles and approaches to methods of evaluating the project efficiency.



**Fig. 4.** General principles and approaches to methods of project efficiency evaluation

The general principles and approaches to methods of project efficiency evaluation (Fig. 4) can be used by investors both separately and jointly. Their selection depends on the competitive characteristics of project/product and on factors affecting the innovative project [6].

The effectiveness of a project determines its relevance to the desired objectives and stakeholder interests [7]. The financial and economic efficiency of a project is the ratio of the financial and economic results of the activities of the project team in relation to the financial and economic cost of the project. Depending on whether or not cash flow discounting is used, evaluation methods are divided into two large groups: static and dynamic (Fig. 5).

Investors more frequently use dynamic methods of efficiency evaluation. These methods are more advantageous, since they take into account time as a significant factor of change in the value of money. Such methods of investment project efficiency evaluation better meet current requirements since they are based on a discounted cash flow model.<sup>9</sup> Nevertheless, in the case of investment in short-term projects, wherein time changes can be assumed to be statically insignificant,

<sup>9</sup> Evaluation of Efficiency of Investment Project: Methods and Recommendations. URL: <https://www.business.ru/article/1829-otsenka-effektivnosti-investitsionnogo-proekta>. Accessed July 4, 2021 (in Russ.).

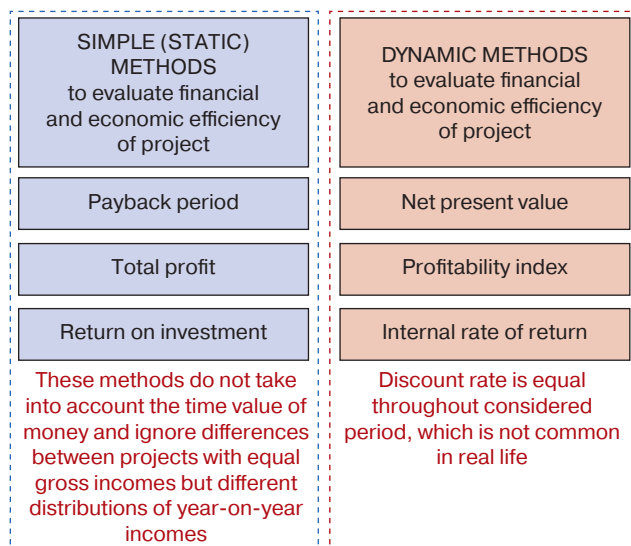


Fig. 5. Main project efficiency evaluation methods

simple methods of evaluating financial and economic efficiency are often used. However, they cannot take into account numerous factors significant for the project in calculations [8].

The models presented below take into account cash flows after the expiration of the payback period. This is an extremely important factor when it came to making the decision of whether or not it is expedient to invest in a high-tech project.

The first of these models (Fig. 6) is a nonlinear programming model of calculating the discounted payback period of investment. This model makes it possible to determine the time needed for the net present value of a high-tech project to be equal to the investment. Figure 6 also gives the parameters of this model [9].

Calculations using this model are quite easily performed in the Microsoft Excel Solver add-in. This add-in is a very good tool for solving optimization problems.

Further reinvestment is not taken into account in this solution. However, if the conditions for the reinvestment of net present values are known, then the modernized discounted payback period can be found.

The second model (Fig. 7) is a nonlinear programming model for calculating the modernized discounted payback period of investment. This model determines the time it takes for the net present value and additional net reinvestment income of a high-tech project to be equal to the initial investment [9].

The methods and models of evaluating the efficiency of high-tech projects presented herein help investors to make an informed decision. However, for a more in-depth analysis, it would be advisable to carry out not an isolated study of only the financial component of a project, but a more extensive investigation. This would take into account the area of implementation of the high-tech project.

The following algorithm of economic assessment of investment attractiveness of high-tech projects (Fig. 8) is also recommended.

The algorithm for the economic assessment of investment attractiveness of high-tech projects consists of two steps:

- selection of priority high-tech projects and their substantiation according to selected criteria;
- evaluation of the economic efficiency of high-tech projects in terms of the financial and economic methods which take into account maximum possible number of factors significant for project.

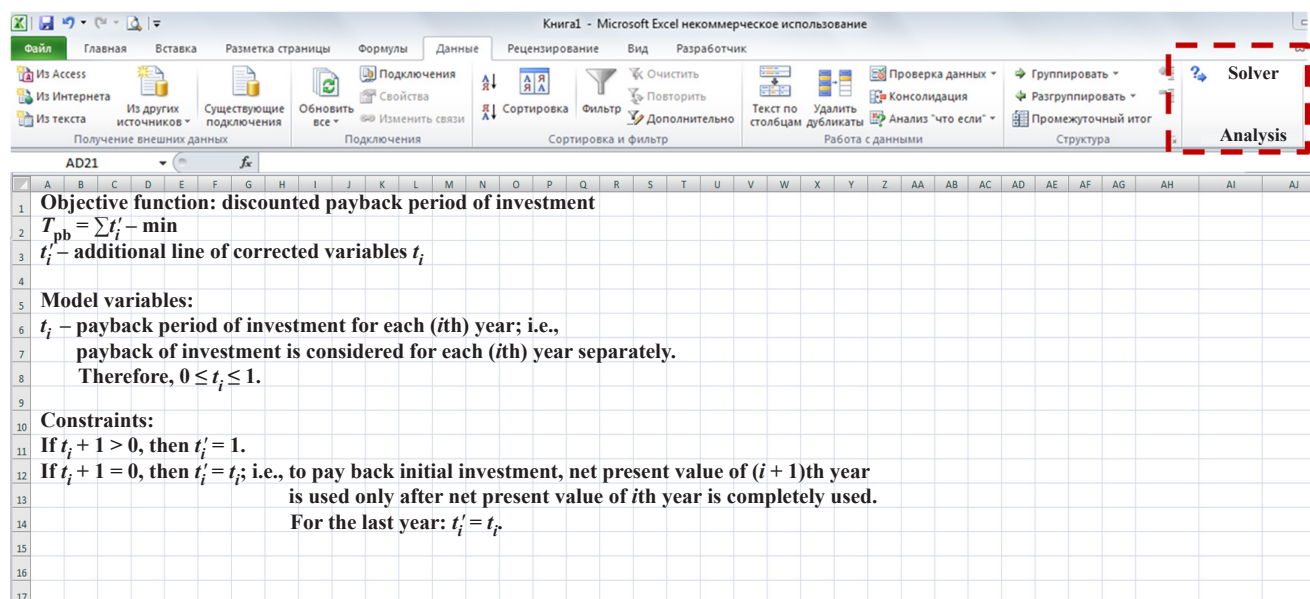
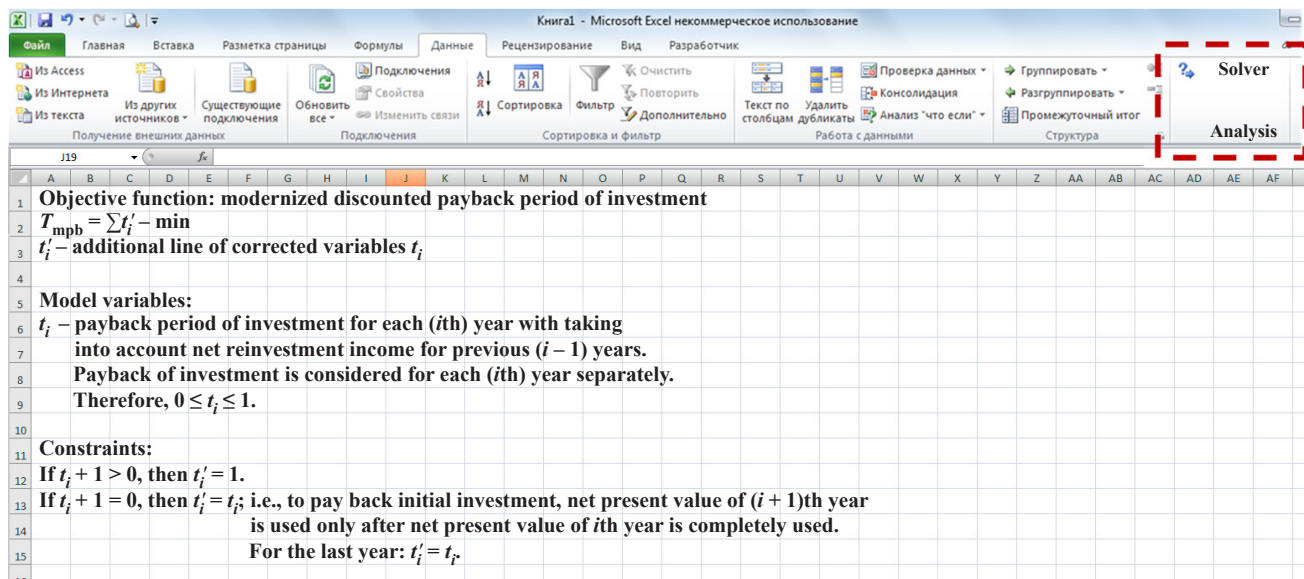
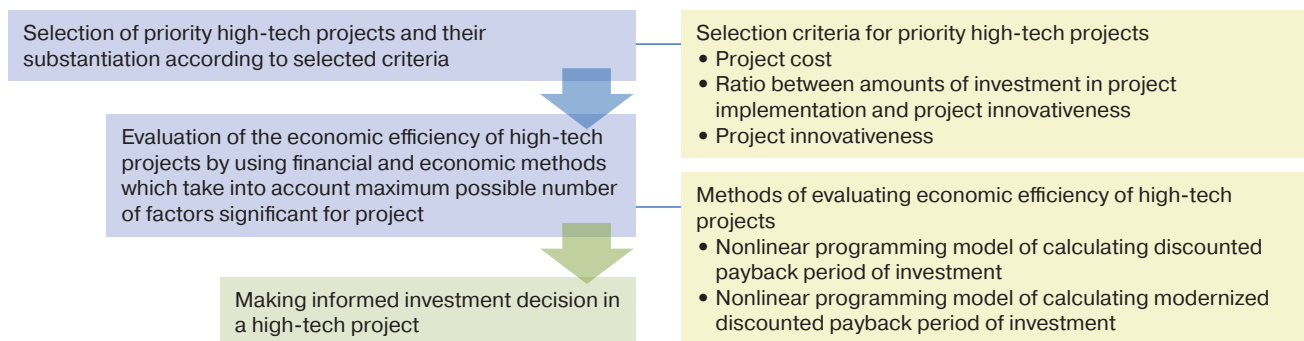


Fig. 6. Parameters of the first model of evaluating the financial and economic efficiency of a high-tech project





**Fig. 7.** Parameters of the second model of evaluating the financial and economic efficiency of a high-tech project



**Fig. 8.** Algorithm of economic assessment of investment attractiveness of high-tech projects

In the first step, the selection criteria for priority high-tech projects are chosen. The main criteria are project cost, ratio between amounts of investments in project implementation and project innovativeness (technological, marketing, or organization innovations). In terms of the latter, we mean the probability of commercial success (expected added value of project product),

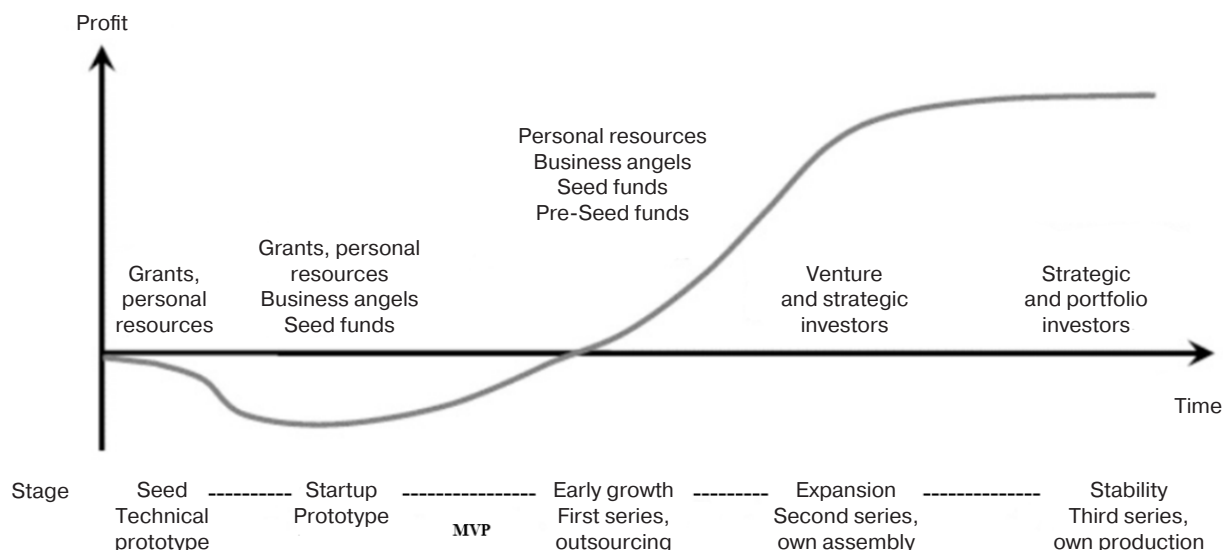
In the second step, the project is evaluated in terms of the financial and economic methods using models which take into account as many factors significant for project as possible:

- nonlinear programming model of calculating discounted payback period of investment;
- nonlinear programming model of calculating modernized discounted payback period of investment.

Importantly, the investment decision lead time is very short. The key stage at which investors decide to invest is the Seed stage. At this stage which, investment is required to bring the product to market requirements (in this case, investment can reach RUR 10 mln). Consequently, the assessment algorithm should be sufficiently simple, and the evaluation methods should be efficient. They should take into account the maximum possible number of factors which are significant for high-tech project.

Figure 9 represents the main stages of financing high-tech projects in terms of rounds of financing.

Certain financing sources correspond to each stage of the project, for example, at the Pre-Seed stages, grants and investment of own resources are required. There may also be a requirement for the support of business angels or seed funds. At later stages, subsidies or convertible loans may be needed.



**Fig. 9.** Rounds of financing

Source: Morozov A. Having a startup capital of RUR 10–15 mln, it is no problem to raise about RUR 600 mln more for a hardware project. There is a lot of money in the country, especially for industry. URL: [https://json.tv/ict\\_news\\_read/aleksandr-morozov-akselerator-territoriya-imeya-10-15-mln-rublej-pervonachalnogo-kapitala-privlech-esche-poryadka-600-millionov-na-hardware-proekt-dlya-promyshlennosti-ne-problema-deneg-v-strane-ochen-mnogo-20171228014631](https://json.tv/ict_news_read/aleksandr-morozov-akselerator-territoriya-imeya-10-15-mln-rublej-pervonachalnogo-kapitala-privlech-esche-poryadka-600-millionov-na-hardware-proekt-dlya-promyshlennosti-ne-problema-deneg-v-strane-ochen-mnogo-20171228014631). Accessed February 3, 2022 (in Russ.).

## CONCLUSIONS

Project financing in innovative developments is a complex and time-consuming process, requiring the attention of investors and meticulous evaluation.

This study aimed to identify features of the investment process in the Russian Federation, as well as the criteria for selecting priority high-tech projects and methods of evaluating these projects, in the aims of making informed investment decisions.

The general principles and approaches to project efficiency evaluation methods were analyzed. A model of priorities of high-tech projects was presented, as well as two models which take cash flows into account after the expiration of the payback period. Furthermore, an algorithm for the

economic assessment of investment attractiveness of high-tech projects was also demonstrated. Thus, this work considered all the instruments which investors require, in order to make the decision of whether or not it is expedient to invest in high-tech projects.

## Authors' contribution

**I.A. Mandych**—data acquisition, analysis, and interpretation, writing the article, the analysis of scientific work, final processing the article.

**A.V. Bykova**—conception and design of the study, data acquisition, analysis, and interpretation, writing the article.

**O.B. Gaiman**—data acquisition, analysis, and interpretation, writing the article, formalization of the list of references.

All authors have read and approved the final manuscript for publication.

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*Translated by V. Glyanchenko*

*Edited for English language and spelling by Dr. David Mossop*