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RISK MANAGEMENT
FOR LONG-TERM PROJECTS IN THE BUSINESS
ENVIRONMENT WITH THE HELP OF REAL OPTIONS AND
LEASING

Abstract

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I. General characteristics of the dissertation

The relevance of the doctoral thesis is determined by circumstances, the most important of which are:

First, the problem of risk management is relevant and complex due to its importance, both in general economic terms and with its specific dimensions.

Second, the development of the concepts of market management dominance, as the basis of all economic activity, takes place in the context of many difficulties and risks that are specific to the state of each economy.

Third, life shows that applying the principle of free interaction of market participants and ensuring healthy market competition inevitably increases uncertainty and economic risk.

Fourth, the majority of management decisions are made in conditions of significant risk due to factors such as lack of complete information, the presence of opposite trends, elements of chance and subjectivism, etc.

Fifth, the problem of quantitative and qualitative risk assessment and its management requires continuous analysis and control of any expected or unexpected situations, dictated by the possibility of large losses, especially in the implementation of long-term projects.

The leading motive in the choice for the development of the selected thesis is the importance and responsibility for finding new practices and possible solutions to these problems in long-term investment projects.

At the heart of the defended thesis are some problems of risk management in long-term investments. In this regard, the analysis is aimed at revealing certain applied aspects of risk in this activity. The possibility of using some methodological aspects of modeling to assess investment risks is sought. The analysis reveals existing problems in the management of long-term projects.

The relevance of the study stems from the development of market relations in Bulgaria, which shows that investment is a major source of economic growth. The objective approach to investments presupposes a scientific substantiation of their management, taking into account the existing risks as much as possible.

Regardless of the significant foreign and Bulgarian experience in risk management in relation to real investment projects, some more specific aspects should always be taken into account in the scientific substantiation of the long-term project risk management system. In addition, the growing dynamics and

specificity of economic processes determine the need to develop and use some new and effective mechanisms in the practice of risk management. That is why the substantiation of the methodological and practical approaches, the development of specific recommendations for risk management in the implementation of long-term investment projects is relevant and important.

Theoretical and methodological basis of the dissertation are the scientific developments of Bulgarian and foreign researchers. The methods of quantitative and systematic, including fundamental and technical analysis, the theory of optimization, economic-mathematical modeling, abstract-logical analysis are used as scientific tools in the analysis. Scientific research method is a complex comparative analysis of theoretical views and practices relevant to risk management in real projects.

The subject of the research is the use of the methodology of the modern tendencies in the risk management in the long-term projects taking into account the peculiarities of the modern stage of their development. The decisive element is the peculiarities of the capital flows in the conditions of the use of **options** and **leasing** and the resulting risks and threats to the investment activity. The object of the study are the risks of investment projects in the real economy on the example of BioPharmGInt. To achieve this goal, the experience of countries that have implemented similar risk management systems, publications of Bulgarian and foreign authors in the field of this study, talks with experts and electronic databases with publications on the topic.

The main feature of the dissertation is that it focuses on the practical possibilities for implementing the methods for managing different types of risk. Each method offers a set of calculations for risk management. Examples are given of the use of contractual and built-in real options and leasing in risk management.

Based on the above, we can define **the purpose** of this dissertation -

Analysis and evaluation of theoretical and applied aspects, manifested as trends in the development of risk in investment activities in the new economic and financial realities. On this basis, it is necessary to identify new problems related to risk management in long-term projects with the help of real options and leasing.

The dissertation includes a thorough analysis of existing and possible approaches to ensure risk minimization in the field of real investment on the example of a particular company - *BioPharmG Int*. The main task is to reveal the potential opportunities for optimizing risk management, dictated by modern realities. This necessitated a search for causal links between weaknesses and threats arising from possible inadequate risk management. In this regard, taking

into account the limited financial capabilities of smaller companies, analyze and offer possible tools for optimizing investment risk management by solving **four main alternative tasks**:

1. Research and analysis of approaches developed and applied in theory and practice to manage and minimize risk.
2. Establishing the causal links between weaknesses and threats arising from possible inadequate risk management.
3. Discovering the potential opportunities for optimizing risk management, dictated by modern realities, following the example of "*BioPharmG Int.* “.
4. Analysis and evaluation of possible tools for optimizing the management of investment risk, taking into account the limited financial capabilities of smaller companies.

Hypotheses

They are related to the possibilities to minimize the risk by using real options and leasing.

To confirm the main thesis, the following research hypotheses are analyzed:

Hypothesis 1.

Necessity to terminate the project when its implementation is unprofitable for the investor and shareholders;

Hypothesis 2.

Activity when at a certain moment the implementation of the project is unprofitable, but in the future an improvement of the market situation can be expected, as well as its full final completion;

Hypothesis 3.

Variants of solutions: first decision - leasing contract until the end of the term or second decision - leasing contract and combined real option for return of the leased object in the first year in case of unfavorable developments and real option for its purchase in the first year favorable development of events.

The main feature of the dissertation research is that it focuses on the practical possibilities for the implementation of the considered methods of risk management in the company *BioPharmG Int.* . A set of risk management calculations is proposed for each method. Examples are given of the use of contractual and built-in real options and leasing in risk management.

Practical significance of the results of the dissertation lies in the fact that the developed mechanisms for optimizing risk protection using options and leasing for the company *BioPharmG Int.*, Can be used in real investment projects in various fields of economic activity, which allows significantly reduce project risks.

The methodological approaches for risk analysis and management developed in the dissertation, as well as the proposed complex system for risk management can be used in the teaching process of higher education, for course and diploma projects.

Main limitations of the study:

The scope of the analysis is in some respects relatively limited, as it is based only on information that is officially published and publicly available.

Qualitative criteria prevail in the analysis system. The reason for this is the limited quantitative information about the company activity of each company in the public space. Therefore, the analysis of risky decisions in most cases refers to recommendations for making risky decisions, taking into account the specifics of the management team, owners or other decision makers.

All calculations in the dissertation research, the included tables and figures are the work of the author. This is explicitly stated in the places where figures and tables from literary sources are used. The calculations were performed on Microsoft Office Excel.

The tables, figures and formulas cited below in this abstract have the original numbering used in the dissertation research.

Introduction

The introduction of the dissertation focuses on the relevance and complexity of risk management problems due to their importance both in general and with their specific dimensions. The development of the concepts of the dominance of market management, as the basis of all investment activity, takes place in the conditions of many difficulties, which are specific to the current state of each economy. The general plan of the defended thesis is based on the problems, the reasons for which are due to the fact that the future results of

investment or other activities are significantly influenced by shocks in economic policy and market conditions, and a large number of non-economic and uncontrollable factors.

In this regard, the study focuses on the main approaches to the planning and implementation of individual models for investment risk management using options and leasing. In this aspect, the opportunity to solve the problem is sought by analyzing and revealing the significant factors in the selection of appropriate solutions in the company policy of *BioPharmGInt.*

Risk management, in general, is seen as the reverse of the freedom of entrepreneurial activity, ie. as a kind of price of this freedom. In the conditions of fierce market competition, the economic entities objectively have to go for the introduction of innovative, non-traditional technologies, which increases the risk. Therefore, in any business idea it is important not to avoid the risk, which is practically impossible, but to anticipate it and, if possible, to minimize it.

II. Structure of the dissertation

The structure of the dissertation is determined by the combination of the object, subject, goals and objectives and reflects the author's approach to research.

The dissertation has a volume of 186 pages, 37 tables, 5 diagrams, mathematical expressions and a list of references with 99 titles.

The content, in accordance with the thesis, purpose, subject and method of research, the doctoral thesis is developed in three chapters and a conclusion.

- 1. Theoretical foundations of risk management**

- 2. Innovative methods for reporting and justifying risks in long-term projects**

- 3. Possible practical approaches to risk management in long-term projects(*on the example of BioPharmGInt.*).**

Conclusion

III. Summary of the dissertation

Chapter One

Theoretical Foundations of Risk Decision Management

This chapter reveals the nature, methodology, classification and management system of risk management. It is composed of four structural components:

first, uncertainty in the management of risk decisions

second, risks in the real sector of the economy

third, strategies for risk management

fourth, methodological aspects and criteria for risk making

In the process of risk management and In assessing risk decisions, great importance is attached to taking into account the nature and content of risk depending on the field of economic activity, the specifics and characteristics of risk decisions. In this regard, emphasis is placed on the fundamental analysis of the relationship between the concepts of "uncertainty" and "risk" taking into account the specifics and peculiarities of the theory and methods of risk management depending on the peculiarities of their manifestation in the real sector.

According to the author, the risk in long-term projects in theoretical and applied aspects should be analyzed completely independently as an important part of the theory and practice of management. The existence of risk is directly related to the problem of uncertainty in any situation, which is diverse in both form and content.

Risk management with real options and leasing is seen as one way to reduce uncertainty, which is inherently ignorant or unreliable. Emphasizing this understanding of risk is important in view of the fact that in practice it is hopeless to optimize management and regulation, ignoring the objective and subjective sources of uncertainty.

The basis of any business activity is related to the expectation of income, but higher than ordinary (average) income, which is quite uncertain and may or may not come true and always associated risk.

Although the consequences of risk most often manifest themselves in the form of financial losses or inability to achieve the expected profit, the risk should not be considered only as an undesirable result of the decisions taken. In the project activity there is always a danger not to achieve the set results, but also an opportunity is sought to exceed the planned profit. In this aspect, the essence of the project risk is analyzed, characterized as a combination of the possibility of achieving both undesirable and particularly favorable deviations from the planned results, which is the driving motive for its assumption.

The analysis of the numerous definitions of risk allows the author to orientate the main aspects that characterize each risk situation:

Ø *random nature of an event;*

Ø *availability of alternative solutions;*

Ø *probability of losses;*

Ø *probability of making an additional profit.*

Emphasis is placed on the notion that only the quantitative assessment of the degree of risk allows a more reliable impact on an economic process in order to increase profits and reduce risk. The difference between risk and uncertainty is related to the way the information is set and is determined by the presence (in case of risk) or the absence (in case of uncertainty) of probabilistic characteristics of uncontrollable changes. In this sense, these concepts are borrowed from the mathematical theory for the study of operations, which distinguishes the tasks of making risky decisions at possible risk and, accordingly, in conditions of uncertainty. Thus, the risk situation is perceived as a kind of uncertainty, when the occurrence of the event is probable and can be determined. These are conditions under which it is objectively possible to assess the likelihood of events arising from the joint activities of business partners, the opposition of competitors or adversaries, under the influence of the environment for economic development, the implementation of scientific achievements etc.

The main difference between the risk of uncertainty is related to the fact that *uncertainty arises from objective factors*, both external to the business and its internal problems. They are considered as the basis for risk generation and are influencing factors on business results.

Risk is considered as a certain *subjectively approximate numerical characteristic of future results*. The quantitative assessments obtained are often referred to simply as risk, although in our opinion it would be more correct to speak of different forms of expression or dimensions of risk that have different quantitative assessments.

At the heart of risk management, the author necessarily relies on the development and implementation of such special activities (commonly called risk management methods), which provide the necessary redistribution of future results and allow sustainable business development in the event of fluctuations in the market situation and other factors influencing its results. In this regard, the following main problems are analyzed:

- *justification of the distribution of the future results of the considered business decision, ie modeling certain unambiguous results for this business;*
- *establishing appropriate costs to achieve such a result (no free lunch);*
- *taking into account the possibility that the expected development of the market situation or other risk parameters will not be actually reached;*
- *lack of guarantees for a clear future useful outcome.*

When managing the risks at the level of an individual company, the author proposes in the first place to ensure compliance with the conditions and opportunities for business development of the emerging or expected market conditions, ie. compliance of the structure of the produced products or the rendered services with their future demand. In the process of this management should ensure:

- *preserving and increasing the value of the company's capital;*
- *improving the financial condition and increasing the intellectual potential of the company;*
- *creating competitive advantages and gaining market share;*
- *management of the company's image, the activity of which should meet all modern requirements.*

In the analysis of risk decisions as a significant problem is the forecasting and use of future results that affect the current assessment of the value of the business or capital assets. Such assessments of the value of risk in business are subjective, which affects the *marginal level of management costs* of the business or its individual assets.

in long-term business projects, although specific to each company, but in general, are analyzed in three main groups: *internal and unknown*.

Risk *factors*, the influence of the activity of the staff (from the ordinary employee and the worker to the top managers) on the business results, which are directly related to the internal production risks.

Methods for managing potential risks are analyzed in terms of the distribution of future results in accordance with *strategies* business development *expectations* and *expectations* of managers or owners of capital.

Their main feature is that together with the formation of the distribution of future results, corresponding to the expectations of management or owners, certain efforts are made to distribute future results. The aim is to reduce the relative losses that can occur in each of the two options (attack or defensive strategy). This allows to ensure the simultaneous preservation of the favorable part of the distribution of future results, and if possible to expand them.

In the study of the project life cycle it is assumed that the process of its formation is determined by the development of production and the actual implementation of the project and the dynamics of income. The analysis of the life cycle of the project allows to distinguish its features in its development and implementation on the market. [2]

Diversification in the company's activity is defined as an important method for managing long-term project risks in real business. In modern conditions, it is associated with activities in several areas or spheres. Diversification creates conditions for expanding the company's activities and creating additional structural units and even a separate independent business. However, this method of risk management also requires mandatory investment in new productions or projects. The difficulties and problems before diversification are related to the analysis of market demand and the determination of the relationship between the income from the created and the available production. In this regard, the attacking strategy is based on diversification in the groups of complementary goods, and the defense - in the groups of interchangeable goods. [3]

According to the author, the choice of risk management strategy should be made taking into account three main circumstances:

first, the specifics and characteristics of the particular business;

second, the willingness or unwillingness of managers or investors to take risks;

third, their strategic goals and expectations for the development of the future market situation.

For these reasons, risk management should be complex and continuous, as processes in the business world become more dynamic.

In the process of substantiation of risk decisions in the analysis an important role is determined by the formalization of risk situations and pre-set numerical parameters of risk to be used in the assessment of risk decisions.

The use of standard deviation (variance) as a measure of risk from a theoretical point of view implies a normal distribution of profitability or other useful result in business, ie. symmetrical deviation from the expected value. From a practical point of view, the variance, as a measure of risk, is associated with the fact that in its magnitude it differs significantly from its expected significance and is therefore incomparable with it. Also, the standard deviation measures the deviations in both directions of the expected value. Therefore, the variance is used as a measure of risk in both material investments and other business decisions.

The measurement of risk through the considered approaches is assessed as a significant shortcoming in that they are formed on the basis of subjective expectations of investors, which have a significant impact on the obtained quantitative risk assessments.

When substantiating material, financial and other long-term investment projects that do not involve direct measurement and assessment of risk, special indirect methods are used to report it in practice: first, *the method of reporting the risk premium* and second, *the method of guaranteed equivalents*.

The use of formal criteria for evaluation and selection of risk decisions in practice is assessed through their features. For example, the possibility of taking into account the propensity or unwillingness to take risks and some psychological peculiarities in the justification of risky decisions by the persons who make these decisions occupies a special place. In particular, such a principle underlies the models *for justifying futures rates equilibrium prices of market options*. [4]

In our opinion, in most cases these are subjective recommendations that can be taken into account in the risk-making decision-making process, taking into account the peculiarities of the character of the manager, owner or other decision-makers.

Chapter Two

Innovative methods and approaches for reporting and justifying risks in long-term projects

The methods for risk assessment and justification for long-term projects in material investments are fundamentally different from the assessment and measurement of financial risks. They involve the use of both *indirect* assessment methods based on risk sensitivity analysis and *direct methods* based on the use of *the event tree* and *scenarios for future developments*. In the scenarios it is essential to take into account the influence of subjective factors in justifying and measuring the risk in the considered projects.

When evaluating long-term investment projects, it is most often suggested that decisions be made based on the numerical value of one of the selection criteria for these projects (eg Net Present Value - NPV). In this case, the project is accepted for implementation only when it is not negative. Otherwise, it is more profitable to alternative capital investment banking system depending on the size of the base interest rate.

The sustainability and efficiency of the investment project is associated with the risk of its implementation. It is proved that the higher the sustainability of the project, the weaker the adverse impact of risk factors for changes in the cash flow parameters of the project.

The simplest *indirect method* for assessing the sustainability of a long-term investment project *Sensitivity analysis is considered to*. Sensitivity analysis is performed by identifying possible options. For example, what will happen if one or more factors change their magnitude (as tabular analyzes are shown). In this regard, the dissertation evaluates not so much the relative sustainability of the project in relation to the analyzed factors, as determining the scope of *changes in internal factors* (the volume of current costs or their individual parts) that the manager can manage.

It is proposed that this method be implemented within two main approaches (*analytical and simulation*) to quantify the resilience of the project to changes in internal and external risk factors.

analytical approach is demonstrated by the formulation of special mathematical expressions that explicitly represent the relationships between cash flow parameters and the numerical values of the project evaluation criteria (eg *NPV*).

approach is related to the modeling of changes in cash flow parameters and the justification of assessments of the sustainability of *NPV* and other criteria for

evaluating projects in the process of simulation calculations using computers. In this case we have two approaches - *discrete analysis* and *the Monte Carlo method*.

Discrete sensitivity analysis assumes:

- modeling through successive steps in the changes of the parameters of the cash flow components for the investment project;
- making consistent calculations for the net present value with relatively small changes in these parameters and justifying the limits of changes in the considered parameters, within which the NPV for the project remains positive and the project is relatively stable in terms of changes in parameters within the specified intervals;
- substantiation of the numerical estimates of the NPV sensitivity for the indicated changes in the cash flow parameters.

Sensitivity analysis *NPV* allows calculations and comparisons of numerical values of net present values for project implementation under conditions of different values of cash flow, which are considered as risk factors and change discretely with a fixed step (ie what is the probability of a certain thing happening).

The Monte Carlo method involves computer modeling of the distribution of cash flow parameters and assessment of the impact of parameters on these distributions of changes in *NPV* and sustainable project implementation. In this case, the sensitivity of the *NPV* is assessed in terms of standard deviation (variance) and other parameters of the modeled distributions of risk factors.

Therefore, from a practical point of view, in the dissertation the imitation approach for analysis of the sustainability of a long-term project in the real economy is assessed as more appropriate. It also improves the ability of management to counteract adverse changes in the conditions of its implementation through discrete analysis and the Monte Carlo method.

The simulation approach, in general, allows a comprehensive analysis, which in particular helps not only to analyze how changes in one or another parameter of cash flow affect changes in the values of *NPV*, but also to clarify in which variants of The development of events remains sufficiently profitable for the investor (indicated in the tables). Based on simulation modeling, the peculiarities of their performance are shown on the example of **BioPharmG Int.**. For the analysis, a variant of the company's project is used, which will provide a maximum production of 8400 units per year for a period of operation of 5 years (Table 5). The unit price of the realized production is conditionally assumed to be BGN 30. For convenience in the calculations it is assumed that it remains unchanged for the whole period. Production by year differs depending on the

utilization factor of production capacity and is defined as the product of this factor and the maximum output.

Table 5

Initial data for the project

Indicators	Period					
	0	-	nd 2nd 2nd	3rd	4th	5th
Coefficient of utilization of the production capacities in%	-	50	60	80	100	100
Maximum volume of production (unit of product)	-	8400	8400	8400 8400	8400	Sales
price per unit	-	30	30	30	30	30
Income in BGN	0	126000	151200	201600	252000	252000
Investment in BGN	44000					

Table 6

Contingent fixed costs in BGN

Indicator	Period					
	0 -	1st	1st	3rd	4th 4th	5th

Premises for rent	-	45000	45000	45000	45000	45000
Heating	-	500	500	500	500	500
Salary		15000	15000	15000	15000	15000
Advertising	8000	6000	6000	8000	9000	9000
Additional organizational. Costs	1500	-	-	-	-	-
Conditional fixed flow	9500	66500	66500	68500	69500	69500

Table 7

Conditionally variable costs in BGN

Indicator	Period					
	0 -	1st	1st	3rd	4th	4th
Materials	-	6	6	6	7	7
Energy resources	-	2	2	3	3	3
Transport	-	3	3	3	3	3
Management	-	1	1	1	1	1

Material and technical maintenance	-	2	2	2	2	2
Total	0	14	14	15	16	16

The conditionally variable costs include the costs for materials and energy resources, as well as the costs for management and maintenance of the respective equipment and technological processes (see Table 7).

A more accurate description of the impact of changes in the estimated interest rate on the net present value (*NPV*) of a given project can be obtained by determining the value of the coefficient of elasticity of net present value by the amount of interest (2) *in the dissertation*). how many percent the *NPV* of the project changes when the estimated interest rate changes by 1%. The results are shown in (Table 11).

Table 11

Elasticity of the net present value of the project (*NPV*) in accordance with the interest rate (BGN)

Interest (%, discount factor)	<i>NPV</i>	Significance of the derivative	Elasticity coefficient
5	65 154	-434 999	-0.334
10	45 809	-343 231	-0.749
15	30 454	-274 158	-1,350
20	18 122	-221 446	-2,444
25	8110	-180 709	-5,570

30	-97	-148 858	460,706
35	-6886	-123 689	6,286
40	-12 550	-103 602	3,302
45	-17 312	-87 423	2,272
50	-21 343	-74 282	1,740

These methods of sensitivity analysis allow to assess the impact of the interest rate on the *NPV* of the project or other indicators.

The analysis of the influence of the cash flow parameters on the significance of the *NPV* of the project using the Monte Carlo method is more meaningful.

Monte Carlo calculations assume that all the values of the parameters determining the magnitude of the individual components of the cash flow of the investment project are known. For these parameters, considered as risk, their initial significance is considered as an expected result of computer modeling of the random distribution of these factors.

The general sequence of calculations using the Monte Carlo method is shown in Figure 1. These calculations can only be performed using the capabilities of Excel or other applications.

Stage 1
Determination of project evaluation indicators

Stage 2
determination of the parameters considered as random variables

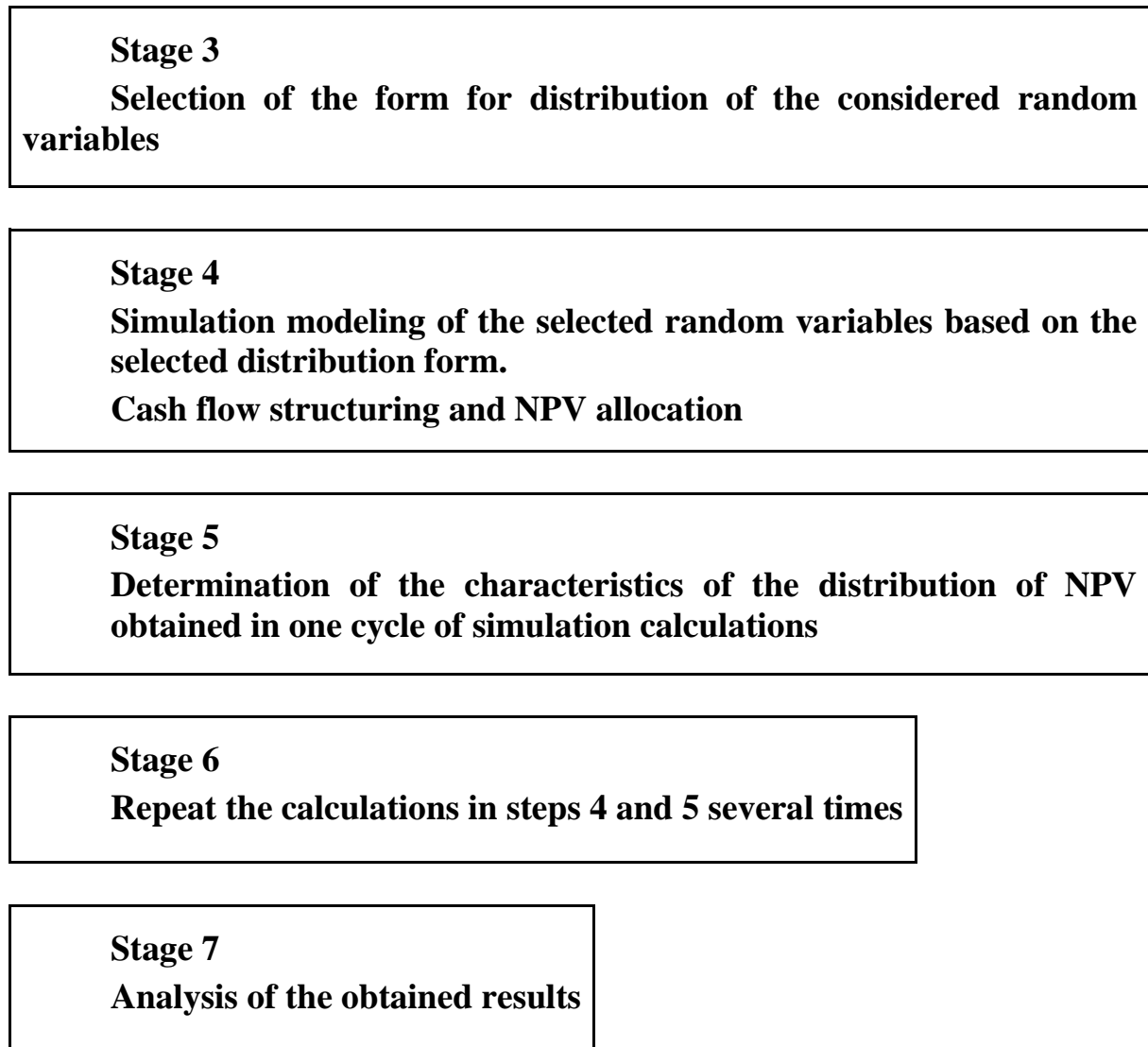


Figure 1. Monte Carlo risk analysis process[5]

When considering the possibilities of using the Monte Carlo method to assess the degree of risk of the project, it is recognized that its *merit* compared to the usual sensitivity analysis is in the following:

first, allows estimates of the degree of risk to be obtained;

second, it is much less labor-intensive;

third, it allows a sufficiently large number of risk factors to be analyzed simultaneously.

When considering and evaluating risk decisions, it is recognized that the methods for their measurement are essential, which in practice characterize the distribution of useful results. In the field of real economy, four main risk indicators are practically used in investment projects:

- first, *the average or expected distribution of the net present value (NPV) of the project;*
- second, *the dispersion;*
- third, *the standard deviation of this distribution;*
- fourth, *the coefficient of variation.*

Depending on the forecasted future development of events, it is proposed to use discounting with a variable or constant rate of the estimated interest rate. The obtained distribution of the values of the net present value ($NPV_1, NPV_2, \dots, NPV_n$) allows to get a certain idea of the investment risk in the project.

What is special and valuable in the assessment of the risk through the distribution of the meanings of the *NPV* is the fact that the *assessment does not depend on the subjective opinions* about the events under consideration.

Taking into account the distribution of *NPV* and some subjective probabilities, relevant indicators can be determined for the expected value of the net present value according to the formula [6]:

(4)

where:

p_j - is the subjective probability for realization of the j -th variant of the future development of events;

$j = 1, 2, \dots, n$.

This indicator should be used to make a risky decision in case the *investor is neutral*, ie. he is not prone to risk and makes a decision based only on the probability of its positive significance.

When calculating the risk of long-term investment projects, it is considered that it is most effective to use the two direct methods of analysis: *the method of the tree of events* and *the method of scenarios for future project development*, which are analyzed sequentially.

The *event tree* is used to describe the future development of market conditions in the case when it is assumed that in each period it is possible to develop events that affect market conditions and as a result will determine future

on the market situation and as a result will determine the future revenues and costs of the project (for example, in *BioPharmGInt.* in the development and testing of one or another drug).

To determine the degree of risk according to formulas (4) to (7) it is necessary to set the subjective probabilities for the realization of each event or, which is the same as the probabilities of transition from one node in the event tree to a neighboring one.

A tree with two consecutive levels of event nodes is analyzed. The assumption of the independence of events in different periods of time is used.

For a more detailed risk assessment (based on the event tree) the expected risk value is determined in the form of a standard deviation [1] of the *NPV* through a conditional investment project of *BioPharmG Int.*, with a implementation period of two years.

For the zero period it is assumed that the company invests BGN 18,000 thousand. The project ensures the receipt of risky income, the possible meanings of which will depend on the implementation of events in each node. It is assumed that in each node of events there are three possible outcomes, differing in the meanings of the respective components of cash flow. For the sake of simplification, we believe that the events are the same in each node, although it is possible to report different outputs for them. In each node, the firm determines the amount of the estimated interest rate and the subjective probabilities of the transition from one node to another. It is assumed that they are the same for each node. All the initial data needed for the calculations are shown in the diagram, which depicts the considered tree of events.

Figure 2. Event tree for BioPharmG Int.

In the conditions of the given example, *nine possible options* for the development of events are considered, ie. nine cash flow options depending on the development of events for each node. Taking into account the cash flows received and the estimated interest rates, the significance of the *NPV* for each flow is determined. For example, for the second variant of the cash flow we will have (in thousand BGN):

The estimates are similar for all other variants of the cash flows for the given tree of events.

The main advantage of using the event tree for risk assessment is that this method allows to assess the risk of a long-term investment project taking into

account the possible or anticipated development of market conditions, as well as other characteristics in each subperiod in the form of expected significance. of NPV, the standard deviation of this indicator, as well as the coefficient of variation.

The justification of the components of cash flows on the branches of the event tree can be quite complex, as this is related to the number of possible options and the problem of providing them with information. Even a qualified expert is not always able to reliably assess the existing probabilities when the number of options is large. An alternative may be a risk assessment methodology involving the study of a limited number of options. However, in order to be representative of the result, the options selected for analysis should be in some sense typical and describe the most typical versions of the future implementation of the investment project of the company. Such options are defined as scenarios, and the method itself - *a method of scenarios for future development*.

The main content of the *method of scenarios for future development* is the assumption that the uncertainty of future development is related only to what scenario will occur, and in the process of implementation the scenario does not change. In this case, it is good to distinguish between *two basic approaches* in the formation of scenarios for future development.

In the first case it is a question of analysis and forecasting of the market situation in the sphere of realization of those goods and services, which the given project produces.

In the second case, which is a broader approach to creating scenarios for future development, it is assumed that the forecast of market conditions will be supplemented by an analysis of the behavior of competitors. This implies the development and launch of competitive products and taking into account the impact of these actions on the projected changes in market conditions. [2]

Taking into account the peculiarities of the development of the modern economy, it is expedient in the risk analysis of long-term investment projects to distinguish *four main types of scenarios* for future development.

First, *favorable future market conditions*, which implies an increase in market capacity at the expense of increased demand and increased prices, as well as a corresponding increase in the company's income at the expense of:

- *favorable changes in market conditions and investment growth;*
- *strengthening competitive positions;*
- *reducing the cost of raw materials, energy;*
- *relative reduction of labor costs;*

- *reduction of interest rates and favorable change of other factors.*

can be formed *optimistic* or *favorable scenario* , taking into account the respective forecasts or expectations.

Second, *sustainable market conditions*, based on a certain preservation of existing trends in market capacity, level of demand and prices, volumes of costs for raw materials, materials, wages, energy, etc.

Third, *unfavorable market conditions*, which are characterized by increased competition and the emergence of new competitors in the market or its segment, reducing market capacity at the expense of reduced demand for manufactured products, increasing prices of raw materials and materials, reducing investments, rising interest rates on loans and adverse changes in other factors. Based on such expectations and forecasts, conditions are created for a *pessimistic* or *unfavorable scenario* for future development for the given business or project.

Fourth, *extremely unfavorable situation*, which is characterized by a significant increase in adverse trends in all factors and their negative impact on business income or the project. Based on expectations and forecasts, conditions are created for *an extremely pessimistic* or *extremely unfavorable scenario* for future development.

Sometimes another scenario is determined - for *the most probable market situation* based on the opinions of the management or other entities deciding on the expected trends in the development of the above factors. In this case, *the most probable* scenario for the future development in the opinion of the management is considered.

The development of the method of scenarios for future development implies mandatory consideration and the behavior of competitors.

First, is it expected or considered possible for competitors to enter the market with *fundamentally new products* that will dramatically reduce the demand for the products that the project in question is expected to offer.

Second, can the competitor offer *similar products*, which would lead to a split in market demand.

Third, can the competitor significantly *reduce its own supply of similar products and even abandon its production*.

The analysis of the peculiarities of the construction of scenarios for future development and the specifics of determining the risk in the conditions of application of the given method is performed on a concrete example.

It is tentatively assumed that *BioPharmG Int.* invests in the construction of a pharmaceutical plant for the production of several types of analgesics, conditionally divided into "*mass*" and "*special*". To facilitate the analysis, the data for only the two types of products classified in this way are considered. The goal of the investment project for the development of the company project is to achieve a sustainable production volume and increase sales. In order to achieve the set goal, the company aims to solve the following main tasks:

- *first*, to replace existing equipment with higher quality and more efficient ones;
- *second*, to master production and bring new types of products to market;
- *third*, move to the use of a new type of packaging;
- *fourth*, to carry out a set of marketing activities for market research and sales.

Using the existing cash flows, the net present value (*NPV*) of the project is determined in the conditions of each of the four scenarios for future development. It is reported that investment costs are also broken down by half-year and their volume does not depend on the scenarios considered. For each scenario, subjective probabilities are set for the realization of each of them and for the interest rate rates, on the basis of which the *NPV* of the project is determined.

The main differences in the approach to determining the risk based on the *method of scenarios for future development* (from the method of the tree of events) are as follows:

- *the number of scenarios is limited, which requires prior quality selection;*
- *it is supposed to fix the scenarios during the whole term of the project implementation;*
- *the probability of realization of one or another scenario is related to its implementation during the whole period of the project implementation.*

The advantages of the method for measuring the risk using the *scenarios for future development* lie in the fact that the preliminary analysis of the conditions for the implementation of the investment project allows to improve the quality of decisions.

Sometimes, together with *the scenario method* and *the event tree*, one or another stage of the project *the decision tree method* at.

to using the project risk assessment method *method advantages*. Tessa related to the fact that at the stage of project development can not only reveal the factors and conditions that determine the risk for the project, but also to anticipate the actions and measures that can be implemented in response to their favorable or adverse effects.

Chapter Three

Possible Practical Approaches to Risk Management in Long-Term Projects

The approaches for operational risk management in a long-term investment project are considered through decisions that are taken before the start of the project. At the same time, the operational risk management implies the possibility that the decisions taken can be adjusted at different stages of the investment project, ie, in the event of a change in the conditions, the decisions taken in advance can be reconsidered.

In the process of justifying the project management it is proposed to distinguish the following main types of decisions based on the direct impact on the parameters of cash flows and the conditions for project implementation.

First, the simplest solution is to terminate the project when it becomes clear before the deadline for its implementation that the net present value of the project will be negative and its implementation becomes completely unprofitable for the investor.

Second, a decision that is subject to changes in the cash flow parameters of the investment project and allows, on the one hand, to compensate for the adverse effects of external market factors, and on the other hand, in the process of operational change of cash flow parameters to the favorable market situation is used to expand the volume of production and increase sales.

Third, in the process of project implementation, more reliable information is obtained about the prospects in the implementation of the project, taking into account the state of the business environment and the emerging market situation.

Fourth, to take into account the possibilities for more complex combinations of solutions, which would involve the implementation of additional projects or additional investment, which would affect the conditions for the implementation of the investment project.

In these cases, the possibilities of the manager or the owner of the capital in the process of project management to take advantage of the three main risk management strategies are analyzed: *defensive, offensive or mixed (combined) strategy*.

One of the approaches for the implementation of the *protection strategy* (the riskier one) is the *early termination of the project implementation*. What is special in this case is that such decisions do not allow to completely reduce the risk when the development starts in an unfavorable scenario. They can only be aimed at reducing the reduction in net present value (*NPV*) or other performance indicator. In this regard, the possibilities for the successful early termination of the investment project with a conditional example are analyzed.

Table 22

Cash flows, expected net present value and risk for the initial project
(thousand BGN)

Scenarios	Period (years)				NPV	Probability	expected	Risk	
	0	1	2	3					
Favorable	-1000	800	900	400	480 480.70	0.10	48.07	23201,05	-
Most likely	-1000	600	800	200	139.43	0.70	97.60	13801.00	-
Unfavorable	-1000	400	-50	-50	- 733.26	0.20	- 146.65	107247.26	-
Total						1.00	- 0.98	144,249.31	379.80

The total expected value for is close to zero, but it is also negative. The chances of getting a positive *NPV* are countered by the chances of getting a negative *NPV*. There is a wide discrepancy between the meanings of *NPVs* in the scenarios. The risk in the form of a standard deviation is high. In the conditions of the unfavorable scenario, net losses are expected in the second and third years. All this allows us to conclude that the project is risky enough. Therefore, in an unfavorable scenario, it is more profitable to sell the business.

The main *disadvantages* of this approach to risk management are related to the fact that *firstly*, in case of termination of the project it is liquidated and lost forever and *secondly*, it is necessary to predict the sale of the business in an unfavorable scenario.

Another approach that is analyzed is *the operational risk management with the help of project diversification*. It stems from the fact that the company should not be limited to a particular type of activity, but should invest its capital either in different risk areas, or expand the number of similar risk projects.

Several forms that can be used in the risk management process based on diversification are recommended:

- *business restructuring;*
- *acquisition or purchase;*
- *construction of new large sites;*
- *change in the structure of the securities portfolio.*

The first three forms imply additional investment projects of the respective type. Two fundamentally different approaches are proposed for the analysis of the processes of diversification in its use for risk management -*parallel implementation of projects and independent investments*.

Each of the decisions - defensive or offensive type of strategy is analyzed with certain advantages depending on the scenario that managers expect in the future - favorable or unfavorable.

The positive impact of capital diversification on independent income projects compared to the risk of their joint implementation is assessed by reducing the risk and increasing the likelihood of income. [3]

It is proposed to take into account that the considered methods of risk management in long-term real investments require substantiation of the cash flow forecasts of the main and additional investment projects as well as the key interest rate rates.

The modern practical methods for risk management are analyzed on the basis of the theory and practice when using *market options*. In this regard, special attention is paid to the opportunities for the use of *contracts and built-in real options* in long-term investments and in the analysis of risky solutions for their management. [4]

The use of real options in risk management, in general, is associated with the occurrence of adverse events or the possibility of a favorable market situation

to ensure the pre-set goals. These solutions seek the opportunity to reduce the impact of undesirable risk factors, or to use their beneficial and beneficial effects. The use of real risk management options implies that the company's managers, when choosing investment decisions and justifying the investment program, take into account

[1] Petrov, S., S. Veleva-Stefanova, General Theory of Statistics, Avangard-Prima, S ., 2013

[2] Andersen, T., Strategic risk management practice: how to deal effectively with major corporate exposures, CammbridgeUniv. Press, 2010

[3] [Merna, T.](#), [Faisal F. Al-Thani](#), Corporate Risk Management, 2nd Edition, Hoboken, NJ. : John Wiley & Sons Ltd, 2012

[4] Mun, j., Real options analysis: Tools and Techniques for Valuing Strategic Investments and Decisions / J. Muil. I loboken, NJ: Wiley, 2002

The possibilities for *flexible redirection of available resources and funds* depending on the changing market situation.

To assess the value of real options, it is proposed to take into account the following more important factors:

- *the state of the income flow from the project or from the business as a whole;*
- *the expected present value of future income;*
- *the volume of additional investments;*
- *the estimated interest rate and the risk premium;*
- *the period until the implementation of the project;*
- *the conditions for the costs of the real option.*

The mentioned factors influencing the value of the option are of a typical nature and are taken into account in practically all types of real options.

Therefore, the real options give managers or businessmen certain choices regarding the volume of production in favorable or unfavorable market conditions. However, it should be noted that the analysis of the time until the option is exercised and its possible rescheduling (ie the time for which the project can be rescheduled) increases the price of the real option. In this regard, the use of real options for long-term projects allows:

First, to reduce the risk of the project at the expense of reducing or completely eliminating opportunities for losses or other adverse results while

maintaining opportunities for implementation and better results in the conditions of a favorable state of the economy. Such risk management strategies, involving the use of real options, refer to safeguard strategies.

Second, in certain cases to increase the risk of the project related to the search for and expansion of the possibilities of this instrument to obtain additional results in the conditions of a favorable state of the economy or deterioration of the results in an unfavorable scenario, ie. implementation of an attacking strategy for risk management.

Third, to use different combinations of offensive and defensive strategies, ie. mixed risk management strategies.

The advantage of real options as a method of risk management is associated with the fact that their use does not imply a direct impact on the project and the investment of additional capital and therefore can be implemented in a sufficiently short time.

The main problems are that the use of contractual real options requires the presence of an interested counterparty who agrees to meet the requirements of conditional fixed-term contracts, which in fact is provided very rarely and is an obstacle to the practical use of this method.

has become much more widespread *built-in (internal) real options*, which do not necessarily involve third parties,

The built-in options are about the future implementation of a new project, the principal possibilities for the implementation of which are determined by the development of the main, starting project, ie. they significantly depend on its implementation.

For the purpose of the analysis in the dissertation thesis the existence of a conditional starting project is assumed, for which a method is used, which assumes forecasting of the cash flows according to different scenarios for future development. Three scenarios for future development of the business environment are classified. Cash flows, as well as the expected net present value and the risk in the form of a standard deviation are shown in Tables 26, 27, 28.

It is noted that the peculiarity of the built-in (internal) real option is the fact that at the moment it is completely unknown whether or not the additional project under consideration will be implemented in three years, but the existence of such an opportunity significantly changes both the corporate risk and the current value of the risky asset or the business as a whole.

In conclusion, it is proposed to take into account that the calculations made are sufficiently simple, but allow to demonstrate that the use of real options (for termination, suspension or development of the project, as well as for embedding real options) allows to manage project risks

Another important method for risk management in projects with long-term material investments is analyzed with the help of options - the use of *contractual real options*. Their main *advantage* is the fact that the conclusion of fixed-term contracts does not require special licensing or other permits from public authorities, but depends entirely on the interest of contractors.

From the point of view of practical implementation, the built-in real options have an advantage, as they do not require attracting counterparties and additional costs for paying for the options. They also allow the formation of mixed risk management strategies the results in case of realization of favorable (optimistic) scenarios for future development, as well as protection against undesirable situations in case of unfavorable (pessimistic) scenarios. The built-in real options can be used individually or within the so-called combined real options related to the implementation of a project or solution.

The main problems with the use of both built-in and contractual real options are in the justification of the initial information, which is largely subjective.

In conclusion, it is concluded that the use of a combination of contractual and built-in real options allows to improve the performance of projects. They are preferable in the implementation of long-term investment projects, even in cases where the value of *NPV* is negative for the base cash flow option. The built-in real options allow, if necessary, to postpone the implementation of decisions for a future period, which creates conditions to better structure the business and its production conditions and features in relation to the emerging environmental conditions for the business environment.

risk management *Leasing* is associated with the fact that the lessee can choose and use for its project equipment in two aspects, *on the one hand*, can buy it on the open market, and on the *other hand*, receive it under the lease .

In the example of *BioPharmG Int.* attention is focused on the possibilities of using the *real options to be built into the lease agreement*.

The effectiveness of the lease for the lessee as a form of acquisition of equipment is determined by the extent to which the lease is more profitable than obtaining a bank loan for the same purpose.

In practice, on the basis of taking into account the term of the lease agreement and the possibilities for repurchase of leased property or its early return, there are *operational and financial leases*.

In *operating leases*, the special feature is that the term of the lease agreement includes a smaller part of the normative depreciation period of the subject of the lease agreement.

In the conditions of *financial leasing* the subject of the lease is provided to the lessee for a longer period (close to its depreciation rate).

It is also reported that in the case of operating leases, the lessor bears both credit risk and property risk, as these assets are returned after operation.

Table 29

Main characteristics of the types of leasing [1]

Characteristics	Financial leasing	Operating lease
Credit risk for the lessor	Yes	Yes
Asset risk for the lessor	No	Yes
Purpose of the lessee	Uses and buys the leased asset	Uses the leased asset in production
from the	lessee	Payments

The financial leasing contract is analyzed as a kind of conditional fixed-term contract, which *on the one hand* regulates the conditions for providing property for use by the lessee, and *on the other hand*, allows the lessee at a convenient time to buy equipment and continue its operation, and return it to the lessor before the expiration of the contract.

To determine the threshold value of the conditional contract in question, it is proposed to use the increase in the expected value of the net present value of the investment project related to the use of the leased equipment.

The *most important advantage* of the leasing contract is the significant savings of initial capital.

The dissertation analyzes a combined built-in real option, which provides for the possibility of returning the lease in both the first and second year in the event of unfavorable developments. It is assumed that the value of this combined option is equal to the sum of the values of the contracts included in it and represents BGN 550 thousand. The results of the calculations are presented in Table 34.

Table 34

Expected net present value and risk for the project when reporting a real option used in the first or second period (thousand BGN)

Year				Probability	NPV		Risk	
0	1	2	3					
-1750	-600	1200	4200	0.384	2057.35	790.02	31536,94	-
-1750	-600	1200	400	0.096	- 952.22	-92.08	715400.83	-
-1750	-600	6298.72	-	0.120	3094.58	371.35	210298.04	-

- 175 0	378 4	-	-	0.400	1753.7 0	-701.48	116.47	-
Total				1,000	-	1,770.7 7	957421.2 7	978.4 8

The characteristics of the solutions including the combined real option are shown in Table 35, which includes the distribution of *NPV*, expected value and risk as standard deviation.

Table 35

Expected net present value and risk for the project when reporting the combined real option used in the first period, in thousands of BGN

Year				Probabili ty	NPV		Risk	
0	1	2	3					
-1800	- 410 0	300 0	600 0	0.384	1738.7 1	667.67	122411, 50	-
-1800	- 410 0	300 0	220 0	0.096	- 1277.8 5	-122.67	577166.7 1	-
-1800	- 410 0	250 0	500 0	0.072	516.21	37.17	31163.32	-
-1800	- 410 0	250 0	200 0	0.048	- 1865.2 8	- 443419. 49	-1800	-

1733.7 0	378 4	-	-	0.400	681.48	80.53	112188.8 1	-
Total				1,000	-	1174.11	1286344. 03	1134.1 7

The advantages of the combined option are considered in the circumstance that a significant increase in income is provided in the event of the most favorable outcome of events. At the same time, protection is provided in case of unfavorable developments in the first year.

Using the cash flows specified in the scheme, the main parameters of the risk solution, involving the acquisition of equipment as property or leasing by applying a combined internal option in the first or second year, can be determined.

The main advantage of using the lease is determined by the significant reduction of the initial capital for the lessee.

The dissertation analyzes *two variants of the decision* related to the conclusion of a leasing contract.

The first option to acquire ownership, taking into account the relevant combined real sale option, is considered to be the most risky, as it corresponds to the widest range of *NPV*.

The second option, involving the return of the lease at the end of the first year in case of adverse events or at the end of the second year in the same situation, but at a pre-established price, in principle, allows significant changes in income flows and, accordingly, of the meanings of *NPV*.

The choice between the options is determined by the expectations of the owner or manager for the development of the situation in the respective markets, the amount of payments for the implementation of each of the solutions and its value for them.

In conclusion, it is concluded that the *benefits to the lessee* from the use of leased equipment are limited to the possibility of significant savings in equity, but at the same time should take into account the emergence of future payments for this equipment. The conclusion of contracts for future use of leasing equipment both in the form of a leasing contract and with built-in real options allow the lessee to change the distribution of future results of the project and provides improvement of its risk characteristics. The result significantly depends on the

expectations of the lessee and his perception of the future development of market conditions.

In the terms of the lease agreement it is proposed to clearly define the rights and obligations of its participants and to allow for the inclusion of options for early return or redemption of the leased object. The use of the opportunities provided to the lessee by including real options in the lease agreement allows him to manage the risks in accordance with his expectations and capabilities, as well as the emerging conditions in the business environment.

Conclusions

The development of the theory and practice of risk management in the project activity is a necessity due to the significant increase in the impact of risk factors on the results of this activity.

An important role in characterizing the risk in the project activity is determined by setting the degree of risk in the form of expected values, variance and coefficient of variation, the specific values of which significantly depend on the subjective distribution of probabilities.

The use of risk management methods based on changes in cash flows of investment projects (primarily through diversification in the company's activities) allows to implement various risk management strategies, taking into account the availability of free capital and the possibilities for its use for similar goals. The emerging corporate risk remains in the hands of management. Diversification of investments between independent income projects is the basis of risky investment.

An important role in the process of risk management is delegated *real options* as a form of risk transfer to third parties. activity, and are fully and completely determined by the interest of the contractors in the implementation of the contract.

The use of real options as a tool for termination, suspension or development of the business allows to change the distribution of future results, to improve the risk characteristics depending on the implemented strategy and the expectations of the management or the owner. The problems in the implementation of this method in the dissertation are related:

- *with the choice of a partner under the contract;*

- *by ensuring his interest in fulfilling the terms of the contract;*
- *with justification of the maximum allowable payment for the conclusion of this contract as a form ensuring the contractor's interest in fulfilling the terms of the contract.*

The use of *built-in real options* is proposed to be used to improve project performance even in cases where the value of net present value is negative. The main advantages of using the built-in real options in risk management are related to the fact that their implementation allows to postpone the implementation of the decision for a future period. They do not necessarily require the involvement of external contractors. Their use allows the implementation of mixed risk management strategies.

The advantages of using the lease are reduced to the possibility of the lessee to realize savings on its own advance capital, although there is a future payment for this equipment. The conclusion of a leasing contract, taking into account the real options built into it, allows to change the distribution of future results of the project, to improve its risk characteristics, ie. to manage risks. However, the outcome of the decisions will significantly depend on the expectations of the lessee and his ideas about the development of future market conditions.

In connection with the analysis, it is proposed that in practical actions, special attention be paid to the following circumstances:

- Recognize that the implementation of a firm's aggregate risk management system in an already established management system may be complicated by the need to remove resistance to innovation.
- To evaluate the functions performed by the risk management department in the company in order to make the financial efficiency of the alternatives more realistic.
- Recognize that the importance of the risk management process of employees in the company should be associated with their fate, which is one of the key elements for risk management.
- The manager of the company, in addition to education and experience in working in a risky situation, to have the ability to motivate employees.
- The risk management department to be integrated into the general corporate information management system of the company.
- Finally, a particularly important circumstance for forecasting cash flows for the project throughout its life cycle is the correct accounting of inflation.

IV. Information on the contributions to the dissertation

In the dissertation the results of the analysis allow the formulation of the following scientific and applied contribution aspects:

First, profitable options for selection of criteria and methods for risk management are developed based on two main approaches to quantify the sustainability of the project internal and external risk factors - *analytical and simulation approach*.

Second, possible scenarios are proposed to justify the future development of the project at appropriate costs and risk decisions, using the net present value of the project to assess or justify risk decisions when starting a business and the ability of management to respond to adverse changes in conditions of its realization.

Third, methods for practical calculations are derived to assess the value of investments in terms of risk when concluding a leasing contract, taking into account the capabilities of the real options built into it as a form of risk transfer to third

parties. of future results and risk measurement in the practice of BioPharmG Int. using the scenario method and the event tree.

V. List of publications on the dissertation

1. Pankova, K., Approaches for operational risk management of a long-term investment project, Yearbook of the Department of Administration and Management of NBU, Volume 5, 2020, ISSN2603-297X, Sofia, 2020.

2. Pankova, K., Analysis and assessment of the sustainability of the investment project, Meždu narodno naučno spisanie Pogledi", izdatel: Nova Naša Reč, Leskovac, Srbija, ISSN 2217 - 737X, CIP Katalogizacija u publikaciji Narodna biblioteka Srbije, Beograd 316.4, COBISS. SR-ID 200035084.

3. Pankova, K., The essence of the method for discrete analysis of an investment project, International scientific-practical conference "Modern realities - problems and prospects" - November 27, NBU, Sofia, 2020.