

Implementation of a Decision Support System for Investment Projects

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Abstract¹

This article discusses approaches for management of the investment projects – strategic decision-making – describes its role in business organization. Also includes analyses of some use cases, benefits and problems and introduces an approach of offensive strategy, describing how to benefit from any informational advantage of your own, and how to curb the other person's informational strengths.

1. Introduction

Becoming of market economy in our country is impossible without an effective investment policy, but effective investment projects are important for its carrying out.

For this reason with special importance rises a question of estimation of investment projects; mainly, what methods of estimation are most effective in specific cases. Thus the problems are posed: researching of existing really used methods, their analysis, development of the decisions eliminating their lacks; and also research of the Russian experience in the given sphere.

2. Introduction into the Problem of Strategic Planning of the Investment Projects: Bases of the Strategic Analysis

Investment activity is rather risky kind of financial activity. For maintenance of long-term financial stability and stability of the organizations their management requires the strategic approach at the decision of long-term financial tasks, in ways of increase of their efficiency, minimization of risk of investment projects.

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To define optimum directions of capital investments and to reveal the most effective ways of its use during rather long period with stable feedback, development of strategy of investment and its successful realization is necessary.

Revealing and substantiation of decisions, choice of alternatives of definition and appreciating of strategy make on the basis of the strategic analysis of investment activity.

The strategic analysis of the external and internal environment of the enterprise pays special attention two groups of factors: first, to conditions in branch and a competition; second, competitiveness, position in the market, to the strong and weak sides of the company.

3. The Analysis of the most Known and Widely Used Methods of the Development of Investment Strategy of the Organization

One of the tools of effective distribution of investment means is the portfolio theory. In brief this theory tells that the maximal income of a portfolio should not be a basis for decision-making because of risk elements. For reduction of risk to a minimum it is necessary a portfolio to be diversified. Reduction of risk, however, means also decrease of profitability. Thus, at reduction of risk incomes of a portfolio should be optimized. Actually, we need such portfolio in which the ratio of risk and the income would be comprehensible for the investor.

It's self-evident that each investor has his own attitude risk. Some investors prefer high risk while others aspire to reduce it to a minimum. It is natural, that, the higher risk is, the higher should be the expected income.

The reason in diversification is in attempt to distribute risk on a portfolio as the risks are connected to each branch. Diversification of the portfolio reduced risk as the total sum of risks in a portfolio is not equal to risk on a portfolio as a whole.

The naive variant of diversification is an advice "not to put all eggs in one basket". From the point of view portfolio investments it means, that the only event can negatively affect on the portfolio in whole.

So what is the best way of using this tool, what are its advantages and disadvantages?

4. The Organization of an Effective Use of Investment Potential of Activity of the Enterprise

Any investor, placing his capital, deal with two tasks, simultaneously aspiring to maximize expected profit and to minimize risk. As these purposes contradict each other, the final investment decision represents the compromise in which the risk and profitableness should be balanced in an optimum proportion for the investor.

The basic method of the portfolio analysis is the construction of matrixes by which help business - unit or products are compared with each other by such criteria, as rates of growth of sales, a relative competitive position, a stage of life cycle, a share of the market, appeal of branch, etc. Thus principles of segmentation of the market (allocation of the most significant criteria on the basis of the analysis of an environment) and the analysis of activity of the enterprise and the coordination (on pair comparisons of criteria) are realized.

Application of the portfolio matrixes assumes that for each branch there are a limited number of strategies which can bring desirable results. Actually there is a selection of strategy to the set conditions.

For carrying out of diversification strategy all opportunities are defined, each of them is tested for efficiency, and then the most attractive are added to an available portfolio. To show logic of the portfolio analysis, it is offered to consider its basic problems.

Thus we consider that the main problem consists of that the purpose of the organization is described not by a uniform parameter, but the whole vector of parameters. Are various (and are disproportionate) units of measurements of the purposes, optimization of one of them distract resources which could be used on optimization of others. Therefore the nearest purposes contradict to long-term, and the purpose "flexibility" - both of them.

In this case it is offered to solve this problem as follows: the corresponding purposes are used as criteria for a rating and sorting of opportunities. So it is possible to reject some inefficient variants, in the least degree satisfying all purposes. From the staying effective opportunities it is possible to select what provide the most balanced growth of the organization.

The second large problem is incompleteness of the information. It means that by this moment when strategic decisions should make, it is impossible to allocate or describe all future opportunities on purchase and/or creation of the perspective goods and technologies.

In result of carrying out competitive and in particular portfolio analysis, it is necessary to work with the

aggregated data describing branches or strategic areas of business, instead of concrete variants of strategic actions.

Hence, it is necessary to use such concept of strategy which defines the future directions of development of products of the organization, its markets and technologies. Thus the direction of search of new opportunities is defined.

As soon as there is the next opportunity, the organization again addresses to strategy to define whether the project to a selected rate corresponds. In case of the negative answer the project deviates, the further researches otherwise are made for its conformity to the purposes of the organization.

Therefore the organization should begin with the analysis of potential opportunities and drawing up of the list of strategic areas of business which satisfy to the following criteria:

1. Allow to achieve the purposes of the organization with expenses smaller, rather than additional investments in current a business - portfolio.
2. Necessary investments are within the limits of the resources of the organization allocated for diversification.
3. Expenses for an entrance in branch are justified by the future incomes which the organization can receive in given branch.
4. There are opportunity for synergetic effects, as on administrative, and on functional levels.

Based on these conclusions, it is offered to use the theory of a portfolio for finding optimum for the investor of a ratio risk - profitableness which is realized by diversification methods. We'll use approach of Markovits according to which the investor should estimate alternative portfolios from the point of view of their average profitableness and dispersions of profitableness.

Making a decision about formation of a portfolio, the investor should mean, that profitableness during the forthcoming period of possession is unknown. However the investor can estimate expected (or average) profitableness, being based on some assumptions, and then to invest means in branch with the greatest expected profitableness. Markovits marks, that it will be in general the unreasonable decision as the typical investor on one hand wishes that " profitableness was high ", but simultaneously wants, that " profitableness would be so determined as far as it is possible ". It is meant, that investor, aspiring simultaneously to maximize expected profitableness and to minimize uncertainty (i.e. the risk), has two purposes contradicting each other which should be balanced at decision-making on investment.

Markovits approves that the investor should found the decision at the choice of a portfolio extremely on expected profitableness and a standard deviation. It

means, that the investor should estimate expected profitableness and a standard deviation of each portfolio, and then to choose "best" of them, being based on a ratio of these two parameters. Expected profitableness can be submitted as the measure of potential compensation connected to a concrete portfolio, and a standard deviation - as the measure of risk connected to the given portfolio. Thus, after each portfolio has been investigated in sense of potential compensation and risk, the investor should choose a portfolio which is for him the most suitable.

We think that the investor does not need to carry out a rating of all portfolios. The investor should consider only a subset of probable portfolios, according to the following the efficient set theorem:

The investor chooses the optimum portfolio from set of portfolios, each of which is:

1. Provides the maximal expected profitableness for some risk level.
2. Provides the minimal risk for some value of expected profitableness.

The set of the portfolios satisfying these two conditions, names as efficient set or effective border.

The incentive reason to the beginning of the analysis is either necessity for it (existence of portfolio's break), or the decision of a management on search of perspective manufactures.

First of all, for successful development and the fullest realization of opportunities of the organization it is necessary to determine long-term objectives and strategy of their achievement.

The following step is carrying out of the strategic branch analysis according to which, it is necessary to specify the purposes determining the characteristics of activity which the organization aspires to achieve in middle-and the long-term period.

The list of the purposes of the organization by this moment will be already made during the competitive analysis. In the portfolio analysis it is used for definition of contributions of various variants of diversification in achievement of the corresponding purposes.

The typical purposes of diversification are growth, profitableness and/or reduction of strategic vulnerability from the point of view of technical and political factors.

The list of the purposes of the organization by this moment will be already made during the competitive analysis. In the portfolio analysis it is used for definition of contributions of various variants of diversification in achievement of the corresponding purposes. The typical purposes of diversification are growth, profitableness and/or reduction of strategic vulnerability from the point of view of technical and political factors. Next step is consideration of financial appeal of the project.

Traditional practice of investment designing gives essential value to the contents of the financial plan of investment project drawing up of the financial reporting and its subsequent analysis. Thus it is declared, that financial plan of the investment project is "the key section" investment - the project, and all design analysis is reduced to the analysis presupposing the financial reporting.

5. Development of a Method of Carrying Out of Diversification Strategy for Penetration into Branch

For the untied diversification was successfully realized into practice, is necessary deeply theoretically worked methodical base which basis make, first of all, procedures of careful strategic branch analysis (SBA) and decision-making on penetration into it.

Purpose of the SBA is definition of appeal of analyzed branch (business - areas) and an establishment of a strategic position in it of the concrete enterprise.

For a rating of the investment project is necessary deeply theoretically worked methodical base which basis make, first of all, procedure of the careful strategic branch analysis and decision-making on penetration into it.

One of the ways of definition of the optimum investment project is offered with the theory of games according to which, in conditions of market economy at the analysis of the financial and economic tasks carrying single character, often is necessary to make of the decision in conditions of full uncertainty of statuses of an environment which refers to as "nature". The mathematical model of such situation refers to "as game with the nature", in which participate two players: one of them, mark him through A, the person accepting the decision on a choice of strategy, and another - N - the nature. Thus the player A operates realized with the purpose of a choice most satisfactory decision while nature N shows the statuses spontaneously and objectively, not counteracting meaningfully to the player A, without taking into account a probable choice it of the strategy.

Probabilities with which can come specified conditions of nature are unknown and upset an opportunity of reception about them any additional statistical information.

The given parameters are reduced in a matrix of a prize of the player A designated through A. She has the following kind (1):

$$A = \begin{pmatrix} N_j/A_i & N_1 & N & \dots & N_n \\ A_1 & a_{11} & a_{12} & \dots & a_{1n} \\ A_2 & a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots & \dots \\ A_m & a_{m1} & a_{m2} & \dots & a_{mn} \end{pmatrix} \quad (1)$$

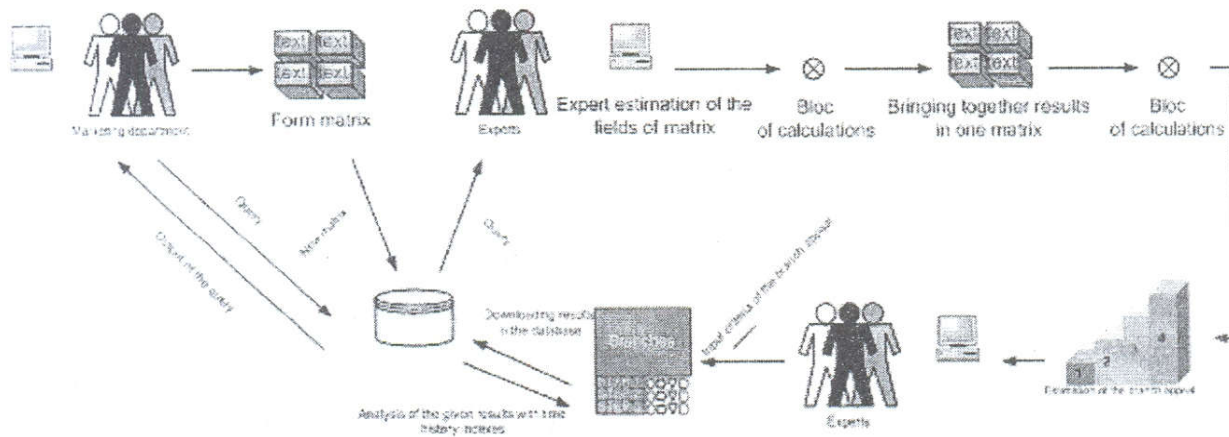
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The given parameters are reduced in a matrix of a prize of the player A designated through A.

As it was stipulated above that the given method is realized by means of model "games with the nature" and reduced to definition of the optimum project in the given business branches.

The optimum project is understood as such project which will be realized at an optimum ratio profitableness / risk.

Schematically, process of carrying out strategic branch analysis will be the following



To estimate a degree of influence of this or that status of "nature" on an outcome, i.e. for filling fields of a matrix A, we had been developed methodical recommendations on use of tools of econometrics for acceptance of investment decisions in conditions of uncertainty and risk, in particular, model of the theory of games for a choice of optimum business - branch in conditions of uncertainty of market conditions.

The following algorithm of construction of model is offered:

1. On the basis of the data of marketing research possible statuses of market conditions and branch are defined in which enterprises can diversify manufacture.

Thus in various situations various combinations of external factors independent of the enterprise can be involved, including: capacity (size) of the market and its prospective growth; availability of the market; profitableness of branch; a technological status; a degree of a competition; a rating of opportunities and threats; duration of life cycle, and also seasonal and cyclic fluctuations; a degree of dependence on a social and political situation, state regulation, etc.

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profitableness of branch; a technological status; a degree of a competition; a rating of opportunities and threats; duration of life cycle, and also seasonal and cyclic fluctuations; a degree of dependence on a social and political situation, state regulation, etc.

In turn, each of these elements is defined by the list of characteristics (parameters).

2. By results of the given research the matrix of characteristics of parameters of a rating of appeal of branch and system of preferences decision-makers is under construction. By each criterion groups of parameters on the basis of which the matrix is under construction are developed.
3. Cells of a matrix are filled by future values of indexes which receive varying values of variables according to the maintenance of the offered purposes and possible statuses of market conditions.

The central question of any investment project is forecasting the given parameters estimating investment appeal of branch by the given criterion on the basis of which efficiency of the project is defined.

To compare projects on several parameters it is possible by Pareto rule, however essential lack of it is the impossibility to range projects since being compared in pairs to projects the mark "+" if on the given parameter it is better than another is simply appropriated or "-" if it is

worse, not showing thus as far as it is better or worse this or that project.

Besides this method leads up a blind alley if compared projects have no property of transitivity, for example in a situation when 1st project, is better than 2nd, 2nd is better than 3rd, but 3rd is better than 1st, Pareto's method does not work.

However that the listed parameters have got estimated character and had property of measurability, it is necessary for each of them to develop an estimated scale where to each level of measurement there should correspond the rating (quantitative or qualitative).

To exclude this lack the author suggests using stricter rule of a choice - Borda's rule. The essence of it consists in the following: all projects are ranged by each criterion in points, for example from 1 up to 10. The winner considers the project, collected the maximal total amount of points. It is necessary to note, that ranging by Borda's rule can be carried out in some rounds with the subsequent distance of the winner, and distribution of ranks thus varies.

Rather reasonable would be to appropriate also factors of weightiness to criteria. It is natural that as criteria can act not only parameters of efficiency, but also risk, etc.

Such rating allows revealing a level of appeal (rating) of branch. The given rating is carried out by experts or decision-makers.

Result of carrying out of the branch analysis is the rating of each expert of fields of a matrix which pays off a method of the weighed sum. General prefer ability of branch is defined according to this method as a score on the parameters established earlier (2)

$$a_{mn} = \sum_{k=1}^f r_k \left(\sum_{j=1}^m v_{kj} \cdot x_{kji} \right) \quad (2)$$

where a_{mn} - general appeal of branch (in points);

The received parameters on each analyzed branch will be worn out in a matrix (A).

4. Further it is offered to use criterion of a choice of optimum strategy (acceptance of the optimum decision) in conditions of the full uncertainty, taking into account all prizes of the person accepting the decision, at each its possible strategy. The suggested criterion generalizes criterion of extreme Vald's pessimism criterion of extreme optimism and criterion of pessimism - optimism of Gurvits. As it is offered to use a method of a choice of factors of the generalized criterion of Gurvits, based on "a principle lack of increasing of average prizes" in case of a dangerous situation, and on "a principle no decreasing average prizes" in case of a situation safe.

The criterion of a choice of optimum strategy in the above described conditions of full uncertainty will pay off on the following parameters:

Maximal criterion of Vald as optimum defines strategy at which the least prize is greatest average of the least prizes of all strategy.

Criterion of Vald is criterion of extreme pessimism since focus the player A on the worst for him conditions of the nature and, hence, on the extremely cautious, circumspect behavior at a choice of strategy.

Other contrast is the maximal criterion recommending as optimum to choose strategy at which the maximal prize is maximal among the maximal prizes of all strategy, i.e. strategy at which one of prizes is maximal among all prizes of all strategy.

The maximal criterion is criterion of extreme optimism as focus the person accepting the decision (player A) on the best, the most favorable for him a condition of the nature and, as consequence - on at times unfairly thoughtless behavior at decision-making.

Between criteria of extreme pessimism and extreme optimism the criterion of pessimism - optimism of Gurvits with factor of optimism is intermediate on which optimum the strategy having the greatest parameter of optimality is considered.

The factor in this criterion expresses quantitative "a measure of optimism" and gets out of subjective reasons. The closer to zero, the less is optimism and more pessimism, and on the contrary if is closer to unit.

By Gurvits's generalized criterion strategy with the greatest parameter of optimality is optimum.

That branch gets out of all variants, maximal which settlement parameter gets in criterion of a safe situation at an optimum status of the nature more often.

The decision on introduction of the given project is accepted on the basis of a rating of a level of its appeal.

Thus three levels of appeal of branch can be established:

1. A high level of appeal, when $A > Y$ points;

Where Y - the top border of appeal of branch which is set by experts;

2. An average level of appeal, when $Y > A > Z$ points;

Where Z - the bottom border of appeal of branch which is set by experts;

3. A low level of appeal, when $Z > A$.

Proceeding from a level of appeal of branch, follows, that the high level of appeal of branch can be examined by a high parameter of risk, and the low level of appeal sets thinking of investment of means in the given branch.

6. Portfolio Approach to Investment Designing

In real practice the investor seldom should solve task of a choice of one of the best project, frequently he should solve a problem of optimum accommodation of the resources under several projects.

From the point of view of risk - management this is the problem of diversification project. It is offered to consider the theory of a portfolio in relation to any sort of actives, including to investment projects as the investment project from the financial point of view is set of monetary streams, i.e. as a matter of fact the active described by a certain series of payments / payments, profitability and risk.

Diversification is based on a simple hypothesis. If each active of a portfolio is characterized by some dispersion of the income the dispersion of a portfolio will be defined by its structure, hence, changing structure of a portfolio definitely it is possible to reduce to a minimum a dispersion, and, hence, and risk.

In turn, the probability of reception of smaller profitability of a portfolio of investments depends on influence specific (diversification risk) and macroeconomic (regular risk) factors of uncertainty. Knowing these base positions, financial managers of the firms which are carrying out investment activity, can really influence a risk level due to a combination of actives in well diversified a portfolio of investments.

In the literature on investment designing the account of uncertainty and risk is offered to be carried out with the help of various methods. For calculation of investment risks it is offered to take advantage of a method of the analysis of scripts. The analysis of scripts is a reception of the analysis of risk which alongside with a base set of the initial data of the project examines a number of other data sets which, in opinion of developers of the project, can take place during realization. The dissertator suggests to use the given method not only for calculation of three parameters as it is usually done with the help of the given method, and in addition using a method imitation modeling to reduce the given method for calculation n parameters.

The given method, alongside with the detailed information on various scripts of realization of the project, assumes presence of probabilities of their realization. Probabilities by different scenarios is offered to set either by expert judgment or statistically to estimate on the basis of the last data on realization of similar projects, that in the first case raises subjectivity of the decision, and in the second creates difficulties for the account of uncertainty in conditions of absence of a corresponding statistical material or instability of the environment of realization of the project.

Making a decision about efficiency of the investment project in conditions of uncertainty, the investor solves as

a minimum two task in other words it is necessary for him to find an optimum combination "risk - profitableness" of the investment project. It is obvious that to find ideal variant "maximal profitableness - minimal risk" is possible only in very rare cases. Therefore the author offers four campaigns for the decision of this optimal of tasks.

1. The approach " a maximum of a prize " consists that the variant giving the greatest result gets out of all variants of capital investments (NPV, profit) at risk comprehensible to the investor (R allowed).

Thus the criterion of decision-making in the formalized kind can be written down as (3, 4)

$$NPV \rightarrow \max \quad (3)$$

$$R_{ip} = R \text{ allowed} \quad (4)$$

2. The approach "optimum probability" will be, that at what the probability of result is comprehensible for the investor (5) gets out of possible decisions.

$$(M)NPV \rightarrow \max \quad (5)$$

where $M(NPV)$ – average of distribution of NPV.

3. In practice "the optimum probability" is recommended to combine the approach with the approach "optimum variability". Variability parameters are expressed by their dispersion, an average quadratic deviation and factor of a variation. The essence of strategy optimum variability result consists that at what probabilities of a prize and loss for the same brave capital investments have small break gets out of possible decisions, i.e. the least size of dispersion, an average quadratic deviation, a variation.

$$CV(NPV) > \min \quad (6)$$

where $CV(NPV)$ – index of variation of NPV.

4. The approach "a minimum of risk". Gets out of all possible variants that allow receiving an expected prize (NPV allowed) at the minimal risk.

$$NPV = NPV \text{ allowed} \quad (7)$$

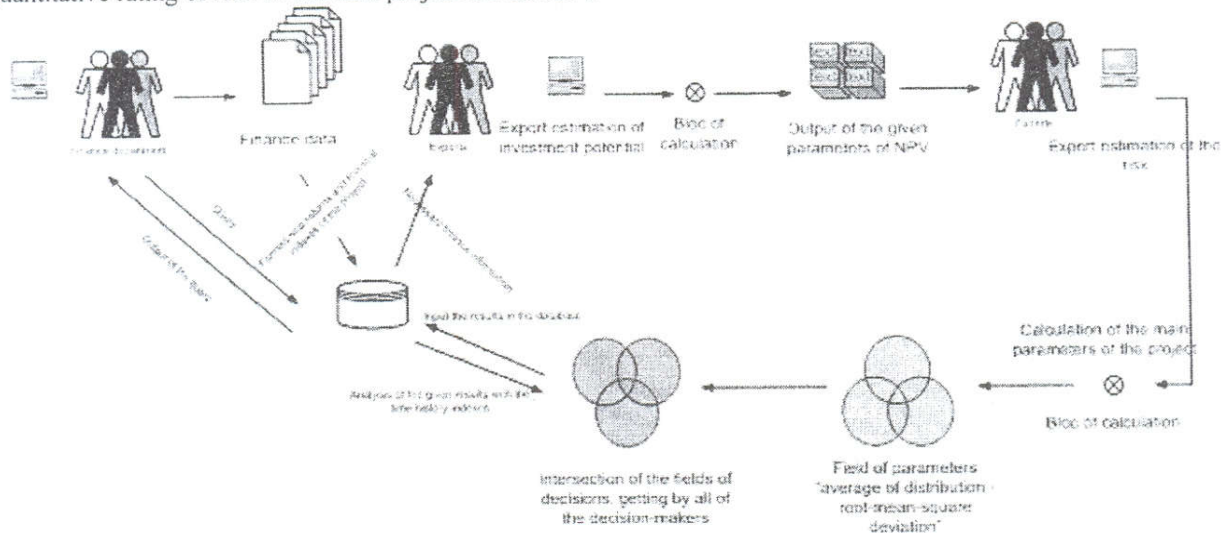
$$R_{ip} > \min \quad (8)$$

The spectrum of the risks connected to realization of investment project is extremely wide. In the literature there are tens classifications of risk. However as a result of research of significant volume of the literature, we came to a conclusion, that criteria of classification it is possible to name hundreds, as a matter of fact, value of any factor of investment project in the future is size uncertain, i.e. is a potential source of risk. In this connection construction of universal general classification of risks investment project is not obviously possible and is not necessary. In our opinion, it is much more important to define an individual complex of the risks potentially dangerous to the concrete investor and to

estimate them; therefore in the given work the basic attention is given toolkit of a quantitative rating of risks of the investment project.

On the basis of the carried out research methodical recommendations for carrying out of risk - analysis of investment project are offered. In particular, for a quantitative rating of risk investment project the author is

offered to use imitating modeling and scenario the analysis. In the considered methods the expert data received only from one expert, however, at a selection parameters are used is expedient, for the greater objectivity to use the data received from set of experts.



In this connection the dissertator has developed the following algorithm of imitating modeling:

1. Key factors of the investment plan are defined on the basis of which net present value of the project (NPV) which under formula (9) is calculated:

$$NPV = \sum_{t=1}^n \frac{NCF_t}{(1+r)^t} - I_0 \quad (9)$$

2. The maximal and minimal values of key factors are defined. As a rule, values of norm of discount r and initial volume of investments I_0 are known and are considered as constants during term of realization of the project.

The following stage of carrying out of the analysis is the choice of laws of distribution of probabilities of key variables. It is generally recommended to use normal distribution.

3. On the basis of the chosen distribution imitation of key factors is carried out in view of the received values NPV pay off.

Key varied parameters are: variable charges V , volume of release Q and price P . Thus we shall start with the assumption, that all key variables have uniform distribution of probabilities.

For simplification of calculations of investment risks of the given model make an assumption, that the stream of payments generated by the project looks like annua, i.e. the monetary payments equal each other paid through

time intervals on account of repayment of the received credit, the loan and interests on it. Then the size of a stream of payments NCF_t is identical to any period and can be determined from the following ratio (10):

$$NCF = [Q(P - V) - F - A] \cdot (1 - T) + A \quad (10)$$

4. Under each of the scenario in view of its probability pays off NPV the project therefore the file of values NPV (tab. 1.) turns out.

Table 1. Array of Values of NPV

Scenario	1	2	3	4	5	...	n
Probability	P_1	P_2	P_3	P_4	P_5	...	P_n
NPV	npv_1	npv_2	npv_3	npv_4	npv_5	...	npv_n

5. On the basis of the data received as a result of imitation the criteria quantitatively describing risk of the investment project (average of distribution of NPV, dispersion, root-mean-square deviation, etc.) are paid off.
6. For each pair "average of distribution -root-mean-square deviation" in system of coordinates put values which set represents set of expert decisions of every decision-maker.
7. The given areas are imposed on each other. Crossing of areas is the decision. The given area also includes the most effective investments of investment means at the set probabilities.

7. Conclusion

In the given report the basic methods of the analysis and processing of the information with the help of the considered methodology are offered.

In the conclusion we shall note, that the basic result of work is maintenance of methodical and information support of preparation of decision-making by the top management of the enterprise on the main financial and economic questions on the basis of the operative strategic analysis and the forecast of financial and economic parameters, and as results of marketing researches and an estimation of financial risk at introduction of investment projects.

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