

The model of decision-making support system designed for the university's investment projects assessment: designing

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Abstract

The purpose of this article is to describe the decision-making support system's innovative schemes for the university's investment projects assessment. As a result this model gives an opportunity to structure higher education's challenges and needs by their priority according to the exact calculations. This system can help not just in project selection but will give a significant impact on the university's development as a whole.

Keywords: investment projects, development strategy, universities, probability method, priority indicator.

1. Introduction

In its arsenal, contemporary literature has a huge number of mathematical methods and algorithms to calculate the economic efficiency of investment projects in different areas of industry and production (Vilenskiy, 2002; Kucharina, 2006; Volkov, 2006). The topics related to investment projects risk assessment are more and more faced by production structures' management (Saati, 2008; Prichinin, 2014; Chodyreva, 2017).

Thus, **the purpose of our research** is to define risks that could affect the effectiveness of decisions on matters related to investment projects, and the implementation of these projects is putted on the scientific-pedagogical stuff of our institution. The innovation projects proposed to the university within the limits of research work not only makes it possible to implement this project but also helps to recognize the teachers' potential in task solution.

There are some systems which aim at the specific of education, for example **The Module of Informational Resources Assessment and Choice for Decision-Making Support in Education**. This module is based on the ontology **The Education System of the RF**, and this module allows identifying a subset of educational system assessment criteria for every concrete situation described by advanced user. The substantive ontology **The System of Education in the RF** is created, and this ontology provided the basis for the Decision-Making Support System (DMSS in the future) that covers a number of agencies. This System relates to the sphere of the RF educational system assessment criteria. The parameters that are necessary to be defined by the Decisions-Maker (DM in the future) are identified. This is made for agent's assessment of a problem situation and an unambiguous understanding of the objectives. The major part of existing systems is connected with the management functions, for example **DSS The Adviser** (Polushkin R.V., 2009) and **The Manager's Monitor** (RDTECH, 2010). **DSS The Adviser** is the universal system of decision support dedicated for individual use. It allows to draw up a list of *criteria* to be met by a solution to the problem, to gauge the weight of each criterion. **The Manager's**

Monitoris is organized to capture many parts of the organization including an electronic documentation management system and a content management system, and it also provides an access to information portals. Owing to these components, there is a possibility to solve the main tasks set for the public authorities: enhancing the effectiveness of public administration and saving in costs of government and people resulting from the electronic interaction. The benefits of this system (Krylov, 2011; Sirotkin, 2011; Gladkiy, 2012):

- It is specially configured for the informational needs of top-management;
- It affords ample opportunities for data analysis in real-time;
- It grants access to a wide range of information on project-related activities;
- It possesses a very simple and intuitive interface;
- It does not need any specific knowledge for applying analysis tools;
- It provides information as human-readable graphical form;
- Using this technology is the best way to make an inexpensive system.

The reviewed systems help to make a choice when deciding based on one method only. Surely, using several methods can give more exact and quality solution. So, nowadays the Decision-Making Theory (DMT in the future) is used to diagnose the problems almost in all spheres of activity. Using the DMT methods allows solving a problem quickly and with reasonable accuracy. And to make a manager sure in his decisions taken on the base of received results with an aim of the DMSS, using several methods to take the only important decision is possible.

The theoretical basis of our research is run at the works of native and foreign authors dedicated to the questions of management automation, the methods of mathematical statistics, the simulation modeling, the methods of structural and object-oriented analysis of an enterprise. The scientists broach the following questions in their works: computer model's development (Tkachenko, 2003); theory and methods of decision-making and innovative activity (Sell, 2001); education technology (Klimanov, 2008); usage of innovative processes in education (Surat, 2010).

Our research input in global pedagogical science in the line of ***The Theory and Methods of Professional Education*** consists of the fact that the innovative didactic system is developed in purposeful, substantial, processual and organizational aspects. This system forms a professional competence of higher-education teaching personnel while making decisions in the university's investment activities on the base of mathematical statistics, the fuzzy sets theory and the decision theory, the theory of database, the methods of formalized analysis of control objects' informational characteristics, the algorithms of the systems' comparison to different criteria and also the contemporary software tools.

The Purpose of study is to form a professional competence of higher-education teaching personnel in research while making decisions for university's innovative projects assessment on the base of mathematical statistics, the fuzzy sets theory and the decision theory, the theory of database, the methods of formalized analysis of control objects' informational characteristics, the algorithms of the systems' comparison to different criteria and also the contemporary software tools.

The Tasks of study are:

- 1) to determine the theoretical background and practical base of designing the model of Decision-Making Support System (DMSS) for the university's investment project assessment;
- 2) to point out the main factors that determine the risks of innovative projects' realization in university research;
- 3) to design the model of Decision-Making Support System (DMSS) for the university's investment project assessment, the model based on the probability and analytical methods and the analytical hierarchy process;
- 4) to mastermind the technological support the Decision Support System's realization in the education area under the risk and uncertainty;
- 5) to prove the certain choice of informational asset to support the decision-making in the education sphere;
- 6) to mastermind the algorithmic and software support of the computer model of decision-making for the university's innovative projects assessment, to make an review of the success of the implementation.

2. Methods

To reach the goal of research and problem solving, there was used a complex of analytic methods: the analysis of philosophic, psychology and pedagogical literature and courseware; the simulating and project planning of didactic theories, comparison, systematization, analysis, general conclusion of theoretical and research data; studying and test assessment of universities' work to form the students' professional competences, supervision, conversation, expert assessment, polling, documentary studying; the pedagogical experiment that let to come down with the students' professional readiness; the mathematical statistics methods and the software applications to elaborate the results of the pedagogical experiment.

The research has a base at the Noyabrsk Institute of Gas and Petroleum in Yamal Nenets Autonomous District.

The veracity and scientific validation of the progress achieved stem from either methodological foundation of theoretical positions, diagnostic tools development that were commensurate with tasks, subject and object of the research, and the representativeness of the sample, quantity and quality determination of experimental data; using the results of the study.

From the position of management functions the monitoring system consisted from diagnosis of professional competence of the higher-educational teaching personnel while making decisions in investment activities under risk and uncertainty. The identification of differences in the professional competence level in our research was made by the test of differences U-Mann-Whitney, that is intended to value differences between two sampled frames according to the quantity modified characteristics.

Based on the received results that were handled by the mathematical statistics, the dynamics of differential exponents of the higher-education teaching personnel's professional competence level was investigated, the hypothesis of effectiveness of the Decision Support System's technological support engineered in the educational research

was confirmed. This support was based on the probability method, the test method and the hierarchy analysis technique.

3. Result

Nowadays in the Decision-Making Theory there is a huge number of methods to solve tasks of any difficulty and direction (Billing, 1996; Bardhan and Sougstad, 2004; Hu et al., 2017).

For the investment valuation in the university's research work the existing methods were analyzed, and this methods allow to make a decision under risk and uncertainty. Development of the model of the Decision-Making Support System for the university's investment projects assessment included the following setups:

- The jury of opinion and receiving results of the jury of opinion;
- The Evaluation Grade in the experts' marks;
- The determination of indicators that reflect public opinion;
- Receiving the probability that the project will implement, basing on the probability and analytical methods and the hierarchy analysis technique.

After following indications of all the indexes and taking account of the priorities of each of them, the most effective project for realization was found (see Table 1).

Table 1. The analysis of the methods realized at the model of university's investment project assessment

Rule Number	Rule Characteristic
Rule 1	If all the three methods (probability, expert and analytical) show the effectiveness of a project N, a manager makes a decision about the effectiveness of a project N to realize it in the university.
Rule 2	If the results of the first (probability) and the second (hierarchy analysis technique) methods showed the effectiveness of a project N, but the results of the third (analytical) method showed the effectiveness of a project M, a manager proposes to make advantage calculations related to the financial part of projects N and M.
Rule 3	If the first (probability) and the second (expert) methods showed different results (regardless of the analytical method), a manager makes a decision to make some advantage mathematical calculations to choose a project (or to abandon the proposed projects).
Rule 4	If all the three methods (probability, expert and analytical) showed different results, a manager takes a decision that it is necessary to ask experts for an advantage survey and an analysis of a current situation (or denies realizing a project).
Rule 5	Results of the probability and expert methods have to be known as right and credible if a high degree of coordination among the experts is demonstrated in all of the methods submitted.

The methods analysis showed that for university the most appropriate methods are: probability; expert (hierarchy analysis technique); analytical methods of project risks assessment.

The considered methods are realized in our research in the model of the university's investment projects assessment, and it allows to measure the project's effectiveness by using an experts' opinion and economical calculation for every project. The developed model of decision-making support system designed for the university's investment projects is based on the probability analytical methods and hierarchy analysis technique and leads to the conclusion about the effectiveness of investment activity in the area of education.

During the experts' selection, the great attention was paid to their opinions coordination, which is characterized by biased or unbiased estimates of scatter (Orlov). For this purpose, there was a control survey with a mathematical calculation of its results, at the setup of the expert group forming. Herewith not only one measuring object was used but several, thus

they were put on the ordinal scale depending on their worth and quality, so their ranks were determined.

As a degree of experts' coherence **the coefficient of concordance** was determined in this case by the following formula:

$$W = \frac{12S}{n^2(m^3 - m)}, \quad (1)$$

where S is the sum of the squared deviation of the every expertise object's ranks sum from of an average arithmetical rank; n is a number of experts; m is a number of expertise objects. Depending on experts' coherence, **the coefficient of concordance** moved from 0 (when there was not any consolidation) to 1 (with total unanimity).

To receive **the weighing coefficients** the different methods were used: the hierarchy analysis technique, the facts prioritizing, the direct assessment setting.

The generalized algorithm of innovation project chooses is presented in the following way: the jury of opinion and receiving its results (the probability method and the hierarchy analysis technique); the ranking of the experts' assessment (for the probability method); defining the coefficient of the consolidated views; project's probability calculation of several proposed by the probability sampling; choosing the best project by the hierarchy analysis technique; making a decision about project's choose; calculating the economic indexes by the analytical method; taking a decision on the indexes obtained; taking a decision about innovation project's choose taking a cue from the three methods according to the strategy worked out.

The structure and degree of risks of innovation projects' realization in the universities is somehow different from risks of different investment projects (Kozlov, 2013; Kozlov). Foremost comes the risks of non-completion in accordance with a technical task and full or part-time non-repayment. Possible total cycle can be considered while analyzing the following components:

- The completeness of work performance according to the project's purpose;
- The improvements possibility (in case of project's non-complete achievement in time);
- The results of partners' repaying performance;
- The value of scientific results received.

Using these components, we can receive the following results:

- The work and repaying performance are done fully;
- The scientific-research part of the work is done fully but an external shareholder has not applied his undertakings, among them financial ones, in the full extent, for some reasons;
- The scientific-research part of the work is done fully but the commercial part of project's is fouled-up (by an external shareholder), financial undertakings are not applied;
- The scientific-research part of the work is not done fully, but the significant science results are received;

- To finish the work additional time is needed;
- The scientific-research part of the work is not done, but some interesting results are received;
- But the scientific result planned at the beginning will not be reached in near time;
- The execution of innovation work is fully fouled-up.

The likelihood that a research group has fully done its work depends on the two groups of factors defined by situations accordingly inside a group or inside the university.

The third risk factor is connected with a partner who can fulfill his part of contract or not (wholly or partly).

The forth risk factor is macroeconomic, meant a situation in the agricultural sector (degree of non-payment, escalation or irrational tax policy etc.). An entrepreneurial risk will not depend on external shareholder unlike in case with innovative projects.

The innovation project's analysis of results allows for the next conclusion: in the first and the second cases we see the full success or the full fall; in the another cases the scientific results are received but they don't confirm the results we planned.



Figure 1. The Possible Risks in innovation program realization

With allowance made for possible risks, an innovation project model can be built. So, let us describe the calculus of probabilities stages of the university's innovation project:

1. *The main factors determination to define risks of the university's innovation projects realization.*

2. *The determination of a main function connected with the mathematical model of the university's projects realization risks.*

The main formula of the mathematical model of the university's projects realization risks has to be depended from the above-mentioned factors, that don't depend on each other (the product rule for the antithetical events). This model is calculated by the following formula:

$$P = P_1 * P_2 * P_3 * P_4 * P_5. \quad (2)$$

3. The scoring of the five possibilities, each of them will be calculated due to the linear functions by the following formula:

$$P_n = 1 - A_{1n}X_{1n} - A_{2n}X_{2n} - \dots - A_{kn}X_{kn}, \quad (3)$$

where $n = 1, 2, 3, 4$,

$X_{1n}, X_{2n}, \dots, X_{kn}$ - the factors (running), that are used during calculation like n ,

$A_{1n}, A_{2n}, \dots, A_{kn}$ - wait coefficients of these factors.

P_n — the possibility of full success, in other words a total cycle a) according to the classification mentioned above, thus the risk of innovation project will not be done fully, it is valued as a possibility that “there won’t be total success”, in other words as a value $(1 - P)$;

P_1 — the possibility of that situation inside the co-workers cannot hurt to realize the innovative project (therefore the collective’s risk is rated as a value $1 - P_1$);

P_2 — the possibility of that situation inside the university cannot hurt to realize the innovative project ($1 - P_2$ — the university’s risk);

P_3 — the possibility of that the external shareholder will fulfill his work totally, after that research group will fulfill its work totally ($1 - P_3$ — the partner’s risk);

P_4 — the possibility of that the situation in the national economy cannot hurt to realize the innovative project ($1 - P_4$ —macro economical risk);

P_5 — the possibility of that specific traits of an education establishment cannot hurt to realize the innovative project ($1 - P_5$ — specific risk).

It is necessary to assess the likelihood of the successful university’s innovative project’s realization and pay attention to the factors affecting the successful project’s realization in the analysis of the terminal evaluations of several projects. The conclusions received have to be noticed while organizing this or that innovative projects.

If the university’s administration insists on some project’s realization it is needed to propose the administration to analyze possible risks and to preview some certain moments if possible, the moments connected with threats. The decision-making happens on the base of received opportunities, and the greatest of them show that this project is under the lowest risk of default. The choice of the innovative projects for financing is efficiently done, if the technology of probabilistic assessment mentioned above is taken into account. These probabilistic assessments have to be about the risk of realization where the experts take part. This concrete model has the absolute priority to be chosen because it covers the different factors that is quite important for the decision-maker.

3.1. Projects Assessment Methodology Based on the Hierarchy Analysis Technique:

The First Stage: The Research Problem Hierarchy Construction.

The Second Stage: The Pairwise Hierarchy Elements Comparison, the Comparison Matrix Construction Building Based on the Comparison Scale.

The comparison matrix construction is built to compare the relativities of the elements on the second level related to the common goal on the first level (the matrix 0) and the

pairwise comparison matrix for every alternative on the third level related to the second level elements. The pair judgments are made by the relativities scale (see table 2).

The comparison begins from the matrix left element and it is defined as if it is more important than the second element. Compared to it itself, ratio is 1. If the first element is more important than the second one, then a whole number from the scale is used, otherwise the reciprocal is used. In any case, the opposite ratios are putted in symmetrical matrix position. So, we offer you to use such rules during your calculations:

- 1) if $a_{ij} = \alpha$, then $a_{ji} = 1/\alpha$;
- 2) if the compared elements have the same importance, then $a_{ij} = a_{ji} = 1$, in particular $a_{ii} = 1$;
- 3) all the matrix zones are fulfilled by the only one scale values.

Table 2. The Relativities Scale

The Relativity Intensity	The Definition
1	The equal importance
3	The middle preeminance
5	The significant preeminance
7	The sizeable preeminance
9	The very force preeminance
2,4,6,8	Intermediate solutions between two nearest-neighbor
Reciprocal quantities of above mentioned numbers	If comparing one parameter with another we receive one of the above mentioned numbers, and then we will receive the contrary while comparing the second and the first.

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ 1/a_{12} & 1 & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{bmatrix}$$

The Third Stage: Mathematical Processing of Obtained Judgments: Local Priorities Vector Calculating and Priorities Synthesis.

The judgment received mathematical treatment includes *local priorities vector calculating* for every matrix and *priorities synthesis*.

Local priorities vector of the matrix $M_{n \times n}$ represents a relative strength, number, value of the every matrix element:

$$M := \begin{pmatrix} a_{11} & a_{12} & a_{13} & \dots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \dots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \dots & a_{3n} \\ \dots & \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & a_{n3} & \dots & a_{nn} \end{pmatrix}$$

The every vector component $b_1, b_2, b_3, \dots, b_n$ of priorities B that belong to the matrix

$M_{n \times n}$ is calculated from every matrix line element (in the first matrix line, there is the component b_1 , in the second line, there is the component b_2 , ... in the n line, there is the component b_n) from the formula:

$$b_i = \sqrt[n]{a_{i1} \cdot a_{i2} \cdot a_{i3} \cdot \dots \cdot a_{in}}, \quad (4)$$

where $i=1, \dots, n$.

Then, the vector $B = \{b_1, b_2, b_3, \dots, b_n\}$ becomes normal. In this case, the vector components union is calculated as follows:

$$\sum_{i=1}^n b_i. \quad (5)$$

Then, every component $b_1, b_2, \dots, b_n$ is divided by the union found. Thus, we receive the local priorities X of matrix M normalized vector, and it is calculated as follows:

$$X := \begin{pmatrix} \frac{b_1}{\sum_{i=1}^n b_i} & \frac{b_2}{\sum_{i=1}^n b_i} & \frac{b_3}{\sum_{i=1}^n b_i} & \dots & \frac{b_n}{\sum_{i=1}^n b_i} \end{pmatrix}$$

To solve the selection problem it is needed to receive the local priorities $X, X_1, \dots, X_n$ vector for each matrix: $X = \{x_1, x_2, \dots, x_n\}$, $X_i = \{x_{i1}, x_{i2}, x_{i3}\}$, where $i=1, 2, \dots, n$.

The Priorities Synthesis. The components of local priority are put in the table.

The priorities are being synthesized, beginning from the second level. The local priorities are multiplied by the relevant criterion's priority at the higher level and are summarized by every element. As consequence, we receive the *global priorities vector*, and its every component is appropriate candidate's global priority. The global priorities vector's components have to be put in the table.

The fourth stage: An Alternative Decision-Making.

The biggest component of the global priority vector is chosen. The project that goes with this component is the preferred one.

In this decision-making method, there is the biggest component of the global priority. The project that goes with this component is the preferred one. This method has a lower priority

than the probability one because only some criteria of project's assessment are noticed by experts.

The third method of the projects' assessment is an analytical one, and it is built on the investment projects' economic assessment procedure. This technology is based on the different economic number-crunching, that allows reducing the ill-considered investment. This method underlies many decision-making computer models (The Feasibility Studies Invest, The Project Expert, The Analyst, The Alt-Invest and others), however it is unable to provide a clear and precise outlook for future. The reason is following. This investment project's functioning comes with such difficult cause and effect relationships that it is practically impossible to provide it with high degree of accuracy. With this in mind, it becomes clear, that the deterministic approach cannot be a solid foundation for an adequate analysis of investment projects. In this regard, this method has a low priority comparing with the probability and expert ones for making a quality decision. In projects assessing, it is suspected that all the initial values, among other factors, the flow of money values, are well known or could be precisely defined (Kozlov et al., 2017; Mi et al., 2017). In a real situation, it is almost impossible. The parameters that determine the flow of money value can gain a value different from desire. For every project, the reckoning of define figures is realized, after that the results are ranged, and then, based on the traces, the conclusion about project's effectiveness is drawn (see Table 3).

Table 3. The Effective Investment Project Figures

The Figure	The Project Characteristics
Payback Period (PP)	$PP = \frac{K_0}{CF_{AA}}$ where PP is the payback period (in years); K_0 is the initial investment; CF_{AA} is the average annual return on the investment project realization.
Accounting Rate of Return Figure (ARR) is the inverse for capital investment's substance and payback period.	Accounting Rate of Return reflects an investment efficiency as a percentage wise return to the start-up investment ratio $ARR = \frac{CF_{CF}}{K_0}$ where ARR is the accounting rate of return, CF_{AA} is the average annual return on business, K_0 is the initial investment.
Net Present Value (NPV) is investment project's estimation criterion. The amount of future flow of money is calculated with the deduction of investment flow of money, but cum return of capital investment's discount period.	Project's New Present Value looks like the following formula: $NPV = PV - I$, where PV is the real value, I is the investment value. An investment project is considered to be effective if the NPV is positive. However, the correction for risk should be made.
Profitability Index (index of return) allows to define relative investment efficiency.	This criterion by the special formula and is the result of dividing of the project's new present value figure by its complete investment outlay figure: $I_p = \frac{\sum PV}{\sum I}$

While projecting the decision-making support system for the university's investment projects assessment, based on the probability and the analytical methods and the hierarchy

analysis technique, there were discovered the soft- and algorithmic- ware of the soft decision-making model and outcasts of its adoption.

Projects Assessment Algorithm Using Probability Method. According to the established methodology, the probabilities investment projects realization begins from the main facts definition. The experts group receives the task to answer the questions or evaluate some object's qualities by the criteria proposed. The results are put in program.

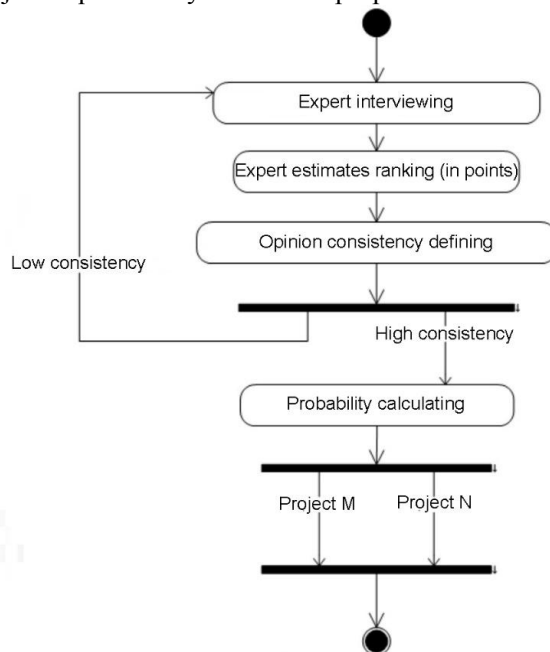


Figure 2. Project assessment algorithm using probability method

It is needed to define an experts' consistency level based on the data received. If it is high, then the program counts the weight numbers that are noticed in probabilities' calculation. Otherwise, there is no next calculation, because there will not be an objective result. The experts are proposed to make their discussion about the task's factors, to make a mutual decision.

The algorithm scheme can be seen on the Figure 2. After probabilities' counting, the project that has received the biggest probability, is the most effective to be produced in future.

3.2. Project Assessment Algorithm Using Hierarchy Analysis Technique

During program algorithm by hierarchy analysis technique it is necessary receiving pair criteria comparison. Thus, interviewing the experts is needed. The results have to be written in the according matrixes. After making the comparison matrix construction, the program figures the local priorities' vector. After that it figures the priorities' synthesis.

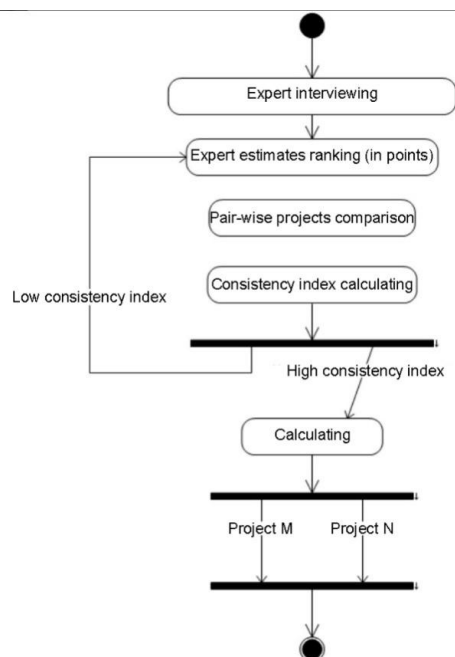


Figure 3 . Project assessment algorithm using hierarchy analysis technique

In this algorithm *the experts' consistency index* is also calculated. This index has to be high to make the system continuing its calculations.

The project is chosen based on the calculations results. The most effective project is that with *the highest grade*.

3.3. Project Assessment Algorithm Using Analytical Method

Using analytical method, it is needed to receive from the university's project management the precise economic data that is noticed by the management while investing into the project.

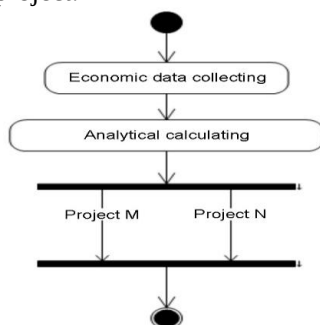


Figure 4. Project assessment algorithm using analytical method

After putting every project's indexes, the program calculates the dimensions. Based on the results received, the Decision-Maker (DM) makes a conclusion about the project's effectiveness, basing on rules formulated in investment project's assessment methodology. Thus, basing on the built algorithms and chosen means, the program system of investment projects assessment is being realized. Also data-base and the future investment decision-making support system interface are being designed. This system consists of three moduli: the innovation project probabilities' calculation modulus, the effectiveness assessment by hierarchy analysis technique modulus and the investment project effectiveness's main figures modulus.

3.4. Projects Joint Assessment Algorithm Based on Three Methods Results

After calculating by all the methods (the probability, the expert and the analytical ones), the program makes a post-execution comparison. And according to the rules proposed in the Chapter 2, makes a decision about project effectiveness and gives recommendations for an analysis advanced.

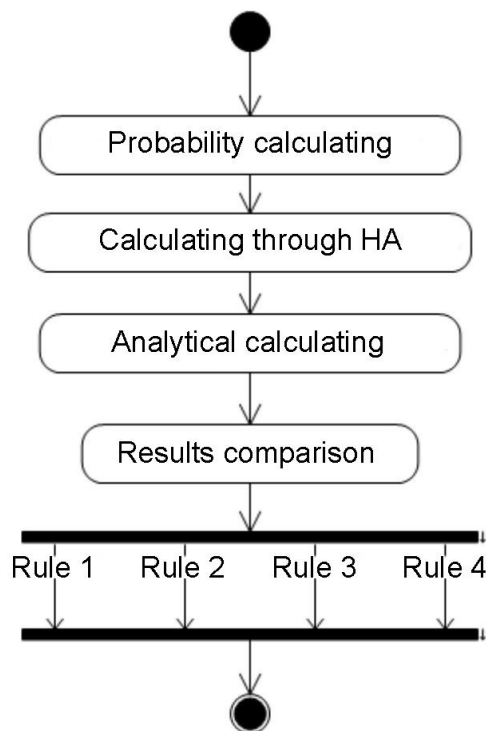


Figure 5. Joint Assessment Algorithm

This system allows choosing a project by three methods and makes a decision on its own. That helps to save time and the Decision-Maker's efforts.

The interface design for the decision-making support system for the university's investment project's assessment, based on the probability, analytical and hierarchy

methods, is designed for 5 investment projects assessment at one time. It is needed to put the data: the experts' assessment, the project effectiveness economic figures. And after that the system makes its calculations and allows to see the most profitable project in comparison with the others. By using the probability method, one needs to calculate the weight numbers. In these methods, the seven experts' opinions are used. During the DM weight numbers calculation, the ranking results of the seven expert's opinions were put in the table.

Weight Numbers Calculation for Line Functions (Ranking Method)

Route number	Object number	Expert assessment						
		1	2	3	4	5	6	7
Collective risk (N-01)	1	1	1	1	1	2	1	1
	2	4	4	4	4	3	4	4
	3	3	3	3	3	4	2	3
	4	2	2	2	2	2	3	2
University's risk (N-02)	1	3	3	3	3	3	2	3
	2	2	2	2	2	2	3	2
	3	1	1	1	1	1	1	1
Partner's risk (N-03)	1	1	1	2	1	1	1	1
	2	3	3	3	4	3	4	3
	3	4	4	4	3	4	3	4
	4	2	2	1	2	2	2	2
Macroeconomic risk (N-04)	1	4	3	4	4	4	4	4
	2	3	4	3	3	3	3	3
	3	2	2	2	2	1	2	2
	4	1	1	1	1	2	1	1
Specific risk (N-05)	1	4	3	3	3	3	3	4
	2	3	4	3	4	4	3	3
	3	2	1	1	2	1	2	2
	4	1	1	2	1	1	1	1

Calculating coefficients

Figure 6. Weight Numbers Calculation Form

The program defines a consistency level of experts' opinions (see Figure 7). If there is low consistency, special means to increase it have to be done. Herewith, future calculations don't guarantee quality decision-making.

Route name	N – 01	N – 02	N – 03	N – 04	N – 05
Ranks Arithmetic Average	17.75	14	17.5	17.5	16.5
Coordination of Plans Coefficient	0.811	0.878	0.869	0.902	0.82
Experts Consistency Level	high	high	high	very high	high

Figure 7. Experts Consistency Assessment Level

Weight and Probability Coefficients	Project 1	Project 2	Project 3	Project 4	Project 5
1. Risk for Collective Body					
An	Xn(1)	Xn(2)	Xn(3)	Xn(4)	Xn(5)
0.023	2	2	4	0	1
0.076	2	3	5	0	2
0.059	2	2	4	1	2
0.042	3	2	2	1	0
2. Risk inside the University					
An	Yn(1)	Yn(2)	Yn(3)	Yn(4)	Yn(5)
0.095	0	3	4	1	1
0.071	1	2	5	1	2
0.033	1	3	4	0	2
3. Partner Risk					
An	Zn(1)	Zn(2)	Zn(3)	Zn(4)	Zn(5)
0.023	1	2	3	0	2
0.066	1	2	2	1	0
0.074	1	3	2	1	1
0.037	1	1	1	0	1
4. Macroeconomic Risk					
An	Wn(1)	Wn(2)	Wn(3)	Wn(4)	Wn(5)
0.077	5	3	2	0	2
0.063	4	2	2	1	2
0.037	5	1	1	1	1
0.023	5	2	0	0	1
5. Specific risk					
An	Sn(1)	Sn(2)	Sn(3)	Sn(4)	Sn(5)
0.07	3	1	2	0	2
0.073	1	5	3	1	2
0.033	5	1	1	3	1
0.024	5	2	0	0	1

Calculate probabilities

Figure 8. Probability Method Calculation Form

Making calculations by hierarchy analysis technique, the Decision-Maker has to collect the results of 5 projects' pair-wise comparison on 4 certain criteria (see Figure 10). After calculations made by hierarchy analysis technique, the system shows the results as a table. In its last column, there are showed the global priorities in reference to 5 considered projects. The highest result zone is painted. Calculating by the analytical method, all the economic data have to be collected by the DM. After that he puts this data into the system, and thus, the program judge, how effective is this or that project.

Project Assessment by Hierarchy Method
 Eligibility criteria: K1 – university's specifics; K2 – partners;
 K3 – economics; K4 – collective

It is assumed that: $1/9=0,111$; $1/8=0,125$; $1/7=0,143$; $1/6=0,167$;
 $1/5=0,2$; $1/4=0,25$; $1/3=0,333$; $1/2=0,5$

Eligibility Criterion	K1	K2	K3	K4
K1	1	3	4	0.111
K2	0.333	1	7	0.333
K3	0.25	0.143	1	0.333
K4	9	3	3	1

Matrix for Criterion 1

K1	P1	P2	P3	P4	P5
P1	1	5	3	0.333	0.333
P2	0.2	1	0.143	5	4
P3	0.333	7	1	0.5	2
P4	3	0.2	2	1	5
P5	3	0.25	0.5	0.2	1

Matrix for Criterion 2

K2	P1	P2	P3	P4	P5
P1	1	3	0.5	4	0.333
P2	0.333	1	0.143	0.333	4
P3	2	7	1	0.5	2
P4	0.25	3	2	1	4
P5	3	0.25	0.5	0.25	1

Figure 9. Data Input for Calculating by Hierarchy Method

After inputting the data, the DM makes a decision about the project's effectiveness. Some functions can be not so high, but the DM can make a decision about the project's effectiveness, basing on another indexes' results.

Decision-Making

Calculation data are listed in the table:

Method's Name	Project number
Probability method	4
Hierarchy method	4
Analytical method	4

According to the calculations done, the most effective project is the Project 4

Figure 10. Project Effectiveness Choice (upon condition that the experts' consistency)

As a check on computer model reliability, the next actions were performed: created system's database queries were tested, different database queries were designed. As a result, it was committed that concrete queries are processed by the database according to the proposed outcome; the program text was checked on its sensitivity to some particular significance, and some changes were made.

4. Discussion

The scientific novelty of the study is as follows: scientific-pedagogical framework and technological infrastructure development of higher-education teaching personnel competence's system, in the area of investment analysis in education. This research is based on the mathematic statistics, the fuzzy sets theory and the decision-making theory, the database theory, the analysis of control object's informational characteristics, the algorithm of systems comparison by different criteria and the contemporary software appliances.

The theoretic weight of the study is as follows: based on the probability, analytical and hierarchy methods, the Decision-Making Support System for university's investment projects assessment was developed.

The practical weight of the study is as follows: the Decision-Making computer Model software is developed and its implementation analysis is made. Also the practical weights have the technical institutions' works that were developed in the study and adopted. And so do the methodical recommendations for the decision-making support system designed for the university's investment projects assessment. It is based on the probability, analytical and hierarchy methods.

The practical weight of the study is as follows: the investment activity can be up leveled, if educational research framework and technological support of quality assessment system for the university's investment projects will be designed, based on the contemporary decision-making system, under risk and uncertainty (Zhanget al., 2016).

In our study, the innovative didactic system is developed, that is able to form scientific-pedagogical framework and technological infrastructure development of higher-education teaching personnel competence's system, in the area of investment analysis in education. This research is based on the mathematic statistics, the fuzzy sets theory and the decision-making theory, the database theory, the analysis of control object's informational characteristics, the algorithm of systems comparison by different criteria and the contemporary software appliances. Surely, all the can not come under the above general

treatment, and such a difficult theme as the model of decision-making support system designed for the university's investment projects assessment has to be developed more. The problems that are in want of future development are the following: technological support of quality assessment system for the university's investment projects, based on the contemporary decision-making system, under risk and uncertainty.

5. Conclusion

Experimental practical approval of study's results confirms the correctness of the hypothesis, its concepts truth and allows drawing the following conclusions:

1. Basing on advancement of scientific research work, there are studied: historical aspects of the decision-making system, of the decision-making support system in education, the software for business planning and investment analysis.
2. There is made an analysis of how possible are: the decision-making system for the university's investment projects assessment in scientific research; informational technologies in management investment task solutions.
3. The model of the decision-making support system for the university's investment projects assessment.
4. The technologic support is designed, to realize the decision-making support system in education, based on the probability, analytical and hierarchy methods.
5. The algorithm is designed, for the decision-making support system in education, based on the probability, analytical and hierarchy methods.
6. There are designed for the project development: the joint assessment algorithm, based on results of the probability, analytical and hierarchy methods, and the interface, based on the contemporary decision-making system, under risk and uncertainty.

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