Program Support for Selection Procedures for Environmentally Oriented Investment Projects

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Abstract. The aim of the work is to develop program support for selection procedures for environmentally oriented investment projects, including the calculation of traditional criteria for the effectiveness of the project, additional environmental criteria for the effectiveness of projects, application of methods for prioritizing projects and their selection with the use of modern information technologies. The article reveals the essence and features of environmentally oriented investment. A system of criteria for assessing the effectiveness of environmentally oriented investment projects has been developed. The conceptual bases of creating an information system for calculating the financial, budgetary, economic, social and environmental indicators of investment projects and their effectiveness, as well as assessing their priority, are proposed for consideration. Calculations of the priority of investment projects were carried out on the basis of the information system developed by the authors using multicriteria analysis methods. As a result, each of the criteria for the effectiveness of the investment project is given a specific quantitative value, and each investment project is a quantitative assessment of the priority of the project, which allows using the results of calculations to select projects and make managerial decisions on their implementation. The proposed information system can be a tool for adopting an effective environmentally oriented economic solution. The conducted experimental calculations showed the adequacy of the developed information system to the existing subject area. The Federal Service for Intellectual Property, Patents and Trademarks of the Russian Federation issued a certificate on the official registration of the computer program for the developed software product.

1. Introduction
The problems of choosing the directions of environmental and economic development are now on the agenda of all countries of the world community. Modern ideas about the future, when environmental aspects become the focus of attention in many countries, are reflected in the documents of the UN Conferences adopted in Paris (December 2015) [1], New York (September 2015) [2] and Rio de Janeiro (June 2012) [3] and other international organizations, as well as in the strategic documents of the Russian Federation that determine the main development paths of the country during the coming decades [4, 5], one of which is the formation of a balanced, environmentally oriented model of economic development. The scientific and methodological justification of the criteria and the software of the procedures for selecting priority environmentally oriented investment projects will make it possible to implement such development models.
2. Literature Review
Problems of considering the environmental factor in investment activities, assessing the environmental and economic efficiency of investment projects, developing organizational, economic and financial mechanisms for attracting investments to the implementation of environmentally-oriented projects have been studied in the works of S.N. Bobylev [6], O.P. Burmatova [7], K.P. Kolotyrin [8], O.V. Kudryavtseva [9], O.E. Medvedeva [10], I.P. Nuzhina [11], E.V. Ryumina [12], A.L. Novoselov [13], I.M. Potravny [14], T.S. Khachaturov [15] and others.

The multifacetedness and complexity of assessing efficiency and selecting priority environmentally-oriented projects require an increase in quality of their development, information management of their implementation through the development of appropriate automated information systems.

3. Priority Strategy
The aim of the work is to develop such an information system that allows automating the process of calculating performance indicators of investment projects, and use this basis necessary for the selection of priority environmentally oriented investment projects.

4. Related Works
The study and systematization of existing approaches to the definition of an «environmentally oriented investment project» [16-19] allowed the following definition: «An environmentally oriented investment project is an investment project aimed at developing environmentally friendly activities using local natural resources, resource saving based on the application of the best available technologies, creating living conditions for the people in areas with limited economic activities within the framework of the environmental reserve area». We understand the term ecological reserve of the territory as the ratio between the assimilation potential and the existing anthropogenic load in this territory.

The decision to implement the project is most often complicated by the existence of several alternative options that can be economically beneficial, but are dangerous from the point of view of the impact on the environment and, conversely, if environmentally safe technology is less economical. To assess the effectiveness of environmentally-oriented projects, we have developed a system of criteria in which traditional criteria for financial, budgetary and social efficiency, as well as environmental criteria that take into account the reduction of the negative impact on the environment, are proposed to be supplemented with criteria for the environmental justification for the location of the investment project. It was suggested to include additional criteria for justification: 1) taking the ecological reserve of the territory into account when assessing the feasibility of the investment project; 2) assessment of the extent of the territory's exposure to negative natural and anthropogenic factors on the basis of a quantitative assessment of economic damage resulting from their negative impact.

The selection of environmentally oriented investment projects is an unstructured process of decision making and it is distinguished by the impossibility to establish mathematical relationships between parameters. In this case, we know only the criteria and the alternatives (projects). The analysis of the existing methods of multicriteria analysis [20-24] allowed concluding that the method of analyzing hierarchies satisfies to the greatest degree the requirements of universality, taking into account the multicriteria nature of choosing between alternatives, the simplicity of development and processing of the initial information.

The main requirements for the development of an information system for the evaluation and selection of investment projects are: the selection and justification of a unified methodology for collecting and classifying information on traditional and additional indicators of the effectiveness of investment projects; selection of a methodical apparatus that allows organizing data of various contents.

A professional programming environment in C++, C# and Visual Basic - SharpDevelop was chosen as the environment for designing and creating a new information system. It is open and freely distributed software. The developed software module includes the following blocks:
- Calculation and evaluation of traditional indicators of the effectiveness of investment projects (including environmental);
- Calculation and assessment of the assimilation potential and anthropogenic load of the territory, identification of the ecological reserve of the territory;
- Quantitative assessment of economic damage resulting from the negative impact of natural and anthropogenic factors;
- Procedure for ranking and selection of investment projects.

Since some of the authors' approaches to the formation of an information system for evaluating the effectiveness of investment projects were published earlier [25], here we briefly describe the last block.

The list of investment projects generated for the selection of priority projects is ranked by the calculated indicators with the help of the hierarchy analysis method [26]. The application of the hierarchy analysis method should begin with alternatives, from which the best alternative will be chosen with the help of this method. The alternatives are the investment projects. The goal is determined (in our case, the aim is to rank and select priority environmentally oriented investment projects). Then the criteria are set, according to which the chosen alternatives will be evaluated. Next, you need to compare the criteria with respect to the goal, and the alternative - with respect to the criteria, and convert non-numeric information into a numerical one, which allows you to reveal the significance of the indicators. The following scale of relative importance is proposed when considering the importance of various criteria in the hierarchy analysis method: 1 - equal importance, 3 - medium degree of superiority, 5 - moderately strong superiority, 7 - very significant superiority, 9 - absolute superiority and 2, 4, 6, 8 - corresponding intermediate values. To determine the significance of the criteria, the so-called matrices of paired comparisons are formed, where each criterion is assigned a number in the range from 1 to 9. At the final stage of the analysis, the synthesis (linear convolution) of project priorities is performed, as a result of which the priorities of alternative solutions are calculated in relation to the main goal. The alternative with the highest priority value is considered the best.

5. Case Studies

Approbation of the developed software was carried out on the materials of the Republic of Buryatia. The data of 231 municipalities were analyzed at the level of municipal districts and rural settlements of the Republic of Buryatia. The calculations used information and statistical materials of state statistical bodies and executive authorities for 2016. The calculations show that there are ecological reserves and additional opportunities for further development of production in 123 municipalities of the Republic of Buryatia. At the same time, in a fairly large number of other municipalities (108 municipal entities), where the actual level of anthropogenic load on the environment exceeds the assimilation potential of the territory, the ecological reserve of production is exhausted.

The updated list of investment projects of the Republic of Buryatia consisted of 210 projects. In order to form the complete list of investment projects that are expected to be implemented on the territory of the Republic of Buryatia in the coming years and carry out its further analysis, the following sources of information were used: data from the Regional Development Fund of the Republic of Buryatia; The investment portal of the Republic of Buryatia; Investment passport of the Republic of Buryatia; Investment passports of municipal entities of the Republic of Buryatia. The final list of priority investment projects for the long-term socio-economic development of the Republic of Buryatia selected on the basis of the developed information system includes 44 projects that can be recommended for consideration for state support.

The results of the selection of projects by the method of analyzing hierarchies indicate that the prospects for the Republic of Buryatia in the world, Russian and regional markets are primarily related to the development of a tourist cluster and environmentally friendly agro-industrial production.

6. Conclusions

In addition to evaluating projects by indicators of economic, budgetary, financial, social and environmental efficiency, the evaluation of environmentally oriented investment projects includes assessing
the feasibility of implementing an investment project, taking into account the environmental characteristics of the location of investment projects, as well as a formalized procedure for ranking and selecting investment projects using the method analysis of hierarchies. As a result, each of the criteria for the effectiveness of the investment project is given a specific quantitative value, and each investment project is a quantitative assessment of the priority of the project, which allows using the results of calculations to select projects and make managerial decisions on their implementation.

The chosen professional level programming environment in C++, C# and Visual Basic - Sharp-Develop languages allowed designing an information system that has the following positive characteristics:
- Allows performing evaluation of efficiency criteria and selection of priority environmentally oriented investment projects;
- Has a convenient intuitive interface;
- Allows you to save the results in MS Excel for further analysis and working with data;
- Stores information about all the indicators used in the calculations, that is, it is a data store;
- Does not require large expenditures of financial and time resources in its development and implementation.

The calculations carried out by the authors demonstrated the adequacy of the developed information system to the formulated requirements and assigned tasks. A certificate of state registration of the computer program was obtained for the developed software product [27].

7. References
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