Evaluation of a Regional Investment Projects

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***Abstract*— The problem of balancing proposals of establish industrial units in the new production in the area level it is investigate (administrative, geographic). The mathematical model is developed; the issue of evaluation of the opportunities is investigated.**

Keywords—investment projects; balancing problem; mathematical model

I. Introduction

It is well known, during the preparation of the investment map of the economic regions within the framework of sustainable development plan, special attention should be paid to the issues in number of problems. Among these the following ones are important:

- use of natural resources to achieve of the high level economic and social development
- involving the stakeholders in the region to use of natural resources and environmental planning, decision-making in accordance with the active participation and involvement in management on the implementation of these decisions
- to direct the investments in environmental, social and economic priority sectors.

In this context, the investment project proposals should be evaluated in terms of the region's economic subjects for the creation of new production areas. As a rule, the evaluation presses going in three directions - social, environmental, and economic factors are taken into account.

It is generally supposed that the project proposals submitted in the initial examination. In this case, social and environmental criteria for each project in terms of fuzzy expert value have been determined. For example, the values can be "bad", "medium", "good", "excellent" or "insignificant", "less important", "significant", "secondary importance", "very important". The expert's evaluation of the project is higher then the social - ecological significance of project is high.

The economic evaluation of a project proposal is basing on the fact of balancing in the consideration period with other project proposals.

It should be noted that each project is identified by a group of three main indicators:

- Production of the goods (proposals)
- The required resources (requirements)
- The project location.

Our goal is to form the balancing problem and to develop the mathematical algorithm to sole it. In principle, there are different variants of balancing of project proposals. It is clear that, by applying additional criteria, these variants can be set the rational version of balancing. In determining the terms of these criteria were taken into consideration the following conditions:

- The geographic area of the proposed projects at the preference (spatial coordinates of the projects shall be appointed by their geographical proximity;
- Possibility of consideration of the couple of projects which is not appropriate for infrastructure terms of balancing or other reasons;
- Possibility to give higher priority to projects with social - ecological importance.

II. Mathematical Formulation of the Problem

A. *Definitions*

The following definitions and agreements adapted to study the nature of the problem and the classical sense, in some cases, their meaning may be different.

"Requirement" is the required recourses for the economic subject (the entity) or for manufacturing of a new production, but the entity can not obtain it. The additional resources the raw materials, semi-finished, spare parts, packing boxes, etc. can be considered as requirement.

The "product" is the company's new products which manufactured by the new shop. It is clear that the product of an enterprise of the other entity may be request.

Note that the amounts required for realization of projects and allocated by the investment banks and the amounts required are included in the list of products.

The project will be understood as the resources required for new economic activities (requirements) and given the proposed end products will be produced. All projects require the same amount and types of products must be expressed in an agreed system of standard units (meters, tones, liters, etc.).

On the geographical point of view the project can be considered in the implementation of the space for the conventional coordinate system defined by its coordinates.

In addition, the proposed location of each project may be related to the administrative-territorial unit (regional identity).

Balancing is the system of the relationship products and requirements for the proposed projects to ensure a maximum of one.

Depending on the needs the balancing problem can be solved for the regional affiliation projects as well as together on projects related to other regional affiliation.

B. Agreements and notations

The balancing problem will be solved for some of the selected projects L. This rule may be determined by a system of regional ethnic identity, or other terms and conditions

Define two subsets of L: $L_n \subseteq L$ is the set of projects with the requirements (at least one), $L_m \subseteq L$ is the set of projects with the offers (at least one).

Denote by M the set of all products offers as well as requirements of projects L. The elements of this set denote by $\mu = 1, 2, ..., \mu_0$, here μ_0 is the number of elements of M.

For each μ by the $L_m^\mu \subseteq L_m$ denote the set of projects which offer the product number μ, and by $L_n^\mu \subseteq L_n$ the set of projects with demand of the same products. The elements of the sets L_m^μ and L_n^μ we will numerate by $i = 1, 2, ..., m_\mu$ and $j = 1, 2, ..., n_\mu$, here m_μ and n_μ are the numbers of elements correspondingly of the sets L_m^μ and L_n^μ.

For simplicity we will identify the elements of L_m^μ and L_n^μ by their numbers, in other words, for $i \in L_m^\mu$ we will understand the *i*-th element (project) of the set L_m^μ and for each $j \in L_n^\mu$ the *j*-th element (project) of the set L_n^μ.

By the a_i^μ we denote the proposed product number μ by the project $i \in L_m^\mu$ and by the b_j^μ the needs of project number $j \in L_n^\mu$ on this product. The units of measurement of products selected in such way that the a_i^μ and b_j^μ are positive integer numbers.

C. The mathematical model

In essence, the considered problem is the transport problem [1, 2]. Let the total volume of proposals of L_m^μ on all projects be $a^\mu = \sum_{i=1}^{n_\mu} a_i^\mu$ and the total volume requirements L_n^μ on all projects be $b^\mu = \sum_{j=1}^{m_\mu} b_j^\mu$. In the statement of the transport problem it is intended to be:

$$a^\mu = b^\mu. \quad (1)$$

If it is not, one can include a new project into L_n with requirement $a^\mu - b^\mu$ if $a^\mu > b^\mu$ or a new project into L_m with proposal $b^\mu - a^\mu$, when $a^\mu < b^\mu$. Thus, the relations (1) always will be held.

Denote by x_{ij}^μ the quantity of products directed from project $i \in L_m^\mu$ to the project $j \in L_n^\mu$. Then, it is clear that balancing requires the integer values x_{ij}^μ in such a way that the following relations will be held:

$$\sum_{i=1}^{m_\mu} x_{ij}^\mu = b^\mu, \quad j = 1, 2, ..., n_\mu, \quad (2)$$

$$\sum_{j=1}^{n_\mu} x_{ij}^\mu = a^\mu, \quad i = 1, 2, ..., m_\mu, \quad (3)$$

$$x_{ij}^\mu \geq 0, \quad i = 1, 2, ..., m_\mu, \; j = 1, 2, ..., n_\mu. \quad (4)$$

Let for each pair *(i, j)* is given the balancing price of unit product C_{ij} in accordance with the priorities. We will require that, the rational value of x_{ij}^μ will find as minimum of given functional $\Im^\mu$. The minimum obtained on the set of projects L_m^μ and L_n^μ:

$$\Im^\mu \equiv \Im(x_{11}^\mu, x_{12}^\mu, \ldots, x_{1n_\mu}^\mu, x_{21}^\mu, \ldots, x_{2n_\mu}^\mu, \ldots, x_{m_\mu 1}^\mu, x_{m_\mu 2}^\mu, \ldots, x_{m_\mu n_\mu}^\mu) = $$
$$= \sum_{i=1}^{m_\mu} \sum_{j=1}^{n_\mu} C_{ij} x_{ij}^\mu \to \min. \quad (5)$$

Calculated coefficients C_{ij} are given below.

Thus, it is required to minimize the functional (5) within (1)-(4) for each μ.

III. DEFINATION OF COEFFICIENTS OF THE FUNCTIONAL

It is clear that the minimum values of functional (5) $x_{ij}^\mu > 0$ are such values that for the appropriate C_{ij} receive relatively small values. In other words, C_{ij} coefficients should be built so that its cost estimate is smaller than that of the priority indicators are high. For definition of C_{ij} first define the following functions.

A. The spatial proximity

For assessing the proximity of couple of project we will use the Euclidean metric:

$$\rho_{ij} = \sqrt{\left(x_i^n - x_j^m\right)^2 + \left(y_i^n - y_j^m\right)^2}\,.$$

Here $\left(x_i^n,\, y_i^n\right)$ and $\left(x_j^m,\, y_j^m\right)$ that determines the spatial coordinates of the geographical position of the projects.

B. The expediency

All of the projects are divided in two subsets. The appropriate for balancing couples as A and not appropriate for balancing as B. Let define the following function to set the factor of expediency to take into account:

$$\theta_{ij} = \begin{cases} 0, & (i,j) \in A, \\ \theta_0, & (i,j) \in B, \end{cases}.$$

here $\theta_0 > 0$ is some constant.

C. Significance

The social-ecological importance of the project we define as shown in the table 1 , according to expert's opinion (the price may be adjusted in this table according to the dictionary):

TABLE 1 SOCIAL-ECOLOGICAL IMPORTANCE

k project of social - ecological significance of the price of words	***Degree of importance of the project (σ_k, here L_m^μ for the majority of projects related to $k = 1, 2, \ldots, m_\mu$ and L_n^μ for the majority of projects related to $k = 1, 2, \ldots, n_\mu$)***
"Insignificant"	2
"Less important"	1 + 1/2
"Significant"	1 + 1/3
"Secondary importance"	1 + 1/4
"Very important"	1 + 1/5

D. Fictitious

The mathematical formalization of the projects in accordance distinguish with the ordinary or fictitious be appointed as follows. Let us define φ the function of fictitious:

$$\varphi = \begin{cases} 0, & \text{ordinary,} \\ 1, & \text{fictitious} \end{cases}$$

Taking into account the above-said coefficients C_{ij} was appointed as follows:

$$C_{ij} = \sigma_i \sigma_j \cdot (P - \rho_{ij}) + P \cdot (\theta_{ij} + \varphi_i + \varphi_j - \varphi_i \varphi_j)\,,$$
$$i = 1, 2, \ldots, m_\mu\,,\ j = 1, 2, \ldots, n_\mu\,.$$

Here

$$P \equiv 1 + \max_{i \in L_m^\mu,\, j \in L_n^\mu} \{\rho_{ij}\}.$$

IV. INTERPRETATION OF THE SOLUTION

Present time are available a number of developed methods and algorithms for solving the transport problem. Among them one can show the method of distribution, potentials method, the delta-method, and others (see, for example, [3-5]). We solve the problem on the program package Delphi. We have applied the method of Potentials. As a result of running the program of each μ according to (1) - (5) as a result of the solution to the problem of $x_{ij}^\mu > 0$ numbers are determined. These numbers are based on a project to assess the degree of balancing. Obtained number $x_{ij}^\mu > 0$ indicates that the considered production number μ for balancing directed from project $i \in L_m^\mu$ to the project $j \in L_n^\mu$. Thus

- if the considered μ the project j does not fictitious index then, the amount $x_{ij}^\mu > 0$ means that for the project $i \in L_m^\mu$ proposal a^μ how much is to be provided for the project j. In this case, to what extent this product may be assessed as follows:

$$1/a_i^\mu \cdot \sum_j x_{ij}^\mu \cdot 100\%\,, \tag{6}$$

- if for the considered μ the project j is fictitious project then, the number $x_{ij}^\mu > 0$ means the value not provided part of the product a^μ of the project $i \in L_m^\mu$. In this case, to what extent the non-use of the product as well as (6) is calculated by the formula:

$$1/a_i^\mu \cdot \sum_j x_{ij}^\mu \cdot 100\%\,,$$

- if the considered μ the project i does not fictitious index then, the amount $x_{ij}^\mu > 0$ means that for the project $j \in L_n^\mu$ demand b^μ how much is to be provided for the project i. In this case, to what extent this product may be assessed as follows:

$$1/b_j^\mu \cdot \sum_i x_{ij}^\mu \cdot 100\%\,, \tag{7}$$

- if for the considered μ the project i is fictitious project then, the number $x_{ij}^\mu > 0$ means the value not provided part of the product b^{μ} of the project $j \in L_n^{\mu}$. In this case, to what extent the non-use of the product is calculated by the formula (7).

V. CONCLUSION

Thus, it was proposed mathematical model for evaluation of investment projects. Herewith coefficients of the functional that are required for minimization was defined. Also the interpretation of results of the program realization was given.

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