THE CONCEPT OF INDICATIVE PLANNING OF SOCIAL AND ECONOMIC DEVELOPMENT OF A REGION FOR SUPPORT OF ACCEPTANCE OF REGIONAL ADMINISTRATIVE DECISIONS

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Key words: indicative planning, forecasting, regional development, management, decision-making support, modeling, problem statement, algorithm of the decision, indicators, regulators.

The article considers questions of use of technology of indicative planning for system engineering of forecasting of social and economic development of region. A description of technology of indicative planning, statement and the scheme of the decision of a problem of indicative planning is achieved.

Currently in the government system there are the qualitative changes connected with transition to a new paradigm of management. The state undertakes attempts to realize society socially significant projects on the scale of the whole country. At the similar approach before authorities there is a whole spectrum of new problems: management in cost, risks, human resources, quality, contracts, terms etc. Thus on the foreground there is a rigid requirement of achievement of the declared results, and in accurate target dates and within the allocated resources. In such conditions obviously there is a necessity to introduce for regional public authorities the methods of the design-focused management, the coordinated application of state regulation strategic and market mechanisms on operative directions of development of economy and social sphere. Creation of systems of the indicative planning coordinating interests of region, the federal centre and business is necessary. Therefore working out methods, information technologies and the automated systems of indicative planning of regional development is an extremely important issue.

Indicative planning is focused on ways to increase efficiency of planned projects, the analysis of real possibilities of achievement of objects in view, a substantiation of their practicability. At the heart of indicative planning is the idea that it is not necessary to predict what can be operated and it is necessary to reveal problems and to search for optimum ways of their decision. Methodologically indicative planning is technology forecasting research, return to situational forecasting. On fig. 1 the scheme of forecasting-analytical research of regional development with use of technology of indicative

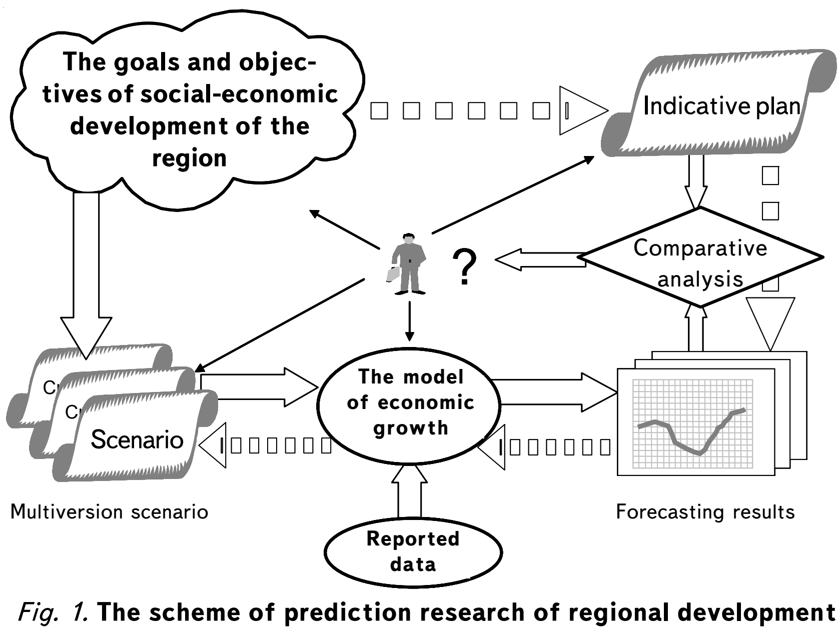

Fig. 1. **The scheme of prediction research of regional development**

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planning and situational forecasting is shown. Components of the given technology are:

- imitating model of social and economic activity of region;
- the purposes and problems of regional development;
- the indicative plan for development;
- development scenarios;
- results of forecasting;
- information base of model.

A key element of considered technology is the model of social and economic activity of the region[1], reproducing processes of formation, redistribution and use of resources of region: material, labour, financial. The model allows us to estimate in medium term and long-term prospect borders of growth of total release and a total regional product depending on investment efforts, solvent demand, demographic factors, behaviour of an environment, and also rates of technological progress and other aspects of steady growth. A conceptual basis of model is regional reproduction process in which manufacture, distribution, an exchange and consumption form organic unity.

This technology assumes allocation in model of social and economic activity of region of so-called indicators and regulators. Indicators are the integrated indicators quantitatively defining qualitative characteristics of social and economic activity of region. We will designate set of indicators:

$$Z = [z_1, z_2, ..., z_n]. \quad (1)$$

Indicators are defined by parameters of borders $[z_{\min,i}, z_{\max,i}]$, $i = 1,2,...,n$ in which limits of the object of management can steadily function and develop. Unlike the "indicator" giving only quantitative ascertaining, indicators have limiting threshold (minimum and maximum) values. Limiting borders of indicators are established according to target reference points socially - economic development of the region, defined public authorities. For example, in the subject of Federation St.-Petersburg borders for indicators were considered at level of Legislative Assembly of the subject[2].

Regulators - influence mechanisms on social and economic processes from economic agents. Values of regulators (operating parameters), which economic agents assume to expose on forecasting horizon, form the development scenario:

$$U_S = [u_1(t),..., u_N(t)], \quad (2)$$

where $u_i(t)$ - a trajectory of regulators i of the economic agent on forecasting horizon.

As a rule, in region model - the subject of the Russian Federation the behavior of following economic agents ($N = 5$) is considered[3]:

1 - the federal government spending a state policy (scenario parameters $u_1(t)$: tax loading for managing subjects, distribution of regulating taxes, the credit, social and customs policy);

2 - a regional management ($u_2(t)$: proportions of an expenditure of budgetary funds);

3 - managing subjects ($u_3(t)$: norm of accumulation, norm of a payment, pace of technological progress);

4 - housekeeping ($u_4(t)$: age-specific factors of birth rate and death rate, balance of migration, distribution on economy sectors);

5 - external factors ($u_5(t)$: a ratio of growth of a dollar exchange rate and a rise in prices, parity change between the prices for resources, consumer goods and investment products).

«The purposes and problems» on fig. 1 set a research direction; on the basis of them variants of scenarios of development and «the Indicative plan for development» are worked out. ***The indicative plan*** represents a set of indicators for which target values which should be reached at the decision of corresponding problems are specified.

In substantial sense indicative planning represents a sequence of problems of situational forecasting. Procedure of situational forecasting represents an investigation phase of possibilities of regional development by a principle «that will be, if ...», namely, to find trajectories of indicators of social and economic development $Z(t)$ within the limits of the proportions set by scenario $U_S(t)$ and restrictions, imposed in industrial potential:

$$Z(t) = M(U_S(t)), \; U_S(t) \subset U_0, \; t \in [0,T], \quad (3)$$

here M - model of social and economic development, U_0 - set of investigated scenarios, T - forecasting horizon.

Statement of a problem of indicative planning. Let the indicative plan in which desirable values of the indicators (1) characterising social and economic development of region, are set by parameters of borders , $i = 1,2,...,n$ in which limits of their value are admissible in the end of forecasting horizon is set:

$$z_{\min,i} \le z_i(T) \le z_{\min,i}, \quad (4)$$

here $Z(T) = M(U_S(T))$. (5)

Values of indicators of regional development in the end of horizon of forecasting T, the problems of situational forecasting received as a result of the decision (3) for set scenario and $t = T$. Clearly, that each new scenario will give new values of indicators (4). It is required to pick up such scenario $U_S(t)$ at which all indicators will appear in desirable borders (4). Thus on components of scenario $U_S = [u_1, u_2, ..., u_m]$ restrictions are imposed:

$$u_{\min,j} \le u_j \le u_{\max,j}, \quad j = 1,2,...,m. \quad (6)$$

Feature of a problem of indicative planning consists that is required to place (3) all set of indicators in the set borders, and if mathematical the problem is unsoluble to offer the decision having the least losses from the point of view of the researcher. Really, in a real life of situations in which «there are no decisions», does not exist. Real economic agents always find decisions by softening of restrictions on indicators or regulators.

$[z_{\min,i}, z_{\max,i}]$ $U_S(t)$ $p = 1$

Let's enter into consideration criterion of management efficiency Q characterising degree of a deviation of indicators from desirable values:

$$Q = \sum_{i=1}^{n} Q_i, \quad (7)$$

where Q_i - the degree of "dissatisfaction" depending on a deviation i of the indicator from set «green corridor».

This dissatisfaction pays off as follows:

$$Q_i = \begin{cases} 0, & \text{если} \quad z_{\min,i} \le z_i(T) \le, z_{\max,i}; \\ (z_{\min,i} - z_i(T))^p g_{\min,i} / m_i, & \text{если} \quad z_{\min,i} > z_i(T); \\ (z_i(T) - z_{\max,i})^p g_{\max,i} / m_i, & \text{если} \quad z_i(T) > z_{\max,i}. \end{cases} \quad (8)$$

Here $g_{\min,i}, g_{\max,i}$ - weight (importance) i of the indicator for the bottom and top borders; p - an exponent (usually or $p = 2$); m_i - the scale factor used for reduction of indicators to a comparable scale.

$$m_i = (|\, z_{\min,i} \,| + |\, z_{\max,i} \,|) / 2. \quad (9)$$

Thus, if the indicator is in «a green corridor» the dissatisfaction (penalty) is equal to the zero, otherwise each unit of a deviation of the indicator from «a green corridor» is fined by the factor equal to weight of corresponding border, to the appointed indicator the researcher, деленному on scale factor (fig. 2).

The problem of indicative planning will be reduced to a finding of the admissible scenario $U_S(t)$, $t \in [0,T]$ minimising an indicator of quality (7). Thus, if there is a basic possibility to place all indicators in the set borders we will receive $Q = 0$. Otherwise it is necessary to endow some indicators, supposing their exit for limits of "a green corridor». Generally value

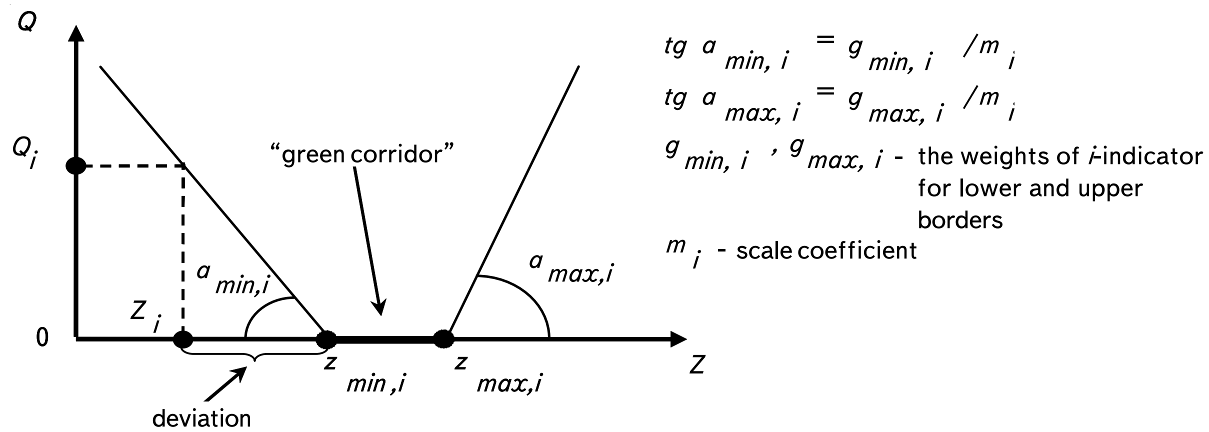

Fig. 2. **The penalty for a deviation of the indicator from «a green corridor» (** $p = 1$ **)**

of scales of the indicator can be accepted as positive, zero and even negative values.

If value of weight of the indicator is more than zero the more indicator weight, the less it will overstep the bounds of a corridor. Increasing weight of the important indicators, we can force to return them to the corridors, the truth, to the detriment of more "superficial" indicators.

If value of weight of the indicator early to zero at transition of corresponding border degree of dissatisfaction Q_i for it remains equal to zero.

If value of weight of the indicator is less than zero at an exit of value of the indicator for corresponding border value of dissatisfaction for the given indicator too will be negative. The deviation of the given indicator from the set interval as though compensates the penalties received for the account of an exit for limits of corresponding intervals of other indicators for borders with positive scales.

The scheme of the decision of a problem of indicative planning. At the decision of economic problems, methods of mathematical programming - linear and nonlinear programming. Linear programming can be used for the decision of the macroeconomic problems described only by the elementary linear models. Nonlinear programming is divided into essentially different two classes - on convex and not convex. In our case we should construct system of optimisation which would be free from the requirement square the criterion necessary for the decision of problems of convex programming. Moreover, criterion can and not to be convex (downwards) or the function of parameters of management bent (upwards).

The most suitable to the decision of problems with not convex criterion are the methods developed in the theory of planning of experiment. It is established, that for development of the administrative decisions conducting to realisation of the indicative plan, consecutive schemes of search are more preferable.

The general idea of consecutive search keeps within the following general iterative scheme:

$$U_S^{(k+1)} = U_S^k + h_k B^{(k)}, \qquad (10)$$

where k - iteration number ($k = 1, 2, ..., N_{\max}$), $U_S^{(k)}$ - a point of factorial space, h_k - the determined scalar multiplier (step parameter); $B^{(k)} = [b_1^{(k)}, b_2^{(k)}, ..., b_m^{(k)}]$ - a vector specifying a direction of movement. Concrete search methods differ, first of all, with a choice of a direction of movement $B^{(k)}$ in the iterative scheme (10) such that response function decreased from a point to a point: $Q(U_S^{(k)}) > Q(U_S^{(k-1)})$, and also the movement organisation in the chosen direction.

At a choice of the scheme of consecutive search possibilities of following most used methods were analyzed:

1. Coordinate specification (Gauss-Seidel Method);
2. Casual coordinates specification;
3. A casual choice of a direction of descent;
4. Gradient methods;
5. The methods based on a simplex-method.

The analysis of the listed methods of optimisation shows, that for the decision of a task in view of optimisation the most comprehensible way - gradient the scheme in which the gradient estimation is carried out by approximation of a surface of criterion in the set point by a hyperplane

$$\hat{Q}(U_S) = b_0 + b_1u_1 + b_2u_2 + ... + b_mu_m \qquad (11)$$

With use of procedures of consecutive planning. Thus factors in the equation of a hyperplane (11) also will specify a direction of the quickest decrease .

Algorithm of the decision of a problem of indicative planning. The algorithm consists of sequence of cycles of "an abrupt ascension». The first cycle of an abrupt ascension consists of following steps.

Stage 1. Initial base point $U_S^{(0)}$ and intervals of a variation for each element (regulator) of vector U_S gets out. In base point $U_S^{(0)}$ experiment is made.

Stage 2. By results of factorial experiment estimations of components of a vector of a gradient ($B = [b_0, b_1, ..., b_m]$) in a base point for linear regression models (11) are calculated.

Stage 3. Co-ordinates of working points in a direction of gradient $B^{(k)}$ with step h_k ($k = 1, 2, ..., N_{\max}$) on regression models(11) are calculated.

Stage 4. In working points experiments on the computer model, the representing problems of situational forecasting (3) solved for scenarios, corresponding to working points are consistently carried out. Working-class movement continue until observable values of the response (Q) will not start to increase. It is a sign of achievement of a local extremum on a gradient direction. On it the first cycle of an abrupt ascension comes to an end.

Stage 5. The found point of a local extremum is accepted to a new base point and the following cycle of an abrupt ascension in which search is conducted by the rules described in points 1-4 will be organised. In the second and the subsequent cycles it is expedient to reduce intervals of a variation of factors at realisation FFE and length of steps at working-class movement in a gradient direction.

Stage 6. Search stops at achievement of area of an extremum or restrictions. A sign of achievement of an extremum are small values a component of a vector of a gradient. For their estimation after each cycle the inequality is checked

$$\|\hat{b}\| \le \varepsilon, \quad (12)$$

Where - a vector of estimations a component regression models, calculated by results of factorial experiment in the next base point, and - the set number characterising accuracy.

Procedure of indicative planning represents purposeful sequence of problems of situational forecasting (3) when on the set borders of indicators the best pay off, in sense of a minimum (6), the values of regulators "exhausting" indicators in desirable borders.

The concept of indicative planning described in the present article is successfully realised by working out of some the automated information systems:

- AIC «the Forecast of SPb», accepted in operation as a part of the Integrated system of information-analytical maintenance of activity of executive powers of the government of St.-Petersburg;
- IAC the "Region", introduced in the Ministry of economic development of Republic Komi;
- AIS the "Region", established in the Ministry of Economics of the government of the Saratov area.

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