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USE OF COGNITIVE MODELLING FOR ANALYSIS OF SOCIO-ECONOMIC PROCESSES AND ESTIMATION OF VARIANTS OF REGIONAL DEVELOPMENT

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Abstract: the analysis of socio-economic processes and estimation of variants of development of a typical economic region of any state with use of cognitive modeling is represented herein.

Keywords: Cognitive science, cognitive systems, economic systems, forecasts, modelling

1. INTRODUCTION

The choice of justified realistic variant of regional development policy is a very complicated problem. To solve this problem objective information on key aspects of socio-economic life of the region is needed. For accumulation such information the modern methods of data acquisition and processing just as methods of modelling should be realised.

Complicated processes formalisation reflected in the regional development model is a basis for taking the advisable administrative decision-by-decision making person (DMP).

Therefore high responsibility of solutions accepted on the basis of such information, vast volumes of the diverse information, high degree of uncertainty, etc. determine necessity of application of cognitive modelling. It allows to justify possible (suggested) directions of the regional policy and to estimate their effectiveness for a raise of the region population living standard at a qualitative level.

Cognitive modelling of socio-economic and socio-political processes in the region consists of available information analysis stages with the purpose to establish the qualitative (cause-effect) correlations between the regional basic indexes (parameters, concepts, factors) and modelling of the various scenarios of the regional situation evolution on the basis of obtained correlations.

The cognitive modelling quality depends on completeness and objectivity of the initial information about socio-economic situation in the region. The regional policy of administration within the framework of cognitive modelling consists in goal-seeking complex control of socio-economic processes to be reflected in cognitive model via temporal changes of corresponding indexes (factors).

2. BASIC NOTIONS OF THE REGION COGNITIVE MODEL

Some typical socio-economic and socio-political processes taking place in any region are considered in the region cognitive model. To construct the region cognitive model the selection and systematisation of the factors suitable for the estimation of medium- and short-term tendencies of region development were carried out.

The regional distinctions in socio-economic development of various regions can conditionally be defined as "objective" and "subjective".

To "objective" distinctions it is possible to refer a level of region development, specialisation and structure of economy, economy-geographical and geopolitical position etc.

To "subjective" ones - policy of regional authorities of all levels, enterprise activity of the population, support or counteraction to reforming, changes in migration streams, etc. In addition, "subjective" factors influence on a velocity and change tendencies of "objective" ones. In this case indicators describing "objective" factors, represent themselves as indicators of higher level in relation to indicators of the "subjective" factors. To understand and to forecast the regional development tendencies, it is necessary to determine regularities, connections, scales and strength of influence of all basic factors.

Before constructing the region cognitive model the following questions should be considered:

- Influence of the basic objective laws (economic, political, social) on the situation evolution in the region; selection of the basic indications of regional process;

- Definition of the requirements, conditions and restrictions intrinsic to a problem under research;

- Selection of the basic socio-political subjects in a present situation, definition of their subjective interests.

- Definition of ways, mechanisms of operation, realisation of economic and political interests of the basic socio-political subjects

All collection of the chosen factors corresponding to regional socio-economic processes is divided into groups describing various aspects of a situation in the region (resources, social area, demographic situation, the regional economy, budget, tax, ecological aspects, etc.) (Tab. 1).

Table 1. Factors of the model "Region"

Factors corresponding to the region resources
1. Region resource potential
2. Possibility of development of region resource potential
3. Regional enterprises capital assets
4. Regional employee (labour potential)
Factors corresponding to the region social area
5. Region population living standard
6. Social tensity in the region
7. Population incomes
8. Crime level in the region
9. Unemployment rate in the region
10. Region social infrastructure development level
Factors corresponding to the demographic situation in the region
11. Death rate in the region
12. Birth rate in the region
13. Migration from the region
Factors corresponding to the regional economy
14. Region economic potential
15. Investment attraction of the region
16. Investment risk of financial investments in the region
17. Region enterprises production volume
18. Demand for production produced in the region
19. Profit (incomes) of the region enterprises
20. Production costs of the region enterprises
21. Investment in the region
22. Development of region industrial infrastructure
23. Consumer goods price level in the region
Factors corresponding to the region budget area
24. Regional budget incomes
25. Regional budget expenditures
26. Regional budget deficit
27. Necessity of the federal financial support to the region
Factors corresponding to the regional tax aspects
28. Income from tenders and privatisation
29. Tax inflows to the regional budget
30. Base of taxation
31. Collection of the taxes (tax gains)
32. Tax privileges to the region enterprises
33. Non-payment of taxes to the regional budget
Political factors
34. Preferences to the region
35. Dependence of the region from the federal centre
36. Possibility of the regional separatism rise
Factors corresponding to ecology of the region
37. Ecological safety of environment

Thus, the region cognitive model contains 37 factors. Direct influences of the factors on each other and these influence estimates to be considered in a base scale [-1,1] are presented in tab. 2. Positive signs of elements of this table represent the positive (strengthening) character of influences. Similarly, negative signs of elements represents the negative (braking) character of the appropriate influences. Influence intensity is represented by corresponding numbers in [0,1]-scale.

The amount of factors according to the purposes of analysis may be enlarged, some factors subdivided and added. However the given factor set is sufficient to reflect the basic socio-economic and socio-political tendencies in the region, to develop the substantial scenarios of overcoming of real and potential threats to steady development of the region and to define the consequences of undertaken activities and solutions on threats overcoming. Real and potential internal and external threats to steady region development are reflected as appropriate initial tendencies of the factors changes.

3. DERIVED INDEXES FOR DESCRIBING SITUATION IN THE REGION

Along with a collection of prime indexes to be chosen for representation the current situation in the region the so called "derived" indexes are widely used. Derived indexes enable to estimate a degree of the strategic purposes reaching in various aspects of region life. For example:

Derived index of demographic policy in the region depends on the following prime indexes:

11. Death rate in the region
12. Birth rate in the region
13. Migration from the region

Analogously, for derived index of the population welfare in the region the prime factors are:

5. Standard of living of the population of the region
7. Incomes of the population of the region
10. Level of development of the social infrastructure of the region

Analogously, for derived index of social comfort level in the region the prime factors are:

The degree of reaching of this index is determined by the tendencies of the following factors of model "Region"

6. Social tensity in the region
8. Crime level in the region
9. Unemployment rate in the region

Analogously, for derived index of an economic potential development the prime factors are:

1. Resource potential of the region
3. Regional enterprises capital assets
4. Regional employee (labour potential)
15. Investment attraction of the region
17. Region enterprises production volume
18. Demand for production produced in the region
21. Investment in the region
22. Development of region industrial infrastructure
26. Regional budget deficit
27. Necessity of the federal financial support to the region.

4. STRUCTURAL PROPERTIES ANALYSIS OF COGNITIVE MODEL OF THE REGION

In collection of possible regional problems not all problems are equally significant - there are problems to be more or less important. To most important (goal) problems we shall refer ones connected with a population living standard and with economic potential evolution. The factors (prime indexes) to be used for formulation goal problems we shall define as goal factors. To the goal factors we shall refer the following ones:

5. Population living standard
6. Social tensity in the region
17. Region enterprises production volume
24. Regional budget incomes
29. Tax inflows in the regional budget

Solution of goal problems is understood as creation of such situation in the region, when each of the goal factors varies in a desirable way. It is a purpose of control. The goal factor desirable direction change is set by correspondence with so-called index URIF ("User Regard to an Increment of the given Factor"). If the given factor increment is desirable, its index URIF is equal +1, in the opposite case its index URIF is equal -1. If the user is uncertain about his regard to a change of some factor, this factor's index URIF is considered as equal to zero. The indexes URIF of all factors of region cognitive model are represented in Application.

Thus, the problems connected with the goal factors 5,6,17,24,29, are considered as have been solved ones, if the integrated change directions of these factors (i.e. changes rided by all direct and indirect influences of the factors against each other) correspond to indexes URIF of these factors (i.e. the factors 5,17,24,29 will increase, and the factor 6 - decreases). It is considered in this case that purpose of control be reached.

Before to solve goal problems it is useful to clarify how goal factors integrally influence against each other. Goal factors set refers to as consistent if the change of any goal factor in a desirable direction

does not induce undesirable integrated changes of any other goal factors.

The character of integrated influences of goal factors 5,6,17,24,29 against each other is submitted in tab. 4. Here +1 and -1 are the indexes URIF of corresponding factors. If to reject very small elements (which module is less 0.03) in this table the goal factors set may be regarded as consistent.

To solve any goal problem in real situation it is necessary to choose and realize the appropriate activities directed to improving a real situation in the region. In region cognitive model the so-called controlling factor corresponds to each of such activities. The following factors are chosen as controlling ones:

7. Population incomes
8. Crime level in the region
15. Investment attraction of the region
20. Enterprises production costs
31. Collection of the taxes (tax gains)
32. Tax privileges to the enterprises of the region
34. Preferences to the region

We consider, that the chosen controlling factors set does not contradict the given purpose of control, if the change of each of the controlling factors in a desirable way does not induce undesirable changes of any of the goal factors.

5. DIALOG SOFTWARE PACKAGE "SITUATION"

The cognitive modelling technology may be realised with the use of dialog software package (DSP) “Situation” which has been developed for structuring, qualitative analysis and obtaining of administrative solutions in complicated situations (economic, socio-political, regional, market, ecological etc.), where is the lack of the complete quantitative or statistical information.

DSP “Situation” allows to describe and justify the usual situation and to offer ways of reaching the goals with consideration of peculiarities of a specific situation on a qualitative level.

DSP “Situation” ensures:

1. Construction of cognitive model of a situation:

- Selection and substantiation of the basic factors of a situation;

- Establishment and substantiation of correlation of the factors;

- Construction of graph model of a situation.

2. Structural interpretation of problems requiring solution in the situation.

3. Searching and substantiation of strategy of goal reaching in stable or changing situations:

- Choice and substantiation of the desirable goals in conditions of uncertainty;

- Choice of activities (controls) for reaching the goals;

- Analysis of basic possibility of reaching of goals from an initial state of a situation with the use of chosen activities;

- Analysis of restrictions on a possibility of realisation of the chosen activities in reality;

- Analysis and substantiation of a real possibility of goal reaching;

- Development and comparison of strategy of goal reaching.

4. Substantiation of possible scenarios of the situation evolution.

5. Machine generation of the reports and systematisation of results of a problem modelling.

6. CONCLUSION

The approach represented herein was also applied to solution of problems of state development, manufacturing development, etc. The results of these works can be seen on http://www.ipu.ru/labs/lab51/51_home.htm.

REFERENCES

http://www.ipu.ru/labs/lab51/51_home.htm