Information and Analytical Support of Decision-Making Procedures in Strategic Corporate Reengineering

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Abstract

The results of testing of the instrumental method of multi-agent situational analysis to decision-making of socio-economic development of the region are presented in the paper. Instrumental method includes the technique of multi-agent situational analysis, instrumental and methodical complex, as well as guidelines and usage scenarios to assess and predict the results of socio-economic development of the regions. As a result, the groups of similar regions are identified, the main factors affecting their growth are revealed and recommendations of development are made.

Keywords: regional development, multi-agent approach, situational analysis, gross regional product, instrumental method.

Administrative processes are characterized by a large number of emergency situations, which require to make prompt responsible decisions, the outcome of which will shape the future state of an object or system. The problems which must be solved by managers in these conditions, as a rule, are multicriteria and bad formalized. These problems have exceptional and not recurring characteristics and are connected to the consideration of a number of alternatives. Such problems have many new elements for decision-making person (DMP): a selection object, or a situation in which the choice is made, or requirements for the justification of the selection, or the consequences of a wrong choice, etc. These features of the decision-making process requires the creation and using of special automated tools – systems of information and analytical support of decision-making procedures (IA DSS). IA DSS are used for justification of social and economic decisions and implementation of actions aimed to improving the efficiency of economic entities.

The generalization of methods of development of automates systems applied to the problems of creation and development of IA DSS based on the A.N. Morozevich concept of PIR-requirements [1] is made in this work. As a result the approach of the sharing description of agreed requirements of the customer, manufacturer and designer

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(the concept of the three P), based on prototyping, modeling and the phased implementation of components and subsystems IA DSS by tools of modern information technology (MMP-methodology) is developed. Moreover the number of IA DSS and automated workplaces (AWP) which ensured the increase of efficiency and quality of decisions by improving their performance are developed based on the offered concept.

A set of methods and techniques for support of effective strategic management and investment decisions [2-3] was developed and complemented by the automation methods of routine and creative operations of interactively building of models of multi-criteria selection of the best alternative from a given set of alternatives (objects, strategies), measured by a number of criteria (indicators efficiency, quality). The application of these results allowed significantly reduce the time of creating models (to carry out interactive modeling and forecasting), to reduce the requirements of the qualification of any rank's members in the field of information technology and simulation, to allow possibility of direct personal involvement of the first persons of organizations to the procedure, to make the procedure more "transparent" and the results more reasonable and understandable.

The methodology for assessing the efficiency and quality of IA DSS was developed for the first time. This methodology is based on the analysis of the satisfaction's degree of requirements of different target groups of experts. Moreover the guidelines for the implementation of IA DSS to the projects of strategic corporate reengineering (SCR) and regional future development. These recommendations allows to plan and to realize the technical and organizational processes of the implementation of IA DSS to reengineering objectives and to make an informed choice of IA DSS needed for improving of the effectiveness of these projects results.

The mathematical and software support of a number of IA DSS was developed. It is complied with international analogues by the main functional characteristics and superior them by some other parameters (ease of development, used mathematical software and others.). The meta-technology of construction of techniques of the analysis and rating of economic objects was offered. The results of research can be used in science for creating tools and methods of decision-making support based on the ratings of the different objects and subjects of economic activity.

The description of the system for decision-making of the management of regional socio-economic development is presented below.

Management of any socio-economic system assumes activities for achieving its objectives, taking into account available resources (labor, time, information, materials, etc.) and restrictions.

Regional Management is the management of the regional development, providing welfare and improvement of living conditions by improving social and economic relations, innovation development and competitiveness of the regional economy. The same time, the region is a component of the state and by this regard its purpose of management is to reduce the existing regional disparities and ensuring the national economic growth and national competitiveness.

The system of regional governance in the Republic of Belarus includes two management structures: local government and self-government. Given the fact that the proposed methods and approaches can be also used in other countries, hereinafter referred for these organizational management structures the term "regional government" and "regional management" will be used synonymously.

The development of regional government in the Republic of Belarus is characterized by:
- expanding of the powers and responsibilities of local government and self-government;
- increasing of using of information-analytical systems and automated data processing;
- information technology development and implementation of e-government.

The given trends allow to conclude the feasibility of the formation of the concept of regional e-government as a modern approach to regional governance. It characterizes by using a barrier-free inter-departmental and inter-regional contacts; preparation of solutions involving decision-support systems, using a single database; the predominant use of electronic services in the implementation of administrative procedures; transparency of the activities of the regional administration; direct interaction with the people and organizations in the region, the citizens' participation in the processes of regional management, etc. It requires new methods and approaches of regional management. That's why this article presents the results of analysis of the regional socio-economic development of Belarus by multi-agent situational analysis and recommendations of improvement of regional management.

The increase of interest to local regional analyzes can be proof by a lot of research on this topic. L. Servillo and others [4] explores territorial attractiveness for migration and it impact to the socio-economic development. J. Mawson [5] presents the UK experience in local governance. B. Blazevic and A. Jelusic [6] developed a model of regional economic and tourism development. All of the researchers confirm that local regional development as a system consists of complex and multidiscipline problems and needs special methods for evaluation.

One of the mistakes of regional governance in post-soviet countries ([7]) is strategy's development based on allocable budget without taking into account territorial potential. It means that the first step in strategy's development should be analysis of current position and tendencies of economic growth. The level of socio-economic development is the result of previous economic growth and the factor of ensuing development.

The inquiries of the information society's development are still important in Belarus. Many researches are devoted to the assessment of the status of information society not only at the level of the state as a whole, but also at the level of regions. More attention to these issues is given in different researches because the spatial factors have large influence to the economic development of regions. There's not only one interest to carry out the rating and compare evaluation of the level of the information society's development. It's also important to assess its impact to the economy's functioning.

The analysis of the development of information and communication sector in the local administrative-territorial units of Belarus showed the lack of the necessary methodology and statistical data in the public domain and the lack of uniform requirements for the structure of administration sites and segmentation of website users and their tasks. Assessment of quantitative regional executive committees sites demonstrates their low demand by the visitors. This analysis also shows that there is insufficient methodical support of assessment of readiness for regional e-government in our country. The development of information and communication sector in the regions is uneven.

The results of the comparative analysis of the information and instrumental support of decision-making process of regional government shows the need of specialized tools that enable to assess the competitive advantages of the areas, to consider its for strategies' development and to facilitate access to statistical information.

An effective management tool on regional level is a situational analysis. By this way decision-making is a result of detailed analysis of the current situation, identifying of the main factors of its development, studying the dynamics of indicators of the risk prediction. Application of the theory of multi-agent systems to development of decision support tools and the use of intelligent agents increases the validity of decisions through the application of mathematical methods and reduce the emotional component in the evaluation.

The multi-agent situation analysis is a technique of decision-making that consists in the decomposition of analysis's process into a set of interrelated procedures, implemented by a system of successively interacting agents on the basis of constant monitoring based on predefined objectives, given the limitations of the current state, the impact of current internal and external factors, the possible risks and prediction of the situation, and aimed to the identification and evaluation of possible changes in the activity of the object and search for effective scenario of the current situation.

An important component of the situation analysis process in terms of the information society's development is a situational center. The necessity of creation and using of situational centers for the management of regional development is confirmed by the expansion of distant control and holding of regions' videoconferences. But the functioning systems in our country are not situational centers and systematic work on their development is not held at the proper level.

One of the main tasks of a support system of decision-making based on multi-agent situation analysis for the regional management is to support strategic decision-making in the management of socio-economic development of regions, and its functions are:

1) structuring of the data of regional socio-economic development;
2) lead-up of a strategic development decisions at the high regional level, taking into account the specificity of local areas and counties;
3) decision-making at the local level by comparing the situation with other regions in the current and prior periods;
4) working-out of scenarios of socio-economic development on the basis of simulation, including the development of propositions for solving existing problems with the assessment of possible implications of the variations of management decisions;
5) choice of variant of development based on rating of developed scenarios.

These functions create the possible scenarios of the system, which will be used by managers and specialists of regional governance at various levels, external users (for example, organisations and individuals, investors, non-governmental organizations, the scientific community and others.). The necessity of providing distance access to the system can be solved by transforming of regional governance's sites to the multi-functional informational portals.

Multiagent situational analysis of the socio-economic development of Grodno Region was held on the data of 2008-2014 and of Belarus's data in 2014. The annual

values of 28 indicators characterizing the level of social and economic development were collected for the study from open statistical sources.

Most of countries have a multitier system of regions. And the facilities of evaluating of high regional development are always much bigger than at local level. There're more statistical data and indexes value at high level. Some of important criteria of economic development (like gross regional product) are not calculating in local level.

The Gross Indicators of Regional Development (GIRD) have been calculated according to the author's method. GIRD is analog of the Gross Regional Product and can be calculated for high regions and for local districts (counties). It indicates the level of socio-economic development of the region. The components of this indicator are the value of retail sales and the cost of paid services for the population (as a characteristic of household expenditures), investment in fixed assets, the value of the regional budget (estimated at the level of public expenditure in the region) and the sum of net exports of goods and services. The results of these calculations are given in the table 1.

Table1. The results of calculation of GIRD for Grodno region, 2008-2014

| County	GIRD value, bln rub						
	2008	2009	2010	2011	2012	2013	2014
Grodno city	4438,75	4669,83	5045,03	10751,95	19951,16	24699,90	27670,59
Berestovitsa	258,89	215,63	237,80	445,57	737,60	901,72	1060,75
Volkovysk	856,52	851,91	972,16	2437,89	3470,86	4273,62	4686,14
Voronovo	290,35	265,67	292,18	531,60	996,97	1222,84	1258,79
Grodno	780,67	786,12	857,69	1162,53	2419,18	2979,12	3180,93
Dyatlovo	295,69	276,01	295,35	464,43	936,47	1250,55	1407,01
Zelva	172,02	165,06	179,71	330,44	642,70	665,93	763,83
Ivje	253,46	236,04	256,96	414,87	802,65	1136,40	1961,86
Korelichi	253,75	267,76	282,08	348,17	684,89	812,91	1057,84
Lida	1310,80	1389,18	1797,59	3496,84	7517,03	9016,70	9579,11
Mosty	381,23	358,96	393,17	716,56	1383,98	2283,10	2126,36
Novogrudok	536,25	492,27	564,45	1008,76	1746,54	2352,37	2691,39
Ostrovets	258,91	360,24	417,27	710,03	2326,81	3210,12	2968,79
Oshmiany	209,58	250,69	547,58	821,80	1383,27	1765,16	2334,46
Svisloch	182,25	202,58	194,09	355,94	639,89	683,62	1020,65
Slonim	732,44	705,44	831,88	1452,98	2735,70	3339,95	3697,87
Smorgon	628,50	530,98	601,63	1045,95	3040,82	3440,08	3632,34
Schuchin	456,13	490,80	515,70	797,43	1900,52	2244,41	2070,83

Source: Own calculations

The GIRD value of Grodno region is more than the sum of counties' GIRD by the value of common region expenses (culture, education and so on). Undistributed between counties part of the GIRD is 10 to 12%.

Most of regions make a minor contribution to the creation of GIRD. The greatest contribution is made by city Grodno (34.37%), Lida District (11.61%) and Volkovysk, Grodno, Slonim and Smorgon districts (average part is 5.13%). This result is predictable as these areas are the most developed industrial centers of the region.

The fuzzy clusters were used for selecting groups of regions that are similar in socio-economic development's level. This approach allows building the rating, but also seeing the potential of the region because a momentary transition from one cluster to another is not possible.

The Membership functions obtained by the results of one-dimensional fuzzy clustering based on GIRD and GIRD per capita are presented below. The whole set of counties could be divided into 4 fuzzy cluster. Grodno city stands out in a separate cluster because it has an ultra-high capacity and level of development by gross indicator. All other counties are divided into clusters of high, medium and low level.

Figure 1. Membership functions of Grodno region, 2014

a)   b)
—— Cluster 1; ------ Cluster 2; ······· Cluster 3; —— Cluster 4
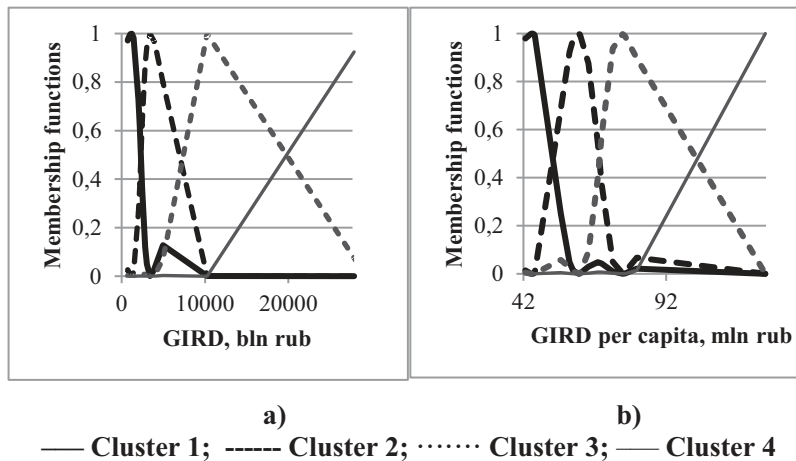
Most of cases belong to the clusters with low and medium level of development. And more than half of all cases entire related to the cluster of low level of development. The mathematical representation of the membership functions (for GIRD) is follows:

$$F_1(x) = \begin{cases} 1, x \in (0;360) \\ -0{,}0031x + 2{,}117, x \in (360;680) \\ 0, x \in (680;\infty) \end{cases}$$

$$F_2(x) = \begin{cases} 0, x \in (0;360) \\ 0{,}0028x - 1{,}002, x \in (360;715) \\ 1, x \in (715;840) \\ -0{,}0014x + 2{,}177, x \in (840;1600) \\ 0, x \in (1600;\infty) \end{cases}$$

$$F_3(x) = \begin{cases} 0, x \in (0;887) \\ 0{,}0013x - 1{,}1531, x \in (887;1650) \\ -0{,}00034x + 1{,}5612, x \in (1650;4590) \\ 0, x \in (4590;\infty) \end{cases}$$

$$F_4(x) = \begin{cases} 0, x \in (0;2300) \\ 0{,}00042x - 0{,}95231, x \in (2300;4650) \\ 1, x \in (4650;\infty) \end{cases}$$

It's possible to calculate the value of membership functions using these formula in the future based on predict GIRD (including forecasting different scenarios), adjusted on price growth rate.

Assessment and analysis of the level of socio-economic development of all

counties of Belarus in 2014 revealed that the cluster of the highest development in each region (except Minsk) is represented by one object - the regional center.

It was found that the main factor which enables the county moves from one cluster to another (of higher level of development) is investments. In this regard, the assessment of the investment climate of counties was held by technique [8]. The components of investment climate are investment potential, investment risk and investment activity.

The ratio of the investment potential and the amount of investment shows that high developed counties used its potential almost completely. Weaknesses counties have low investment activity. Investment risks of medium and low levels' counties are significant.

The analysis of the relationship between the rates of investments grows and the values of investment allowed to determine the strategic position of regions on the investment market. It's possible to divide all regions into 4 groups by strategic position. First group includes the most successful and perspective counties which get large share of investments and have high rates of investment's growth. In Belarus this group is empty. Second group characterizes by large amounts of investments but low rates of its growth. This group includes most of the cities of regional subordination which traditionally attract investors. Third group includes counties which have the sharp jump in investment. Only Gorodok and Glubokoe counties of Vitebsk region showed high rates of investment growth. But these investment's jumps were not associated with the execution of major investment projects, but with low values of investments in the previous period.

Most of counties do not implement an active investment policy and do not carry out breakthrough projects, contributing to significant economic growth.

The correlation and factor analysis led to the conclusion that the main factors of economic development of counties are the number of employed in the economy and the value of investments in real capital.

These factors are the basis of modeling of economic indicators on production functions. As a result of the simulation of regional development of Grodno region the production functions presented in the formulas were received:

$$GIRD_{2008} = 12,38 \cdot L^{0,7445} \cdot K^{0,2814}$$
$$GIRD_{2009} = 9,3 \cdot L^{0,6996} \cdot K^{0,3663}$$
$$GIRD_{2010} = 12,45 \cdot L^{0,6867} \cdot K^{0,3543}$$
$$GIRD_{2011} = 19,14 \cdot L^{0,846} \cdot K^{0,2504}$$
$$GIRD_{2012} = 17,49 \cdot L^{0,7602} \cdot K^{0,3806}$$
$$GIRD_{2013} = 17,27 \cdot L^{0,7811} \cdot K^{0,3844}$$
$$GIRD_{2014} = 52,05 \cdot L^{0,8248} \cdot K^{0,2222}$$

The prediction and retrospective analysis of regional development can be held according to the simulation results.

The increase of the value of free factor from 2009 shows the improvement of exist and introduction of new technologies into production.

The coefficients of elasticity α (degree under L) and β (degree at K) show that the

payment for labor greatly exceeds the payments for investments in fixed assets. Thus, the development of the Belarusian economy remains largely labor-intensive.

The role of capital and investments increased in long-term prediction. It can be explained by the effect of delay of investments influence on real capital.

Investments lead to economic growth in short and long terms. But as the value of investments in most cases is determined by the population size, the significant impulses to the economic development do not occur.

As a result of the analysis of the system of regional government in the Republic of Belarus, information support of decision-making at the level of local counties, some problems of regional management were identified. The problem is insufficiently high motivation to increase competitiveness; weak influence of non-state and public organizations to improvement of the procedures of collection, analysis and processing of statistical information; insufficiently wide use of decision support systems' tools and others.

Solving of the identified problems will enhance the independence of the regions, the expansion of responsibility areas of leadership and extention group of people affecting to the preparation and accepting of management decisions.

The following set of measures may be offered for solving the problems:
1) the specialized tools aimed to the preparation and support of management decision-making should be introduced into practice of regional government;
2) the mechanism of interaction of third-party users of information (trade unions, business, academic community, civil society organizations and others) with statistical agencies and regional government for additional information, suggestions, presenting the results of evaluation and analysis, etc. should be developed;
3) the mechanism of operational cooperation of businesses and individuals, associations and alliances with regional governments aimed to the emerging challenges (problems) of the regional socio-economic development should be determined.

The implementation of the proposed activities do not require significant funding and allows to improve the quality of governance at the local level.

Conclusion

The instrumental method of multi-agent situational analysis in decision-making processes of regional development, including the theoretical and methodological positions, instrumental and methodical system and guidelines for its use for the evaluation and prediction of the results of socio-economic development of the administrative counties was developed.

The technique of assessment of impact of county into result of socio-economic development of the high region was defined.

The analysis of the development and investment position of counties of the Grodno region and of the Republic of Belarus was made.

Most of counties of Grodno region bring a minor contribution (less than 4%) into result of socio-economic development of the region, the contribution of city Grodno is more than 30% of the total GIRD.

The functioning of the economy of Grodno region remains predominantly labor-

intensive and the result of socio-economic development is determined mainly by demographic factors.

The fuzzy clusters characterized by similar level of socio-economic development of local counties were made, the dynamics of objects in clusters and analysis of investment activity showed the impact on the development of the regional economy.

Theoretical and practical results are implemented in 14 enterprises and organizations of various forms of ownership, including foreign and multinational organizations. Their implementation has allowed to increase the effectiveness of management decisions, which ultimately led to the improvement of the financial condition of the organization, increasing of the profitability of their activities, and in some cases allowed to find out a way of the crisis situation.

The results are original, correspond to the current level of science's development in given subject area, implemented into practice. They are widely used in the educational process and can be considered as evidence of the formation of a new scientific field. The complex of results can be considered as theoretical generalization and decision a major scientific problem of creating modeling methodology and design agency of IADSS.

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