NEW METHODS OF SOFT COMPUTING IN REGIONAL DEVELOPMENT STRATEGY FORMATION

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Abstract

An urgent necessity in socio-economic regional development strategy specification is being substantiated for the purpose of reconstructing and adjusting the TEA (Types of Economic Activity) structure, which is able to speed up the development of GRP (Gross Regional Product), GS (Gross Surplus) per person and steadily grade current interregional differentiation and asymmetry. To reach the target a special algorithm for Soft Computing has been created. On the example of the selected region it was proved that the present economic system is not self-organized and it requires an efficient public management. If the regional management strategy is not optimally chosen then in the system some uncontrolled fluctuations can be observed, that may lead to an economic crisis and the "collapse" of the economy system. Mathematical models of optimization of strategies building of 3 types have been constructed and their effectiveness has been quantitatively researched. It is proved, that the dynamic management strategy with the maximizing of the objective function at the end of the period under investigation, turned out to be the most effective. It is established that public administration which is based on a scientifically grounded quantitative approach, using advanced mathematical models of Soft Computing, allows building a strong economic foundation, which will be the basis for a further rapid growth of the regional economy.

Keywords: *soft computing, economic modelling, neural networks, regional development strategy*

1 INTRODUCTION

The issues of asymmetry and unequal regional development, striking differentiation are under consideration in numerous publications on the subject. New approaches to the development of reproducing different structural types in the framework of the intensive growth and interregional leveling of added value creation per capita are not founded, a driving force algorithm, which might be oriented on fulfilling the task as a stable way practice, haven’t been proposed yet.

In general terms the task lies in the following: to formulate an algorithm of defining envisaging the constituents and dynamics of tempo and proportions meeting the demands of the relevant regional conditions of various forms of economic activities which provide a necessary scale of the market actors’ participation in the reproduction process to increase the output of the added value per capita. It can also be proved that the deviation of the predicted values from the analogous values elaborated by the classical trend models can be an important criterion of the regional development efficiency evaluation which was already calculated for the regional development strategy by the classical trend models.

It is suggested to consider the referred issues and make calculations on the data of Chernivtsi region of Ukraine.

2 THE PROGNOSTICATION OF THE REGIONAL DEVELOPMENT ON THE BASIS OF TRENDS MODELS.

Let's arrange the economic activities according to two criteria: (1) the proportion of value added in the production of economic activity, and (2) the ratio of the contribution of economic activity in the GVA of the region (table 1).

***Table 1** The basic economic activities of Chernivtsy region*

No.	The share of value added in production of economic activity kinds (EAK)	The share of EAK contribution to GVA of the area
1	Financing activities (77.1%)	Agriculture, hunting and forestry (18.7 %)
2	Education (71.0%)	Trade, repair of motor vehicles, household goods, and items of personal use (16.8 %)
3	Public administration (67.9%)	Education (11.1%)
4	Trade, repair of motor vehicles, household goods, and items of personal use (66.9%)	Public administration (9.7%)
5	Health care and social assistance (66.4%)	Transport and communications activities (8.7%)
6	Provision of collective and individual service; activities in the field of culture and sport; activities of households; activities of extra-territory organizations (62.5 %)	Manufacturing (8.4%)
7	Transport, storage and communication (55.5%)	Health care and social assistance (5.5%)
8	Real estate, leasing, engineering and providing services to businessmen (55.3%)	Real estate, leasing, engineering and providing services to businessmen (5.4%)
9	Mining (46.7%)	Construction (5.3%)
10	Agriculture, hunting and forestry (44.8%)	Financial activities (3.4%)

Source: Calculated by the authors on the basis of data from the State Statistics Service of Ukraine.

***Table 2.** Dynamics of gross value added according to the types of economic activities (At current prices in mln. UAH)*

№	Types of economic activities	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GVA	Total	**1740**	**2002**	**2382**	**2888**	**3665**	**4401**	**5792**	**7586**	**7391**	**8617**
(x_1)	Agriculture, hunting and forestry	575	600	581	734	894	916	1194	1503	1488	1800
(x_2)	Manufacturing	230	248	321	337	470	604	860	973	770	808
(x_3)	Construction	70	90	131	171	233	326	464	627	443	513
(x_4)	Trade, repair of motor vehicles, household goods and items of personal use	311	349	467	593	708	804	1127	1433	1383	1620
(x_5)	Transport and communication	145	206	264	311	356	432	472	694	721	834
(x_6)	Real estate, leasing, engineering, and providing services to businessmen	98	114	123	142	174	258	337	447	449	515
(x_7)	Public administration	90	119	138	176	285	379	483	773	787	932
(x_8)	Education	149	188	245	290	375	466	583	788	925	1070
(x_9)	Healthcare and social assistance	72	88	112	134	170	216	272	348	425	525

The proposed ranking actualizes the issue of the rates and proportions which should be used to develop economic activities in the region to maximize the production of GVA.

Thus, we come to the conclusion that to model a modified strategy of the EAK development we must find a similar form of the functional dependence of the total value added of GVA upon EAK. It is logical to select the most important economic activities to achieve the objective. On the basis of ranking, nine most influential EAK have been selected (the Table 2).

The trend model involves the calculation of predictive values, provided that the system will evolve according to well-established trends. During the calculation the 25 classical trend functions were analyzed. The best agreement with experimental data was shown by the linear and quadratic function:

$$\mathrm{GVA}_{\mathrm{line}} = \text{-}1637238{,}2 + 818{,}69091 \cdot \mathrm{Y} \quad (1)$$

$$GVA_{quad} = -191176060 - 191466{,}221 \cdot Y + 47{,}939394 \cdot Y^2 \quad (2)$$

where *Y* – is a year.

According to created trend models in 5 years in 2015 we can expect the next size of added values: 12,424 mln UAH according to the linear prognostication and 16,353 mln UAH if the growing has quadratic trend. We will consider these values as patterns (figure 1)

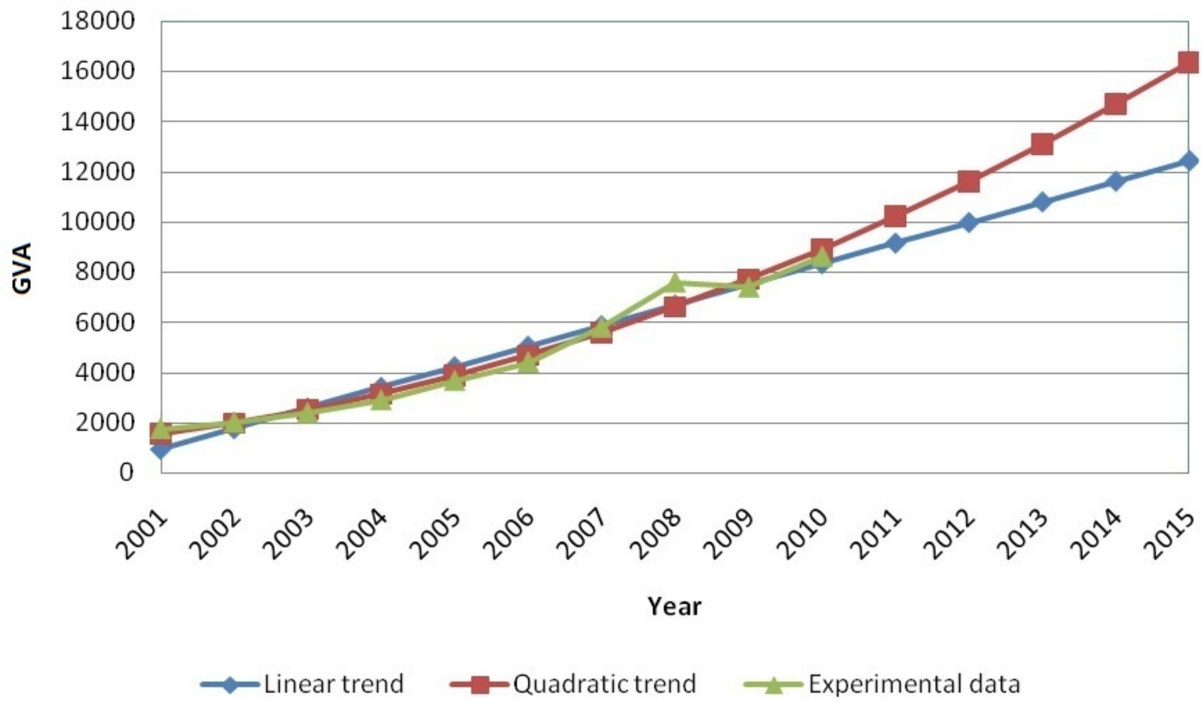

Fig.1 The dynamics of the Gross Value Added

The problem of the construction of region development strategy based on analytical form of functional dependences of the gross value added on their components means that there are no data about factors which affect x_i components. The classical prognostication method means it is necessary to build the trend model for each x_i. Next, on the prognostication values of x_i, prognostication values of the gross value added can be determined. Our calculation showed the similar results can be achieved. The disadvantage of this approach is that it is unusable to realization of the sensitivity analyses and therefore it is unable to use for optimization of region development strategy. The correlation analysis was held for investigation of x_i components interplay (table 3).

Table 3 The results of the correlation analyses between components of the gross value added

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
x_1	1.00								
x_2	0.90	1.00							
x_3	0.93	0.99	1.00						
x_4	0.99	0.94	0.96	1.00					
x_5	0.98	0.89	0.92	0.99	1.00				
x_6	0.99	0.93	0.95	0.99	0.98	1.00			
x_7	0.99	0.90	0.93	0.99	0.99	0.99	1.00		
x_8	0.99	0.88	0.90	0.98	0.99	0.99	0.99	1.00	
x_9	0.99	0.85	0.88	0.97	0.99	0.98	0.99	1.00	1.00

As it can be seen from the table the close correlation relationship between all x_i components is observed. Moreover the minimum value of correlation coefficient is equal to 0.85. According to the classical math theory the factor analysis must be carried through for decreasing of model components number (Katsikatsou, Moustaki, Yang-Wallentin, & Joreskog, 2012). As a result of this analysis the new factors are obtained. These factors are linear dependent on x_i components. Unfortunately, the semantic content of new factors is lost. This makes further analysis and interpretation of results more difficult.

3 THE DEVELOPMENT OF ECONOMIC-MATHEMATICAL METHOD FOR PROGNOSTICATION OF THE REGION STRATEGY DEVELOPMENT ON THE BASIS OF HOPFIELD NEURAL NETWORK.

A new math method for optimization of the region strategy development in a close relationship between economic activities was proposed. It consists of the following steps:

Step 1. *Development of the regression models.*

On this step it is necessary to carry through the regression analysis. It will enable to determine the functional dependences between x_i factors and conduct the sensitivity analysis. The nine dependencies were obtained after that:

$$x_1 = -0,02 \cdot x_2 - 0,45 \cdot x_3 + 1,09 \cdot x_4 - 0,78 \cdot x_5 - 1,21 \cdot x_6 + 1,93 \cdot x_7 - 1,88 \cdot x_8 + 2,55 \cdot x_9 + 440 \quad (3)$$

$$x_2 = -0,002 \cdot x_1 + 2,67 \cdot x_3 - 0,55 \cdot x_4 - 1,40 \cdot x_5 - 1,04 \cdot x_6 - 0,78 \cdot x_7 + 2,70 \cdot x_8 - 0,72 \cdot x_9 + 247 \quad (4)$$

$$x_3 = -0,006 \cdot x_1 + 0,36 \cdot x_2 + 0,22 \cdot x_4 + 0,51 \cdot x_5 + 0,40 \cdot x_6 + 0,30 \cdot x_7 - 1,02 \cdot x_8 + 0,27 \cdot x_9 - 89 \quad (5)$$

$$x_4 = 0,23 \cdot x_1 - 1,13 \cdot x_2 + 3,36 \cdot x_3 - 1,47 \cdot x_5 - 1,11 \cdot x_6 - 1,33 \cdot x_7 + 3,67 \cdot x_8 - 1,29 \cdot x_9 + 199 \quad (6)$$

$$x_5 = -0,04 \cdot x_1 - 0,66 \cdot x_2 + 1,78 \cdot x_3 - 0,33 \cdot x_4 - 0,81 \cdot x_6 - 0,43 \cdot x_7 + 1,77 \cdot x_8 - 0,39 \cdot x_9 + 186 \quad (7)$$

$$x_6 = -0,07 \cdot x_1 - 0,59 \cdot x_2 + 1,68 \cdot x_3 - 0,31 \cdot x_4 - 0,97 \cdot x_5 - 0,27 \cdot x_7 + 1,59 \cdot x_8 - 0,17 \cdot x_9 + 196 \quad (8)$$

$$x_7 = 0,18 \cdot x_1 - 0,73 \cdot x_2 + 2,04 \cdot x_3 - 0,61 \cdot x_4 - 0,85 \cdot x_5 - 0,45 \cdot x_6 + 2,36 \cdot x_8 - 1,05 \cdot x_9 + 91 \quad (9)$$

$$x_8 = -0,02 \cdot x_1 + 0,34 \cdot x_2 - 0,93 \cdot x_3 + 0,22 \cdot x_4 + 0,47 \cdot x_5 + 0,35 \cdot x_6 + 0,31 \cdot x_7 + 0,33 \cdot x_9 - 75 \quad (10)$$

$$x_9 = 0,15 \cdot x_1 - 0,42 \cdot x_2 + 1,15 \cdot x_3 - 0,37 \cdot x_4 - 0,48 \cdot x_5 - 0,17 \cdot x_6 - 0,65 \cdot x_7 + 1,60 \cdot x_8 + 31 \quad (11)$$

Step 2*. Sensitivity analysis.*

On this step the analyses "What-if" is conducted. To do this the values of x_i factors were fixed on 2010 year and after that these factors have been changing alternately on 10%. It allowed investigating the change of output values (VGA) for both absolute and relative terms. Such analysis allows building the strategy of development for one time period, in our case for one year. The results of this analysis are presented in the Table 4.

Table 4. The sensitivity analysis of the regression models after the change of input parameters on 10%

Output parameters		Input parameters								
		x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
x_1	mln. UAH		1802	1780	1979	1738	1741	1983	1603	1937
	increment		0%	-1%	10%	-4%	-3%	10%	-11%	7%
x_2	mln. UAH	807		944	718	691	754	735	1096	769
	increment	0%		17%	-11%	-14%	-7%	-9%	36%	-5%
x_3	mln. UAH	512	543		549	556	534	541	405	527
	increment	0%	6%		7%	8%	4%	5%	-21%	3%
x_4	mln. UAH	1659	1526	1789		1495	1560	1493	2011	1550
	increment	3%	-6%	11%		-8%	-4%	-8%	24%	-4%
x_5	mln. UAH	827	780	925	779		792	793	1023	813
	increment	-1%	-6%	11%	-7%		-5%	-5%	23%	-2%
x_6	mln. UAH	502	467	601	465	434		490	685	506
	increment	-2%	-9%	17%	-10%	-16%		-5%	33%	-2%
x_7	mln. UAH	963	871	1035	831	859	907		1183	875
	increment	4%	-6%	11%	-11%	-8%	-2%		27%	-6%
x_8	mln. UAH	1067	1098	1023	1107	1110	1089	1100		1088
	increment	0%	3%	-4%	3%	4%	2%	3%		2%
x_9	mln. UAH	548	486	579	461	480	511	459	687	
	increment	5%	-7%	11%	-11%	-8%	-2%	-12%	32%	

As it can be seen on the table, the processing industry does not affect agriculture, while the increasing of the added value of trade or public administration on 10% will lead to corresponding increase of added value in the agriculture. In contrast, the education development (the added value will increase on 10%) will lead to decreasing of added value in agriculture on 11%.

It means that the analysis of each coefficient of the table is very capacious and the grouping of economic activities, existing in statistics, makes it impossible to guarantee adequate values and conclusions. Therefore, for taking account of interplay of factors, SoftComputing methods can be used.

Step 3. *Building of the Hopfield neural network.*

As it can be seen from (3-11) equations the GVA value of any kind of economic activity can be expressed with the help of other ones. The neural network with feedbacks (Hopfield neural networks [(Hopfield J.J., 1982), (Atencia, Joya, & Sandoval, 2005)]) can be used for analysis of such systems (fig. 2.). As it can be seen from the figure, solid lines show the influence of one kind of neurons to others. Dashed lines indicate the lack of communication between neurons. The feedbacks transmit signals from the second neuron layer to the first one unchanged. On the first step the values of gross value added for the last year (2010) are submitted on the first neuron layer. The next equation is used for calculation of the values of the second neuron layers, and accordingly the values of the first neuron layer for the second iteration step:

$$X^{i+1} = X^i \cdot W^T + B^T \qquad (12)$$

where:

X^i – is a vector of the first neuron layer for *i*-th iteration,

W and B – the linear regressions coefficients, that link types of economic activities.

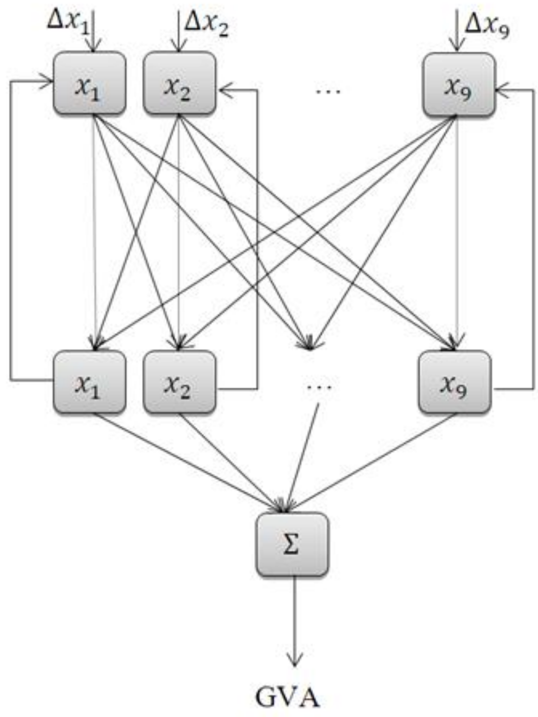

Fig.2 Hopfield neural network for gross value added calculation

The next values of matrix elements were obtained accordingly to (3-11) and the Table 2:

$$W=\begin{vmatrix} 0 & -0,02 & -0,45 & 1,09 & -0,78 & -1,21 & 1,93 & -1,88 & 2,55 \\ 0,00 & 0 & 2,67 & -0,55 & -1,40 & -1,04 & -0,78 & 2,70 & -0,72 \\ -0,01 & 0,36 & 0 & 0,22 & 0,51 & 0,40 & 0,30 & -1,02 & 0,27 \\ 0,23 & -1,13 & 3,34 & 0 & -1,47 & -1,11 & -1,33 & 3,67 & -1,29 \\ -0,04 & -0,66 & 1,78 & -0,33 & 0 & -0,81 & -0,43 & 1,77 & -0,39 \\ -0,07 & -0,59 & 1,68 & -0,31 & -0,97 & 0 & -0,27 & 1,59 & -0,17 \\ 0,18 & -0,73 & 2,04 & -0,61 & -0,85 & -0,45 & 0 & 2,36 & -1,05 \\ -0,02 & 0,34 & -0,93 & 0,22 & 0,47 & 0,35 & 0,31 & 0 & 0,33 \\ 0,15 & -0,43 & 1,15 & -0,37 & -0,48 & -0,17 & -0,65 & 1,56 & 0 \end{vmatrix} \qquad B=\begin{vmatrix} 440 \\ 247 \\ -89 \\ 199 \\ 186 \\ 196 \\ 91 \\ -75 \\ 31 \end{vmatrix}$$

$$X(2010) = X^1 = |1800 \quad 808 \quad 513 \quad 1620 \quad 834 \quad 515 \quad 932 \quad 1070 \quad 525|$$

Table 4. The change of the GVA values according to iterations.

Iteration	1	2	3	4	5	6
GVA	8617	8611	8638	8438	9519	3661

Iteration	7	8	9	10	11	12
GVA	35185	-134442	778077	-4130802	22276218	-119778668

As it can be seen, the diagonal elements of the *W* matrix equals to zero. However this matrix isn't symmetric. The dissymmetry of the *W* matrix is observed on sensitivity analysis results either (table 4). It is clearly seen, for example, that the impact of education on agriculture is strong, and on the contrary the development of agriculture doesn't impact on education. The symmetry of the matrix had to mean that among all economic activities there are equal direct and inverse relationships. Today the dominant influence of some economic activity sectors on the others without feedback is observed, for example the education affects the agriculture, construction has impact on real estate transactions, public administration affects health care etc. Therefore, as it was proved in the research (Cohen & Grossberg, 1983), the proposed neural network isn't stable. To check this fact it is enough to make several iterations of correlation (12) and to track the dynamics of *GVA*, which is calculated as the sum of the elements of the vector:

$X^{i+1} = (x_j)^{i+1}, j = \overline{1,9}$ (table 4).

As it can be seen on the table, the *GVA* value was slightly changed on 5 first iterations. These changes are related to calculations rounding errors. Such errors don't lead to strong fluctuations in case of stable neural networks. However starting from the 6-th iteration, a very strong fluctuation, that had disastrous effects, was observed.

Thus, approximating these results on the investigating area, it can be stated, that the self-organizing processes are missed in the system with unequal relationships between economic activities. In other words, after some time the irreversible processes of collapse will be observed in the system left without state governance.

Step 4. The construction of development strategy. To avoid such phenomena it is necessary to develop an effective impact strategy on each model factor for each step of iteration. This can be done by typing additional inputs Δx_j in neural network (fig. 2). Their semantic content is the external impact of government or investors on x_j factors. In fact they reflect the growing of GVA from *j*-th type of economic activity which resulted by effective governance before the next iteration step. Each step of iteration is an analogue to the reporting period and equal to 1 year in this case. Model, presented in a form of Hopfield neural network, allows investigating several possible strategies for managing of the region development. The time period equal to 5 years was investigated as a sample. The 3 strategies are most widespread in this case.

Strategy #1.

The development of strategy plan for 5 years with constant stimulation of all types of economic activities. It is necessary to find such impact factors $\Delta X = \{\Delta x_j\}_{j=\overline{1,9}}$, that will be unchanged for 5 years.

Then there is the following task:

$$GVA(2015) = GVA^6 = \sum_{j=1}^{9} (x_j)^6 \rightarrow max \qquad (13)$$

with limitations:

$$X^{i+1} = (X^i + \Delta X) \cdot W^T + B^T, i = \overline{1,5}$$

$$0 \leq \Delta x_j \leq p_j \cdot (x_j)^i, j = \overline{1,9}$$

$$(x_j)^i \geq 0$$

where p_j – maximum percentage increase of factor $(x_j)^i$.

Strategy #2.

The dynamic strategy, which involves the development of a unique optimal strategy for every next year with annual change of impact factors. This leads to an increase of total number of decision variables $\Delta X^i = \{\Delta x_j\}^i_{j=\overline{1,9};i=\overline{1,5}}$. According to dynamic system theory it may lead to better results. To do this it is necessary to solve a separate linear optimization task for each year. The numbers of decision variables for each task are equal to previous case.

$$GVA^{i+1} = \sum_{j=1}^{9}(x_j)^{i+1} \to max, i = \overline{1,5} \quad (14)$$

with limitations:

$$X^{i+1} = (X^i + \Delta X^i) \cdot W^T + B^T, i = \overline{1,5}$$

$$0 \leq (\Delta x_j)^i \leq (p_j)^i \cdot (x_j)^i, j = \overline{1,9}$$

$$(x_j)^i \geq 0$$

where $(p_j)^i$maximum percentage increase of factor $(x_j)^i$for *i*-th period .

Strategy #3.

The dynamic strategy of maximization of one goal function for the last 5th year. The number of decision variables of this task is $K = 5 \cdot 9 = 45$ and limitations are analogues to previous case. The goal function looks like in (13). According to dynamic system theory, this strategy must be the most effective (Moore & Weatherford, 2001).

4 COMPUTER EXPERIMENT

As it can be seen from the (13)-(14) equations, each iteration step can appear as a linear programming task. Therefore strategy #2 is easy to build by using simplex method. The optimization tasks for the first and the third strategies are related to the nonlinear programming because of X^i vectors iteration calculation. As our calculations showed, the goal function is nonlinear and consists of local extremes. It makes impossible to use the conjugate gradient method (Maksimov & Filippovskaya, 1982) because its solution depends on the initial values of decision variables. If the choice is wrong this method finds a local extreme instead of global. Our calculations showed that it's exactly what happens in this case.

Another progressive optimization method is a genetic algorithm. According to it the values of decision variables are the analogue to the genes of living beings. And the goal function determines the adaptation state of living beings with certain genes. The genetic algorithm randomly generates the population of living beings (100 living beings show the population in our calculations). Then the processes of crossing and mutation of these living beings are simulated according to Darwin theory [(Zhang, Chung, & Lo, 2007), (Akbari & Ziarati, 2011)]. The advantage of this method is that the optimization results are not dependent on the initial values of the decision variables. The obtained value is located near the global extreme. The disadvantage is a slow speed of calculations (in our case it takes about 30 minutes for each optimization). The peculiarity of this method is that it allows violating the limitations only slightly.

Therefore the genetic algorithm was used for finding an initial approximation of optimal solutions. After that it was clarified by the classical conjugate gradient method. Calculations were carried out in the approximation that the maximum percentage of impact factors increase consists $(p_j)^i = p_j = 10\%$.

The development strategies, obtained as a result of calculations, are presented in the table 6.

Table 6. The obtained development strategies of region

	Δx_1	Δx_2	Δx_3	Δx_4	Δx_5	Δx_6	Δx_7	Δx_8	Δx_9	GVA
Strategy #1										
Impact factors										

	10%	10%	10%	10%	10%	10%	10%	10%	8%	
Gross value added										
2011	1980	889	564	1782	917	567	1025	1177	566	**9467**
2012	1909	872	570	1775	903	549	1026	1181	569	**9355**
2013	1935	940	545	1850	950	597	1070	1159	592	**9637**
2014	2116	604	672	1402	728	392	789	1281	415	**8398**
2015	779	2385	0	3849	1888	1443	2353	625	1412	**14735**
Strategy #2										
Impact factors										
2011	10%	10%	10%	10%	10%	0%	10%	9%	10%	
2012	10%	10%	10%	10%	6%	0%	10%	10%	10%	
2013	10%	10%	10%	10%	1%	0%	10%	10%	10%	
2014	7%	4%	9%	10%	9%	7%	9%	8%	3%	
2015	10%	0%	10%	0%	0%	0%	0%	10%	0%	
Gross value added										
2011	2014	900	559	1795	929	537	1023	1167	569	**9492**
2012	2220	1006	608	1999	1000	567	1128	1278	624	**10430**
2013	2531	1149	651	2237	1052	628	1244	1391	682	**11565**
2014	2662	977	793	2195	998	539	1202	1572	626	**11565**
2015	1647	2690	226	4544	2119	1565	2700	1097	1588	**18176**
Strategy #3										
Impact factors										
2011	10%	10%	9%	10%	10%	3%	9%	10%	8%	
2012	8%	9%	10%	10%	3%	0%	10%	10%	10%	
2013	10%	10%	10%	10%	4%	2%	9%	10%	8%	
2014	8%	5%	10%	10%	8%	6%	10%	10%	6%	
2015	10%	0%	10%	0%	0%	0%	0%	10%	0%	
Gross value added										
2011	1947	904	553	1811	928	543	1030	1171	577	**9463**
2012	2290	1008	600	1980	984	590	1105	1284	606	**10445**
2013	2293	1164	637	2294	1054	634	1278	1385	719	**11459**
2014	2938	908	819	2040	947	526	1082	1643	557	**11459**
2015	970	3289	0	5412	2483	1898	3265	917	1981	**20216**

As it can be seen on the table, compared to trend forecasts (12,424 million UAH and 16,353 million UAH), according to the first strategy in 5 years control of the region will be able to get total gross value added for about 14,735 million UAH. It is foreseen by the classical forecasting methods. Instead, the second management strategy will lead to better results (18,176 million UAH) than after the optimistic quadratic trend itself. Exceeding of GVA will be 46% above the linear trend and 11% over quadratic one. The third strategy appeared to be the most effective. Exceeding of GVA is 63% and 23% accordingly. In comparison to the strategy #2 the goal function increasing is 11%.

Figure 3 presents the comparison of GVA growing dynamics accordingly to 2 trend models and 3 developed strategies. As it can be seen from figures, strategy #1 isn't effective because during 4 years the GVA value is below the benchmark forecast. For strategies #2 and #3 it can be seen that despite the substantial difference of these strategies during the first 4 years their total result was almost identical and was within the linear and quadratic trends. And only for the 5-th year a significant increase in GVA of all three strategies can be observed. Thus strategy planning allows accumulating "internal potential energy" of the system during the first 4 years. This makes it possible to create a stable economic foundation for the further sharp increase in economic performance. Moreover the strategic management for 5 years shows 11% better results than the annual strategy management.

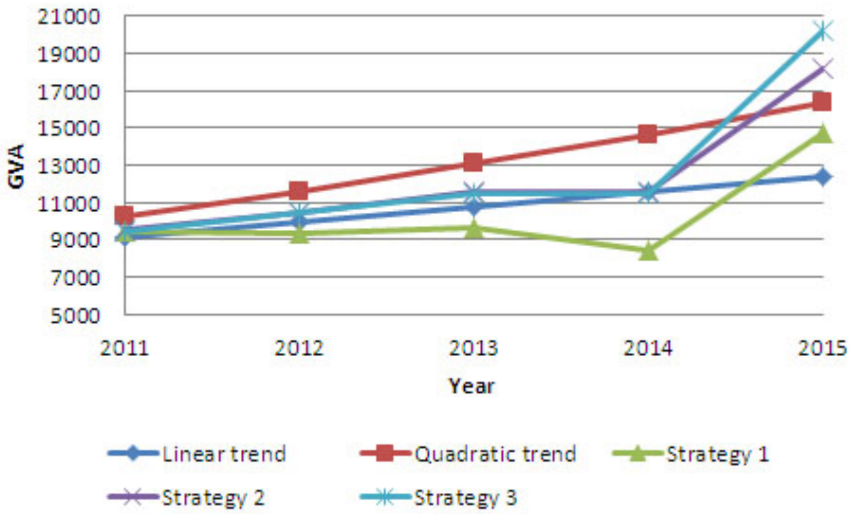

Fig.3 The GVA dynamics according to regional development strategies.

As it is shown in the Table 6, to achieve the maximum effect for the GVA output increase it is necessary to classify them into three groups according to EAK rates and proportions:

Group 1 includes education, construction and agriculture which require a sustained annual dynamic development within the entire billing period.

Group 2 includes trade and repair of motor vehicles, public administration which require a special care as for the development rate during the first four years;   manufacturing and healthcare –during the first three years. These are specific pulses for the self-development of the system in the future.

Group 3 of EAK includes transport, communications, real estate, leasing, engineering, and providing services to businessmen. This group is not nominating in modeling the development strategy.

5 CONCLUSIONS

A new method of modeling a regional strategic management based on the Soft Computing is constructed. Unlike classical approaches, which use mainly an expert analysis, it allows maximizing an economic impact and conduct a quantitative analysis of the proposed strategy.

On the example of the selected region it was proved that the present economic system is not self-organized and it requires an efficient public management. If the regional management strategy is not optimally chosen then in the system some uncontrolled fluctuations can be observed, that may lead to an economic crisis and the "collapse" of the economy system.

Mathematical models of optimization of strategies building of 3 types have been constructed and their effectiveness has been quantitatively researched. It is proved, that the dynamic management strategy with the maximizing of the objective function at the end of the period under investigation, turned out to be the most effective. It is established that public administration which is based on a scientifically grounded quantitative approach, using advanced mathematical models of Soft Computing, allows building a strong economic foundation, which will be the basis for a further rapid growth of the regional economy.

Unlike the current practice it is proposed to complete an expert approach to prioritizing strategies in socio-economic development of regions with some objective quantitative methods.

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