Use of Cognitive Technology Methods in Modeling Business Scenarios in Recreational Area of the Region*

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Abstract. The article is devoted to the modeling of business development scenarios in the recreational sector of the region. The paper presents an assessment of the resource and institutional support for the development of entrepreneurship in the recreational area of the region. Priority elements of the institutional support system, on their basis, provide an opportunity to develop activities and scenarios for the development of entrepreneurship in the recreational sector of the region. The paper notes the problems of moral and physical obsolescence of recreational and general infrastructure, off-season, and employment of the population. Based on the results of further research using the method of cognitive modeling, an assessment of the prospects for the development of entrepreneurship in the recreational sector shows that it is necessary to pay attention to the modernization and organization of the recreational complex of the region, the formation of a constructive dialogue between the private and public sectors, and the need to develop sanatorium.

Keywords: Entrepreneurship in the Recreational Sector, Resource Provision, System of Institutional Factors, Cognitive Technology, Factors of Adjacency Matrix, Scenarios for Modeling Entrepreneurship Development in the Recreational Sphere.

1 Introduction

In the process of research, economic phenomena in the recreational industry of the region are presented as a combination of multifactorial and interrelated occurring phenomena characterized by constant variability of their causes. All changes in political, social, and economic aspects are considered as factors in the development of entrepreneurship in this area. In the process of researching entrepreneurial activity, there is a problem of insufficient quantitative information, which allows the use of qualitative characteristics. Regardless of the complexity of such situations, decisions are required regarding the methods and tools used to solve the problem.

The problem associated with the development of entrepreneurship as a form of realization of recreational potential requires the development of certain measures, the effectiveness of which depends on assessing the state of the system of institutional factors that provide entrepreneurship in the field of recreation. The number of factors in the situations understudy can be not only many but also their significance and condition depend on other changing conditions. Such a situation makes it possible to characterize many institutional formations that are forming in the economy as weakly structured systems and use cognitive modeling tools to solve their goals and objectives.

Cognitive technology in its complex makes extensive use of the method of simulation of complex weakly structured systems.

To study the development of the tourism and recreation industry, you can use simulation and other means of a cognitive approach, which are widely used in the economies of developed countries, and their scope is constantly expanding. This method is developed by scientists N. A. Abramova [1], Z. K. Avdeeva, S. V. Kovrigoy, D. I. Makarenko [2], E. K. Kornoushenko [3], V. I. Maksimov [4], G.V. Gorelova [5].

Purpose of the study. To analyze scenarios for the development of entrepreneurship in the recreational sphere of the region based on the use of cognitive technology methods.

Methodology. The methods of simulation modeling of complex weakly structured systems were used in assessing the development scenarios of entrepreneurship in the recreational sphere.

2 Analysis of the prospects for the development of the recreational sphere of Crimea and Big Yalta

2.1 Analysis of the economic and geopolitical state of the region

The presence of Crimea's unique natural resources is the basis for the development of entrepreneurship in the recreational industry, but resource provision alone is not enough for the effective economic development of the region. Thus, a system of institutional factors plays a special role, on which, in essence, the efficiency of resource use in the recreational industry depends.

Over the last ten years in the Big Yalta, entrepreneurial activity marked the highest revenues in the regional budget of Crimea from recreational activities. This fact is not surprising as the territory of the Big Yalta has excellent resources for entrepreneurship in the recreational sphere and high concentration. In [6] presents an assessment of the resource potential of the Big Yalta in respect of the Republic of Crimea. The resource potential of the Big Yalta is 20.3% of the regional capacity in the occupied area 1.1% of the area of Crimea. The territorial concentration of the recreational potential at 18.4 times higher than in the region.

In such a situation, when the existing material base and natural component represent a high level of competitive advantages relative to other regions of the Crimea, great importance is given to the system of institutional factors that provide entrepreneurship in the field of recreation [7-8].

In the calculations carried out in [9], the effectiveness of the system of institutional factors for the realization of potential received an assessment of 6 points out of a 10-point scale.

Each group takes an appropriate place in the priority order. The most important indicator in the system is the formation of the competitiveness of the material and technical base of recreation and tourism. The sequence of several elements of the system of institutional factors is the basis for developing a strategy for improving efficiency [10-11].

2.2 Formation of the sequence of priorities of the elements of the system of institutional factors

When forming the sequence of priority of the elements of the system of institutional factors, the first to be predominantly those elements that have a high significance of the group into which they belong regardless of the assessment of their level and significance in the group. So, in the work, a sequence of elements was formed according to the obtained values of the coefficients, which are located in decreasing order: 1 - permit-coordination system of investment in the industry - 0.3708; 2 - equipped pebble beaches - 0.3102; 3 - the scale of the organization of the subjects of the SC and the hotel industry - 0.2754; 4 - SC integration in market relations - 0.2576; 5 - coordination in the actions of all subjects of the region - 0.2323; 6 - non-tourist development of the region - 0.2203; 7 - organizational and economic structure of private sector development - 0.2132; 8 - transport accessibility of the region - 0.1654; 9 - organizational and economic structure of the consumer market - 0.1629; 10 - organizational and economic structure of the leisure and entertainment sector - 0.1540; 11 - qualification of existing industry experts - 0.1506; 12 - the availability of lending to the tourism business - 0.1337; 13 - transport improvement - 0.1288; 14 - state support for the regional development strategy - 0.1264; 15 - innovation and event tourism during the off-season - 0.1021; 16 - legality of the industry - 0,0896; 17 - competitiveness of the ratio of price and quality of services in the international market - 0.0745; 18 - accessibility of cultural and historical sites - 0.0744; 19 - improvement of the mountainous zone - 0.0654; 20 - the necessary conditions for the growth of real incomes of the local population - 0.0647; 21 - methods of spa treatment - 0.0641; 22 - development and interest of the training system in training and professional development of an industry employee - 0.0613; 23 - placement of information on recreational and tourist facilities on the Internet - 0.0576; 24 - measures to develop a uniform development of potential - 0.0571; 25 - environmental measures - 0.052.

Following the existing groups of the system, there are problematic elements that require appropriate improvements.

To increase the level of investment attractiveness and activity in the region, measures are needed to form investment and tourism cooperation with other regions and at the international level, the use of franchising in tourism, and the adaptation of international experience. An increase in the level of investment activity will affect the improvement of the material and technical base of tourism and recreation, the development of innovations, and the extension of seasonality.

The sequence and attitude to groups are presented in the form of a priority graph in Fig. 1.

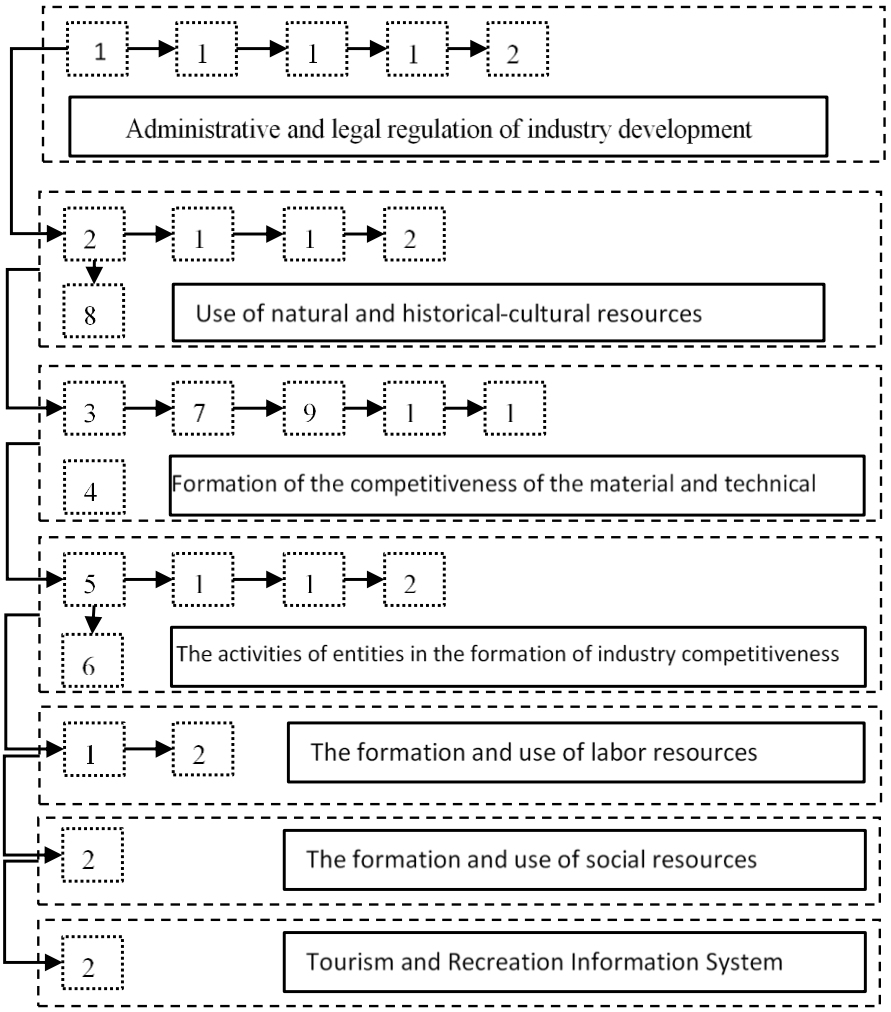

Fig. 1. Priority elements of the system of institutional factors for the development of entrepreneurship in the recreational sphere of the region.

Budget financing of infrastructure development and public-private partnerships can be used to develop transport and urban infrastructure, as well as the uniformity of the recreational development of Big Yalta.

Improving the effectiveness of instruments of economic stimulation of development. Formation of the benefits of using the guest card tool and the procedure for obtaining

it using information technology through the mandatory registration of all business entities following the services and prices provided, which will affect the legality of the industry, the development of coordination of actions and, as a result, the improvement of the price-quality ratio.

Regarding the rationality of the use of natural and historical and cultural resources of recreation, it is especially worth noting the use of beach resources associated with the presence of a departmental approach. In the region, the loading of public beaches exceeds permissible norms, while on sanatorium and other beaches with limited access there is an underload.

The mechanism for the development of entrepreneurship in the recreational sphere of the region (see Fig. 1) is formed according to the previously identified priority elements and the groups to which they relate. To structure information regarding the significance of the basic factors of the system, a sensitivity analysis was used, which is necessary for constructing a graph and implementing scenario modeling. The sensitivity analysis allows us to establish causal relationships between the factors of the system, that is, how one factor affects the state of others, determine the value of the factor for the system, and the influence of the system on its state.

3 Stages of cognitive research

To implement the procedure for analyzing the sensitivity of factors, stimulation, and inhibition matrices were constructed based on expert estimates. The expert survey at the first stage was based on the implementation of the Moscow Aviation Institute and took into account the results obtained (Fig. 1), according to which key factors were compiled (Fig. 2) and the degree of interaction between them was established. In the questionnaire, experts were asked to indicate the degree of influence and interaction of the factors compiled, to determine their positive and negative impact.

All factors of the mechanism to study scenario development were divided into categories of target, indicators, and leverage [7].

1. Target (CF) are those factors whose change is the goal of the system:
- the formation and use of labor resources (F 1);
- competitiveness of tourism and recreational services (F 4);
- seasonality of the industry (F 10);
- the formation of the competitiveness of the material and technical base of recreation and tourism (F 12).

2. Indicator factors are compiled based on groups of indicators reflecting ongoing changes in the system that are limiting the recreational potential:
- rational use of natural and historical and cultural resources of recreation (F5);
- the formation and use of social resources of the region (F 7);
- change in the number of people in the region (F 8);
- the state of natural recreational factors and the environment (F 13).

3. Factors (RF) of the controlled impact on the system. Changes in these factors can affect changes in the state of the system:

- the formation of public-private partnership (PPP) in the development of medical tourism and innovation (F 2);
- investment activity and international tourism cooperation (F 3);
- budget financing of the development of tourism infrastructure (including PPP) (F 6);
- the development of instruments of economic incentives for the tourism and recreation industry (F 9);
- formation of a resort education system in the region (F 11).

The next stage of cognitive research based on causal relationships of factors is the construction of a cognitive map, which is a partial similarity in the construction technique with the matrices of stimulation and inhibition.

According to the results of the analysis of the questionnaires of the relationships of each pair of factors, arcs were formed to build a graph and adjacency matrix. In the questionnaires, it was required to indicate the values: positive, negative, zero.

Thus, five main factors-development levers are identified, which are formed to increase the levels of priority elements. The factor in the formation of public-private partnership (PPP) in the development of medical tourism and innovation is the focus of state support for the development of entrepreneurship in the recreational sphere of the region as a certainty of the problem and the need to solve it. Factors of one group may be related to the formation of different levers for the development of entrepreneurship in the recreational sphere of the region

Cognitive map [3] is a square table containing rows and columns according to the form of underlying factors, and at the intersection of the ith row and jth column reflects the impact of one factor on another in the form of a plus sign (+) positive or (–) negative. Moreover, the connection will be (+) if an increase (decrease) in the ith factor leads to an increase (decrease) in the jth factor, and if there is a discrepancy to the above, the connection will be (-). A cognitive map can be expressed as a directed graph, where F - is the set of vertices (factors), A - are arcs reflecting the influence of factors. The next step is the need to check the model for adequacy, which is a comparison of the information of the simulated system in a certain parameter area with the information that the model provides in this area of system parameters. In the case of small discrepancies, the model is considered adequate [3]. The oriented graph is depicted (Table 1) as an adjacency (incidence) matrix of the graph.

Table 1. Adjacency Matrix.

Factors	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
F1	0	1	0	1	0	0	0	1	0	0	0	0	0
F2	0	0	1	1	0	0	1	1	0	-1	0	1	1
F3	1	1	0	1	1	1	0	0	1	-1	0	1	-1
F4	0	0	0	0	0	0	0	1	0	-1	0	0	0
F5	0	1	0	0	0	0	1	1	0	1	0	0	0
F6	0	1	1	0	0	0	0	0	1	0	0	1	0
F7	1	0	0	1	0	0	0	1	0	0	0	0	0

F8	1	1	1	-1	-1	0	-1	0	0	0	1	0	-1
F9	0	1	0	1	1	1	1	0	0	0	1	0	0
F10	-1	0	-1	-1	-1	0	-1	-1	0	0	0	0	-1
F11	1	1	0	0	0	0	1	1	0	-1	0	0	0
F12	1	1	1	1	0	0	0	1	0	0	0	0	0
F13	0	1	0	1	0	0	0	1	-1	0	0	0	0

The oriented graph with the stability of each of its vertices is absolutely and momentum stable. To check the graph for stability, the roots of the characteristic equation of the adjacency matrix are calculated, and the graph is stable if each modulo value is at most unity [4].

To study the stability matrix formula (1) is used to obtain a nonlinear equation

$$|A - \lambda E| = 0, \tag{1}$$

Where A – oriented graph adjacency matrix G;

λ – roots of the characteristic equation;

E – unit matrix.

The nonlinear equation was solved in the MathCAD system and the results of the eigenvalues were obtained:

λ = 4,221;
-0,103+1,97i;
1,659+0,673i;
-0,525+0,946i;
2,313*10-3-0,959i;
-0,599; 0,432+0,407i;
0,432-0,407i; 0,084.

Following the results obtained, many eigenvalues of the matrix modulo exceed unity and characterize the mechanism for realizing the region's potential as structurally unstable, which stimulates its changes to environmental conditions. After the creation of the cognitive map and checking the model adequacy the next step is modeling, the purpose of which is to develop areas (pulse processes) of the object in the future, and on this basis, it is possible to choose the optimal variant. Modeling of simple impulse processes is based on a theorem on the propagation of disturbances on a graph (formula 2) [5;12]:

$$p(t) = p(0) \cdot [A^t], \; X(t) = X(0) + \left[E + A + A^2 + ... + A^t\right], \tag{2}$$

where *p(t)* – vector of graph vertex parameters changes;

p(0) – vector of initial pulses;

A – adjacency matrix;

t – modeling steps *t(0, 1, 2, 3, …, n)*;

X(t) – the values of the parameters of the vertices on the modeling cycle *t*;

X(0) – the value of the parameters of the vertices at the initial cycle;

E – unit matrix.

The developed scenarios of behavior modeling exclude the use of a large set of combinations of factors and are based on the desired impulse effects on the mechanism as a system following.

According to the presented development scenarios, we demonstrate only some of them (Table 2).

Scenario 1 simulation results *Qf3=+1*, where $p_i(0)$ – initial impulse, directed to the top of the graph, and *i* – script number *(i=1, 2, 3, ..., n)*. In order to develop the scenario *i=1*, we set the vector of initial pulses $p_1^T(0)=(0,0, +1,0,0,0,0,0,0,0,0,0)$ to the vertex *F3*. A pulse arrives at one vertex of a digraph, which is a simple process of propagation of pulses on a graph [5].

As *(t=5)* we define the vectors of variation of the parameters of the vertices of the graph *p(1), ..., p(5)* according to each of the $n_1, \ldots, n_5$.

Table 2. Scenarios for modeling the behavior of the mechanism for the development of entrepreneurship in the recreational sphere of the region*.

Simulation Scenarios	Pulses	F1	F2	F 3	F 4	F 5	F 6	F 7	F 8	F 9	F 10	F 11	F 12	F 13
		The formation and use of labor resources	Formation of public-private partnership in the development of medical tourism and	investment activity in the region and international tourism cooperation	Competitiveness of tourist and recreational services	Rational use of natural and historical-cultural resources	Budget financing of tourism infrastructure development	The formation and use of social resources of the region	Change in population in the region	Development of instruments of economic incentives	Seasonality of the industry	Formation of a resort education system in the region	Formation of competitiveness of the material and technical base of recreation and	Use of natural recreational factors and the environment
1	Qf3=+1			+1										
2	Qf3=+1 Qf6=+1			+1			+1							
3	Qf3=–1 Q4=–1			–1	–1									
4	Qf2=+1 Qf6=–1 Qf9=–1		+1				–1			–1				
5	Qf2=+1 Qf6=+1 Qf9=+1		+1				+1			+1				

* Compiled by the author based on expert judgment

System simulation beats n=5:

1) n_1: $\boldsymbol{p^T(1) = p^T(0) = (0\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0)}$;

2) n_2: $\boldsymbol{p^T(2) = (p(0) \cdot A)^T = (1\ \ 1\ \ 0\ \ 1\ \ 1\ \ 1\ \ 0\ \ 0\ \ 1\ \ -1\ \ 0\ \ 1\ \ -1)}$;

3) n_3: $\boldsymbol{p^T(3) = (p(0) \cdot A^2)^T = (2\ \ 4\ \ 4\ \ 4\ \ 2\ \ 1\ \ 4\ \ 5\ \ 2\ \ -1\ \ 1\ \ 2\ \ 2)}$;

4) n_4: $p^T(4) = (p(0) \cdot A^3)^T = (17\ \ 21\ \ 13\ \ 16\ \ 2\ \ 6\ \ 5\ \ 22\ \ 3\ \ -11\ \ 7\ \ 9\ \ -4)$;

5) n_5: $p^T(5) = (p(0) \cdot A^4)^T = (67\ \ 75\ \ 69\ \ 53\ \ 5\ \ 16\ \ 22\ \ 84\ \ 23\ \ -55\ \ 25\ \ 40\ \ -3)$

After the calculations *p(1), …, p(5)* find vectors *X(1), …, X(5)* vertex parameters:

$$\boldsymbol{X^T(1) = X^T(0) + p^T(1) = (0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0) +}$$
$$\boldsymbol{(0\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0) =}$$
$$\boldsymbol{(0\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0)};$$

$$\boldsymbol{X^T(2) = X^T(1) + p^T(2) = (0\ \ 0\ \ 1\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ 0) +}$$
$$\boldsymbol{(1\ \ 1\ \ 0\ \ 1\ \ 1\ \ 1\ \ 0\ \ 0\ \ 1\ \ -1\ \ 0\ \ 1\ \ -1) =}$$
$$\boldsymbol{(1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 0\ \ 0\ \ 1\ \ -1\ \ 0\ \ 1\ \ -1)};$$

$$\boldsymbol{X^T(3) = X^T(2) + p^T(3) = (1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 1\ \ 0\ \ 0\ \ 1\ \ -1\ \ 0\ \ 1\ \ -1) +}$$
$$\boldsymbol{(2\ \ 4\ \ 4\ \ 4\ \ 2\ \ 1\ \ 4\ \ 5\ \ 2\ \ -1\ \ 1\ \ 2\ \ 2)}$$
$$\boldsymbol{(3\ \ 5\ \ 5\ \ 5\ \ 3\ \ 2\ \ 4\ \ 5\ \ 3\ \ -2\ \ 1\ \ 3\ \ 1)};$$

Impulse arrival at the top of the graph F3. According to the impulse scenario, an increase in the level of investment activity in the region contributes to the improvement of the material and technical base of recreation and tourism, the development of a training system. The growth of indicators is observed from the third step of modeling. The results are presented in the table of values of the vertices of the graph after modeling the generated pulse (Table 3) and see Fig. 2.

Table 3. First development scenario Qf3=+1.

	X(1)	*X(2)*	*X(3)*	*X(4)*	*X(5)*	*X(6)*
F1	0	1	3	20	87	382
F2	0	1	5	26	101	427
F3	1	1	5	18	87	357
F4	0	1	5	21	74	338
F5	0	1	3	5	10	73
F6	0	1	2	8	24	116
F7	0	0	4	9	31	130
F8	0	0	5	27	111	450
F9	0	1	3	6	29	117
F10	0	-1	-2	-13	-68	-285
F11	0	0	1	8	33	140
F12	0	1	3	12	52	212
F13	0	-1	1	-3	-6	-29

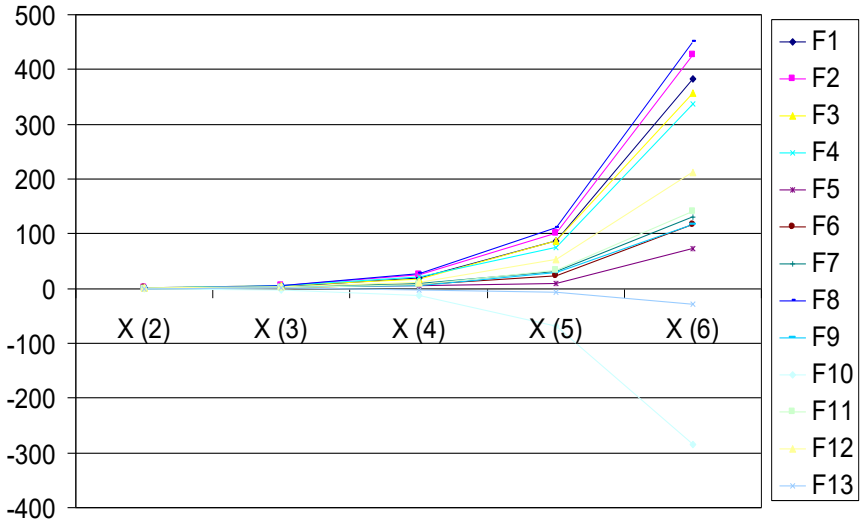

Fig. 2. Development modeling scenario Qf3=+1.

Positive impulses arrive at the top *F2, F6,* and *F9* (Table 4)) and see Fig. 3.

Table 4. Fifth Development Scenario Qf2=+1, Qf6=+1, Qf9=+1.

	X(1)	*X(2)*	*X(3)*	*X(4)*	*X(5)*	*X(6)*
F1	0	0	9	46	203	850
F2	1	3	13	56	232	967
F3	0	2	9	45	193	808
F4	0	2	12	44	174	759
F5	0	1	4	7	29	164
F6	1	2	5	14	60	256
F7	0	2	7	18	64	309
F8	0	1	13	63	246	1030
F9	1	2	4	14	62	273
F10	0	-1	-7	-33	-155	-647
F11	0	1	3	17	77	308
F12	0	2	7	27	115	485
F13	0	1	1	-2	-19	-52

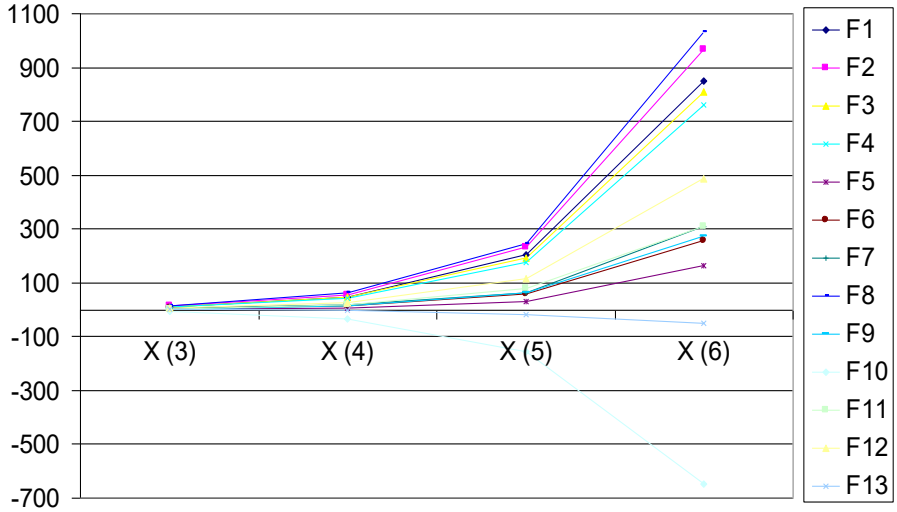

Fig. 3. Development modeling scenario Qf2=+1, Qf6=+1, Qf9=+1.

4 Conclusion

In the fifth scenario, there is a significant increase in system performance, especially after the fifth cycle of modeling. Of the simulated development scenarios, this is the most favorable for the system. Factors Qf6=+1, Qf9=+1 that provide positive impulses to the top of the system and cause a balanced development of tourism. Impulse moves to the top Qf2=+1, which is reflected in the development of entrepreneurship innovations in tourism and recreation services and medical tourism during the off-season.

Cognitive technology in its complex makes extensive use of the method of simulation of complex weakly structured systems. Simulation and other means of the cognitive approach are widely used in the economies of developed countries, and the scope is constantly expanding.

The use of cognitive technology makes it possible to obtain a qualitative assessment of the interaction of factors, scenario development of the situation, and trend, as well as evaluate the results of the proposed activities.

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