ФІНАНСИ. БАНКІВСЬКА СПРАВА

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THE SIMULATION MODELING OF THE SAFETY LEVEL OF THE INSURANCE MARKET IN UKRAINE

Abstract. *In this paper, a theoretical study of existing approaches to determining the safety level of the insurance market has been analysed, it is proposed that application toolkit evaluation factors influence the insurance market security goal-oriented to the identification of sources of threats and determining the prospects for further development. The implementation logic of the cognitive approach to the modelling of the insurance market security has been revealed. As a result of cognitive modelling the concepts of insurance market security, as well as the causal relationship between them were justified.*

Keywords: *insurance market; insurance market safety; simulation modelling; cognitive modelling; scenario approach.*

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ІМІТАЦІЙНЕ МОДЕЛЮВАННЯ РІВНЯ БЕЗПЕКИ СТРАХОВОГО РИНКУ УКРАЇНИ

Анотація. *В даній статті проведено теоретичне дослідження наявних підходів до визначення рівня безпеки страхового ринку, запропоновано прикладний інструментарій оцінки факторів впливу на безпеку страхового ринку цілеорієнтованого на ідентифікацію джерел загроз та визначення перспектив подальшого розвитку. Розкрито логіку реалізації когнітивного підходу до моделювання безпеки страхового ринку. Також за результатами когнітивного моделювання було обґрунтовано концепти забезпечення безпеки страхового ринку, а також причинно-наслідкові зв'язки між ними.*

Ключові слова: *страховий ринок; безпека страхового ринку; імітаційне моделювання; когнітивне моделювання; сценарний підхід.*

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ИМИТАЦИОННОГО МОДЕЛИРОВАНИЯ УРОВНЯ БЕЗОПАСНОСТИ СТРАХОВОГО РЫНКА УКРАИНЫ

Аннотация. *В данной статье проведено теоретическое исследование существующих подходов к определению уровня безопасности страхового рынка, предложено прикладной инструментарий оценки факторов влияния на безопасность страхового рынка целеориентированного на идентификацию источников угроз и определения перспектив дальнейшего развития. Раскрыто логику реализации когнитивного подхода к моделированию безопасности страхового рынка. Также по результатам когнитивного моделирования было обосновано* *концепты обеспечения безопасности страхового рынка, а также причинно-следственные связи между ними.*

Ключевые слова: *страховой рынок; безопасность страхового рынка; имитационное моделирование; когнитивное моделирование; сценарный подход.*

Urgency of the research. Increased instability and uncertainty in today's world, territorial, economic and political globalization necessitate improving insurance market security approaches. Domestic insurance market is characterized by the increasing complexity of business environment as a result of the accumulation of destructive influence of environmental factors and uncertainty state. Thus on the basis of empirical research it can be stated that in the near future the situation in the insurance market of Ukraine will not change significantly. This means the design and implementation of strategic imperative of insurance market development issue becomes relevant, to ensure its functioning safety.

Actual scientific researches and issues analysis. Issues of the insurance market theory and practice, its role in the country and the rising issues of the economy are presented in the scientific papers of such renowned scholars as: V. Bazylevych, K. Bazylevych, N. Vnukov, K. Voblyi, O. Hvozdenko, V. Homell, O. Zhuravka, O. Zalietov, O. Kozmenko, V. Navrotskyi, S. Osadets, D. Furman, V. Shakhov, H. Shershenevych, Ya. Shumelda, R. Yuldashev.

The aim of the paper is development of scientific approaches to assessing the level of insurance market security.

The statement of basic materials. Insurance market is a complex dynamic system, which is characterized by the following features: unpredictability, self-organization, counterintuitivity, insensitivity to changes in most parameters, high sensitivity to changes in only a small number of defined parameters and so on. Since the insurance market has all the characteristics of complex systems, it is sensible to use complex systems modelling methods for insurance market safety assessment and analysis, among which the most common are: econometric modelling, mathematical programming and simulation. In (Figure 1) the comparative characteristic of these methods is given. Based on the above information, it can be argued that under turbulence and uncertainty conditions simulation modelling is the most promising method of mathematical modelling of insurance market safety that allows predicting its development under different conditions, including considering random changes as well.

In our opinion, cognitive modelling, which combines the advantages of fuzzy logic and neural networks is an effective tool of imitation modelling of insurance market security and forecasting the situation. This approach will make it possible to develop the economic and mathematical model for evaluating the insurance market security and, on this basis, make decisions on its development strategy formation. Cognitive modelling allows studying the situation, including the following components: self-development, modelling of external factors, targeted development of the situation modelling (managed development).

Cognitive modelling of insurance market security can be expressed through the interaction of four components (Figure 2.): The insurance market security, logical-mathematical model of the insurance market security, simulation model of the insurance market security and the aimed calculated experiment.

Cognitive modeling in the analysis and management of complex systems is studying of the functioning and development of the situation by constructing a model of a complex system based on cognitive map. In this model, cognitive map reflects the subjective views (individual or collective) study the problem, the situation related to the operation and development of the system. A special feature of cognitive modeling is the possibility of static and dynamic analysis of situations. Static analysis involves the study of the structure of cognitive maps and determines the degree of interference factors. Also, the division of factors occurs to the target and control [2].

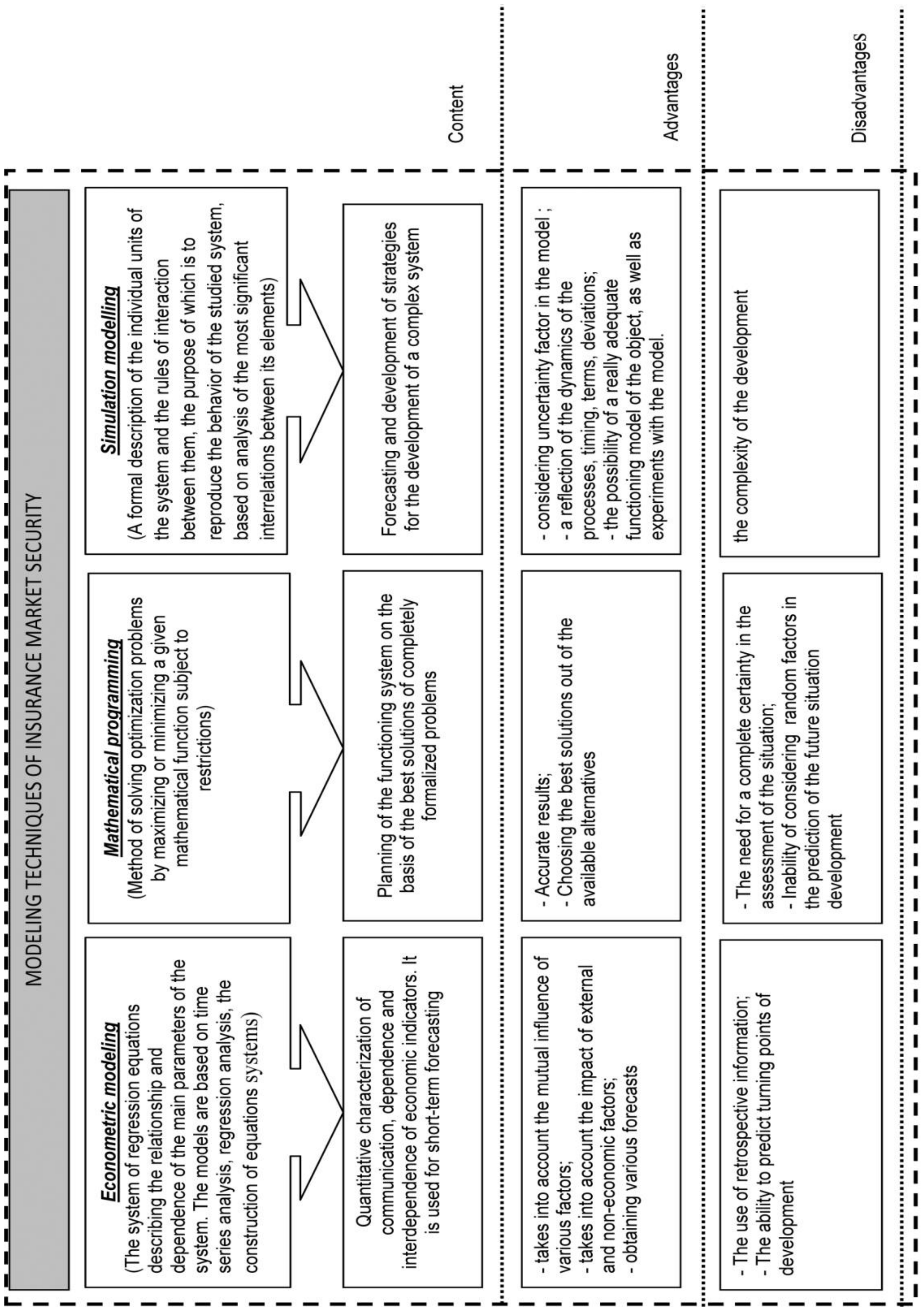

Fig.1. Comparative characteristics of the main methods of mathematical modeling of insurance market security.
***Source:** systematized and completed by the author*

Target factors are the ones the value of which is necessary to change within a particular task, and the control factors are the factors that can be used to influence target ones. Dynamic analysis involves dynamic control of target factors depending on the change of control factors, as well as creating time development scenarios and choosing the best option.

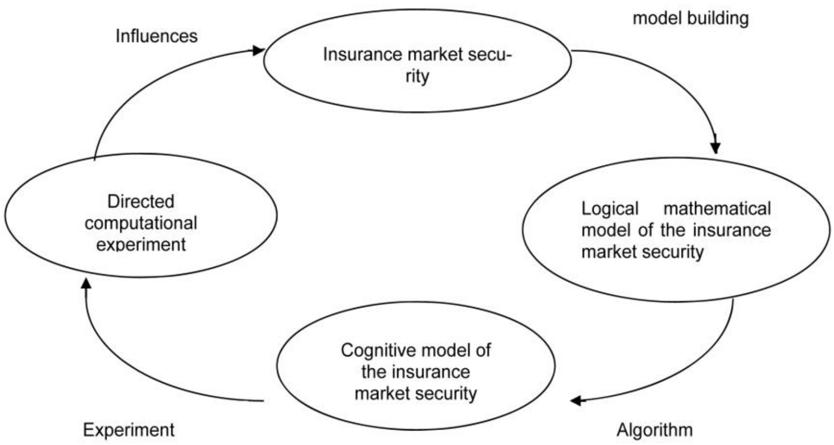

Fig. 2. Decomposition of cognitive modeling process of the insurance market security
Source: created by the author

So, cognitive modelling theory makes it possible to substantiate the insurance market safety as a complex dissipative system functioning under the influence under external and internal environment factors from the perspective of system-synergetic approach.The advantages of using cognitive modelling of the insurance market security are presented in (Table. 1).

The main elements of cognitive map are the basic factors (or simply factors) and the cause and effect relationships between them. [4] Basic factors (in various publications the terms "concept", "setting" or "variable" are also used) - are the ones that define and limit the phenomena and processes in the system and its environment. They are interpreted by subject of management as essential, key parameters, attributes of these phenomena and processes [8].

Table 1

Advantages of cognitive modeling of the insurance market security

Benefits	**Content**	**Peculiarity of insurance market security assessment**
1	2	3
Efficiency in terms of information asymmetry	Standard strategic management methods do not enable considering all the external environment impact. This restriction is lifted because of reduced number and variety of affect factors on the safety of the CP	Simulation of the insurance market security enables creating a basis for the development of its ensuring strategy, taking into account the impact of the key factors
model structuring of problem solving	Poly alternativity of insurance market security ensuring scenarios and the organization of the selected scenarios implementation monitoring	The possibility of the introduction of cognitive models of any factors makes it possible to predict all possible links between security ensuring members
visibility of cognitive maps and models	Representation of only basic factors and relationships. Displays of only the basic regularity of the insurance market safety	It allows additionally considering the subjective opinion of decision-makers in ensuring insurance market security

Continuation of Table 1

1	2	3
The multidimensionality and interconnectedness of phenomena and processes consideration	Presentation of cognitive maps in the form of graphs makes it possible to provide indirect relationship between the factors of influence on the insurance market security and reflect the cause and effect relationships between them	Complex hierarchical structuring of the insurance market requires consideration of the relationship between them. The cognitive approach provides the necessary tools
quality increasing of produced management decisions	Creating a system of cause and effect relationships between factors of influence allows to develop a variety of CP safety scenarios	The integration of scenario and the competency approaches allows to provide all options for future insurance market security ensuring
the dynamic nature of elements relations of the card	Presentation of cognitive map as a directed graph makes it possible to fix the spatial and temporal relationships between the security system and its relationships with others	Presentation of the dynamic relationships between the factors of influence on the insurance market security, available resources and competencies allows to identify the bifurcation point and select development attractors
a holistic view of the main problems of the blocks	The links between the elements of the cognitive map provides a view of all important aspects of insurance market security	The integrity feature provides a more efficient way to define the integration limits on the actions of competence possessors involved in the CP security system ensuring
Showing density connections between factors	Implemented by the introduction of weight characteristics of the matrix graph connectedness that reflects the cognitive map elements	Introduction of weight characteristics enables to adapt the reference cognitive maps to CP security ensuring conditions

Source: created by the author [9]

Algorithm of the cognitive approach realization can be displayed as follows: study of the problem and definition of the goals and objectives of the study; construction of cognitive maps; construction of the cognitive model and checking its adequacy; analysis of the spread of excitation (impulses) on the graph; solving the problems of complexity, sensuality and stability systems [1], [7] (Fig. 3)

To determine the nature of the relationship, the importance of factors and clarify the parameters of the system it is necessary to go to the next modelling level that is to create a cognitive model [6].

Cognitive model is a functional graph of the studied system (insurance market security), where the vertices correspond to the system factors, and the arcs reflect the functional relationship between them. A common modelling approach, according to which the spread of the pulse in the system is investigated. Impulse is interpreted as an external impact on the system, and the edges are assigned to the coefficients of the pulse resistance [1].

Computer realization of cognitive insurance market security model requires software implementation of the model in a simulation environment, makes it possible to automatize the process of system research.

The cognitive analysis and modelling of complex systems research begins with solving the problem of its identification as a cognitive model [7], one of the common forms of which - a parametric function graph vector - tuple:

$$G << V,E >, X ,F,\theta >, \quad (1)$$

де $G = < V,E >$, $V = \{v_i \mid v_i \in V,\ i = 1,2,...,k\}$; $E = \{e_i \mid e_i \in E,\ i = 1,2,...,k\}$;

G – cognitive map, *V* – the set of vertices, the vertex ("Concepts") $v_i \in V$, $i = 1,2,...,k$ are elements of the study of the insurance market security; *E* – set of arcs, the arc $e_{ij} \in E$, $ij = 1,2,...,n$ reflect the relationship between the vertices V_i and V_j ; impact of V_i on V_j in the system can be positive ("+" sign

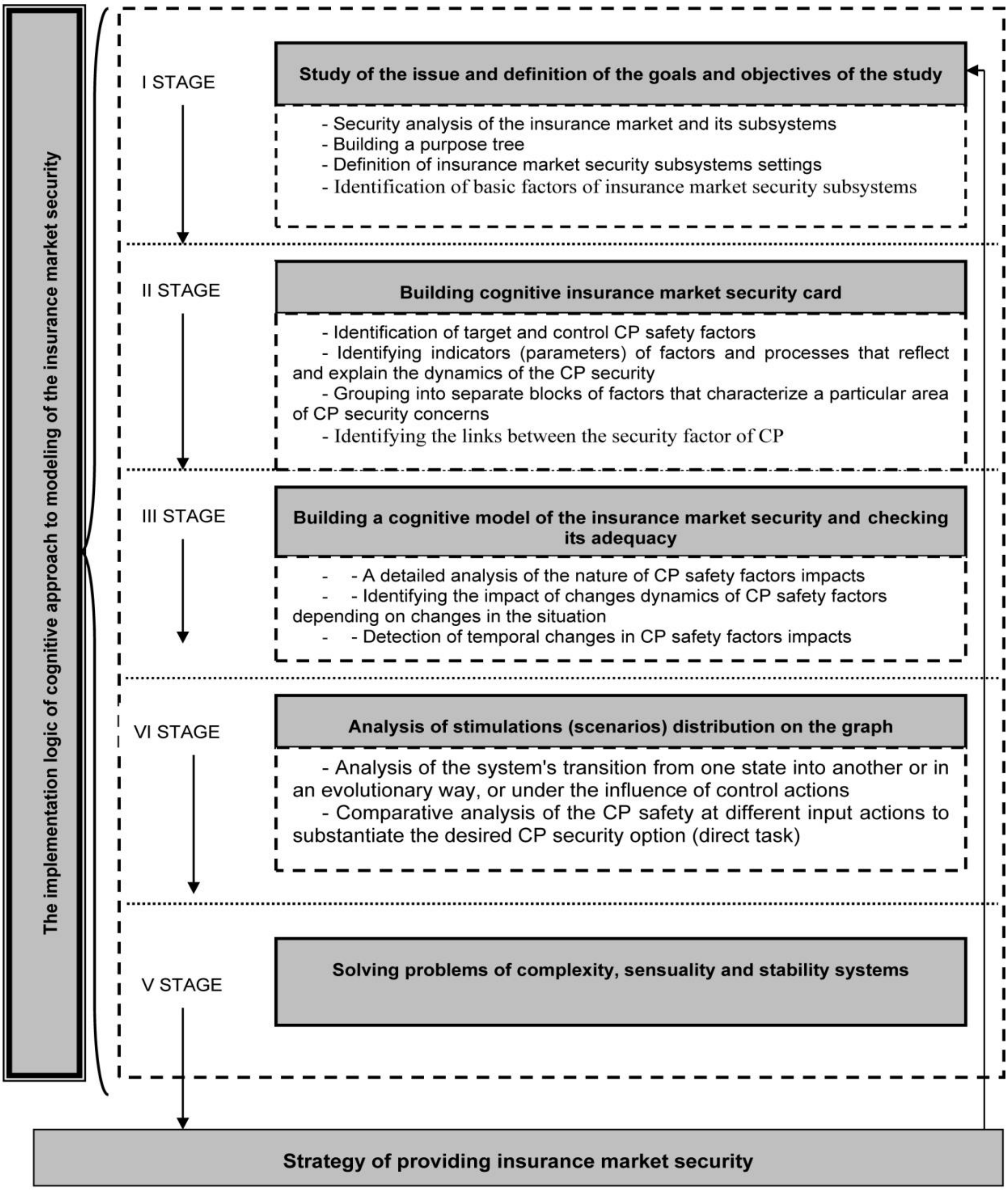

Fig. 3. *The implementation logic of cognitive approach to the insurance market security modeling*
Source: *systematized and constructed by the author*

above the arc) if an increase (decrease) of one factor leads to an increase (decrease) of the other, or negative ("-" sign above the arc) if an increase (decrease) of one factor leads to decrease (increase) of the other, or is absent; X :V $\rightarrow\theta$, X – parameter set of vertices, $X = \left\{X^{(V_i)} \middle| X^{(V_i)} \in X, i = 1,2,\ldots,k\right\}$ $X^{(V_i)} = \left\{x^i{}_g\right\}, g = 1,2,\ldots,l$, $x^i{}_g - g$ – parameter of vertice V_i , if g =1, then $x^i{}_g = x_i$, θ – space vertex parameters, that is, each vertex is assigned a vector of independent variables;

1) $F = F(X,E)$ – arcs conversion functionality, $F : E \times X \times \theta \rightarrow R$. Dependence of f_{ij} can be not only functional, but also in the form of stochastic regression equations. Defining the parameters of the characteristics off_{ij} pressuposes the establishment of a certain scale, performance, technique, precision measurement units.

Cognitive map except graphic image can be represented in matrix as matrix relationships A_G – is a square matrix which rows and columns are indicated vertices of the graph, and at the intersection of i-line, j-column stand (or not) units, if any (none) the relationship between the elements of V_i and V_j , that is:

$$A_G = \lfloor a_{ij} \rfloor_{K \times K} ,$$

Where the relation:

$$\begin{cases} 1 - if\ V_i \quad connected \quad c\ V_j \\ \quad 0 - in\ other\ case \end{cases} \tag{2}$$

a_{ij} ratio can be set to «+1» or «–1»

$$X_i\ (n+1) = X_i\ (n) + \sum f\ (X_i\ , X_j\ , e_{ij}\ )P_j\ (n), \tag{3}$$

due to unknown initial values of X (n = 0) at all the vertices and the initial disturbance vector P(0). In the presence of external perturbations Q_i impulse process is defined by the rule

$$X_i\ (n+1) = X_i\ (n) + \sum f\ (X_i\ , X_j\ , e_{ij}\ )P_j\ (n) + Q_i\ (n+1). \tag{4}$$

Impulse model processes can be represented in matrix form that is more convenient for modeling on the iconic graph. Let the vector vertex parameter at time t is given by equation (4). Then vertex parameter changes is generally given by the following equation:

$$X_i\ (n+1) = X_i\ (n) + AP(n) + Q_i\ (n+1), \tag{5}$$

where: A – matrix of the cognitive map graph relations G. We get the equation (5) taking into account (4) for $P(n)$:

$$P(n) = A^{n-1}Q_0 + A^{n-2}Q_1 + \ldots + AQ_{n-2} + IQ_{n-1}, \tag{6}$$

where: I – identity matrix.

Stability Analysis of the modelled weighted directed graph of the insurance market security system requires the use of specific mathematical apparatus.

We take as a basis the available results of this analysis [0] in order to adapt them to the analysis of the insurance market security.

We take as a basis the available results of this analysis [3] in order to adapt them to the analysis of the insurance market security. To determine the adequacy of the cognitive map we have studied stability in the value and stability of the insurance market in the perturbation of the security system in the course of its evolution. Known theorems [3]:

Vertex V_j stable by value, but the sequence of values $\{| X(t) | : t = 0,1,...\}$ are limited.

Vertex V_j is resistant to disturbance, if the sequence of pulses is limited $\{| P_j (t)|: t = 0,1,...\}$.

The weighted graph is stable in impulses (values), if such property is characteristic for its every vertex. Resistance to impulse does not mean stability value, although the reverse is true as well. Between the introduction of sustainability concept, that corresponds to the internal description and the system resistance of type "black box" (external description) there is a clear analogy, although there is a considerable difference in the mathematical description. Let`s consider the concept of algebraic stability criterion to the impulse and the initial value and consider the stability of the connection graph with its topological structure, relying on well-known works [3], [5]. Fundamental in the development of sustainability criteria is a graph describing the idea of the matrix of the graph relations - a cognitive model of the system [3]. Let the matrix A for the relationship graph is defined as follows:

$$A = \lfloor a_{ij} \rfloor, a_{ij} = f(V_i, V_j), \quad ij = 1,2,...,n , (7)$$

where V_i , V_j – vertex of the graph, $f(V_i, V_j)$ – weighting function.

Characterized graph values are defined as proper values of A (the proper values are the roots of the polynomial characterizing matrix, $Y(\lambda) = |\lambda I - A|$, λ – characterizing matrix for A, the independent variable; I – the identity matrix).

To construct a cognitive map of the insurance market it is necessary to determine the safety vertices (concepts) that are directly investigated within the model. As part of this study the parameters that affect the security of the insurance market are highlighted (Table 2, Fig. 4) .To assess the strength of the impact of each concept such scale of features effects is used (Table. 3).

Table 3

Scale of qualitative assessments of direction and influence strength between concepts

The nature of influence between concepts	Numeric variables
Absent	0,0
Very weak	0,1; 0,2 (-0,1; -0,2)
Weak	0,3; 0,4 (-0,3; -0,4)
Moderate	0,5; 0,6 (-0,5; -0,6)
Considerable	0,7; 0,8 (-0,7; -0,8)
Substantive	0,9; 1,0 (-0,9; -1,0)

Scenario analysis is an expert "qualitative" analysis of possible scenarios for the development of stability, identifying the worst and best possible scenarios and choosing the desired scenario according to the research objectives.

Conclusions. Based on cognitive modelling results we can justify the concepts of insurance market security, as well as the cause and effect relationship between them. Therefore, the proposed approach allows taking a reasoned decision on the justification of effective alternative scenarios of insurance market security and paves the way for obtaining the vector of structured knowledge about the interaction architecture between the following concepts: insurer's security, insurer's safety. Based on the results of the cognitive analysis, we can develop a set of means of influence on the individual insurance market safety factors with the aim of its providing.

Cognitive modelling makes it possible to justify management decisions for effective security scenario of the insurance market from the standpoint of economic rationality and timely make necessary adjustments in deviation case and promptly respond to them.

Table 2

The adjacency matrix of interdependence and impact strength between the concepts of insurance market security system*

Indicators	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}
X_1	1,00	0,71	-0,52	-0,18	-0,80	0,05	0,56	0,85	-0,30	-0,71	-0,62	-0,82	-0,12	-0,84	-0,81	0,61	0,83	-0,71
X_2	0,71	1,00	0,13	-0,66	-0,62	-0,17	0,52	0,93	-0,19	-0,35	0,06	-0,66	0,21	-0,73	-0,95	0,98	0,86	-0,87
X_3	-0,52	0,13	1,00	-0,57	0,53	0,12	-0,08	-0,11	0,40	0,61	0,96	0,60	0,67	0,53	0,12	0,23	-0,28	-0,12
X_4	-0,18	-0,66	-0,57	1,00	0,29	-0,10	0,05	-0,44	-0,47	-0,02	-0,54	0,03	-0,69	0,14	0,42	-0,65	-0,25	0,37
X_5	-0,80	-0,62	0,53	0,29	1,00	0,01	-0,01	-0,75	0,03	0,88	0,58	0,86	0,02	0,90	0,74	-0,56	-0,80	0,35
X_6	0,05	-0,17	0,12	-0,10	0,01	1,00	-0,20	0,01	0,74	-0,30	-0,12	0,39	0,71	0,32	0,20	-0,19	-0,20	0,05
X_7	0,56	0,52	-0,08	0,05	-0,01	-0,20	1,00	0,51	-0,67	0,06	-0,13	-0,36	-0,29	-0,33	-0,52	0,46	0,47	-0,82
X_8	0,85	0,93	-0,11	-0,44	-0,75	0,01	0,51	1,00	-0,22	-0,63	-0,25	-0,77	0,15	-0,83	-0,98	0,91	0,96	-0,87
X_9	-0,30	-0,19	0,40	-0,47	0,03	0,74	-0,67	-0,22	1,00	-0,06	0,30	0,54	0,85	0,44	0,35	-0,19	-0,41	0,38
X_{10}	-0,71	-0,35	0,61	-0,02	0,88	-0,30	0,06	-0,63	-0,06	1,00	0,75	0,71	-0,02	0,74	0,56	-0,32	-0,68	0,24
X_{11}	-0,62	0,06	0,96	-0,54	0,58	-0,12	-0,13	-0,25	0,30	0,75	1,00	0,60	0,50	0,55	0,21	0,15	-0,37	0,02
X_{12}	-0,82	-0,66	0,60	0,03	0,86	0,39	-0,36	-0,77	0,54	0,71	0,60	1,00	0,42	0,99	0,84	-0,61	-0,91	0,53
X_{13}	-0,12	0,21	0,67	-0,69	0,02	0,71	-0,29	0,15	0,85	-0,02	0,50	0,42	1,00	0,30	-0,01	0,25	-0,10	-0,10
X_{14}	-0,84	-0,73	0,53	0,14	0,90	0,32	-0,33	-0,83	0,44	0,74	0,55	0,99	0,30	1,00	0,88	-0,68	-0,94	0,57
X_{15}	-0,81	-0,95	0,12	0,42	0,74	0,20	-0,52	-0,98	0,35	0,56	0,21	0,84	-0,01	0,88	1,00	-0,93	-0,98	0,85
X_{16}	0,61	0,98	0,23	-0,65	-0,56	-0,19	0,46	0,91	-0,19	-0,32	0,15	-0,61	0,25	-0,68	-0,93	1,00	0,85	-0,86
X_{17}	0,83	0,86	-0,28	-0,25	-0,80	-0,20	0,47	0,96	-0,41	-0,68	-0,37	-0,91	-0,10	-0,94	-0,98	0,85	1,00	-0,78
X_{18}	-0,71	-0,87	-0,12	0,37	0,35	0,05	-0,82	-0,87	0,38	0,24	0,02	0,53	-0,10	0,57	0,85	-0,86	-0,78	1,00

Note: X_1 - insurance penetration indicator (insurance premiums to GDP), %; X_2 – "insurance density" index (premiums per capita), USD; X_3 – the proportion of long-term insurance in the total volume of collected insurance premiums, %; X_4 – the level of insurance payments, %; X_5 – the proportion of premiums ceded to non-resident reinsurers, %; X_6 – the proportion of the total volume of the authorized capital of insurance companies owned by non-residents in the total volume, %; X_7 – the capital adequacy of the insurance market; X_8 – reliability index; X_9 – financial capacity indicator; X_{10} – an indicator of current liquidity; X_{11} – equity capital of insurance companies, mln UAH; X_{12} – insurance reserves, mln UAH; X_{13} – the total amount of paid + statutory insurance funds; X_{14} – the ratio of insurance reserves and the statutory capital; X_{15} – the inflation index, %; X_{16} – GDP per capita; X_{17} – real income of the previous year,%; X_{18} – the unemployment rate of the working population.

* ***Source:*** calculated by the author

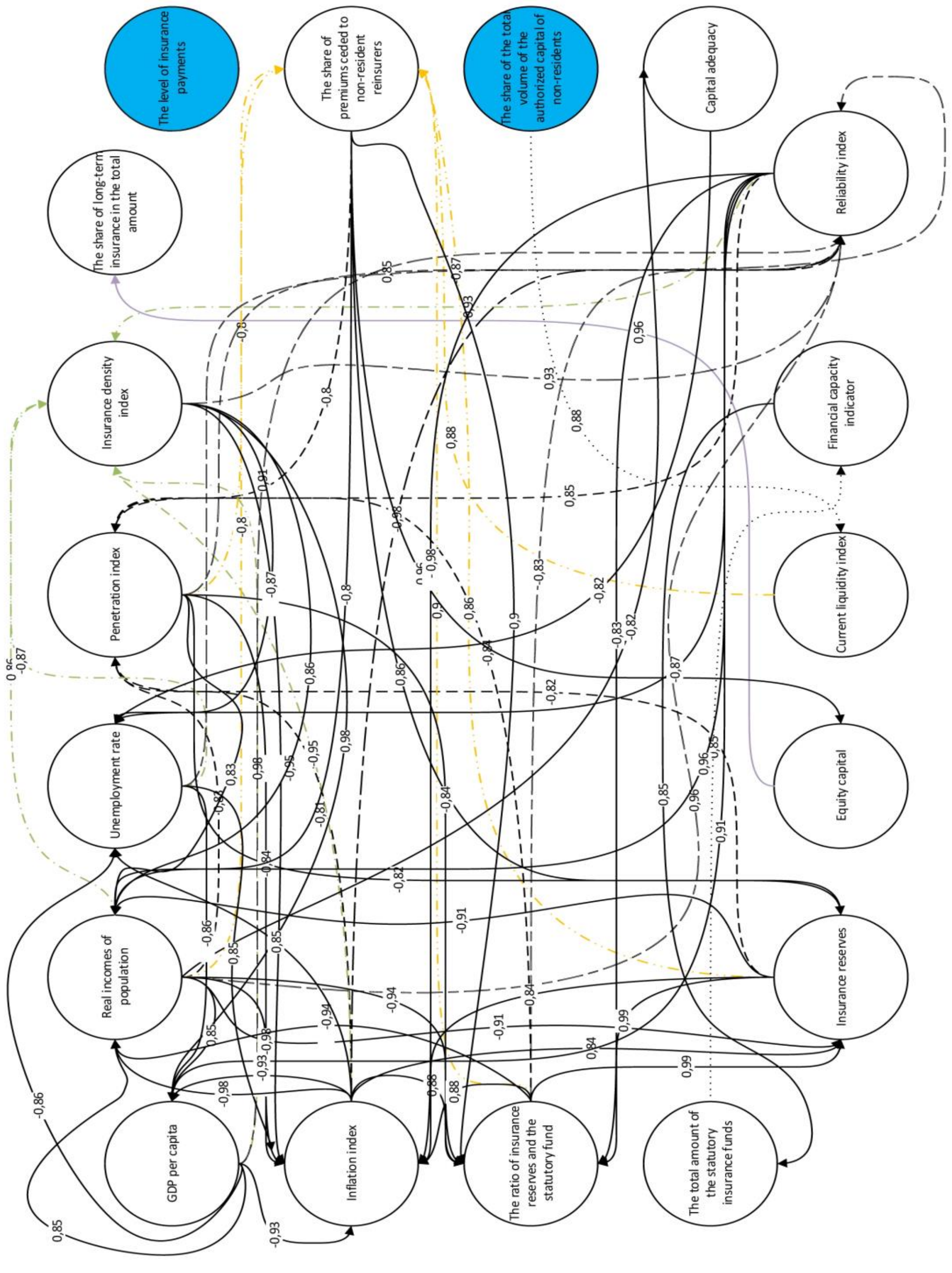

Fig. 4. **Graphical representation of interdependencies and power of influence between the concepts of insurance market security system**

Sourte: created by the author

References

1. Gorelova, G. V., Zakharova, Ye. N., Radchenko, S. A. (2006). Issledovaniie slabostrukturirovannykh sotsialno-ekonomicheskikh sistem: kognitivnyi podkhod [Study of semistructured socio-economic systems: cognitive approach]. Rostov-on-Don. Publisher: Rostov University [in Russian].

2. Kamaiiev, V. A. (2012). Kognitivnoie sotsialno-ekonomicheskikh system [Cognitive modeling of socio-economic systems]. Volgograd: IUNL VSTU, № 6, p. 39 [in Russian].

3. Kasti Dzh. (1982). Bolshiie sistemy: sviaznost, slozhnost i katastrofy [Large systems: connectivity, complexity and disaster]. Moscow: World [in Russian].

4. Kuznetsov, O. P., Kulipich, A. A., Markovskiy, A. V., et al. (2006). Analiz vliianiy pri upravlenii slabostrukturirovannymi situatsiiami na osnove kognitivnykh kart [Analysis of the effects in semistructured situations management on the basis of cognitive maps]. Chelovecheskiy factor v upravlenii – The human factor in management Moscow : Book [in Russian].

5 .Kulba, V. V., Kovalevskiy, S. V., Kononov, D. A., Chernov, I. V., Shelkov, A. B. (2000). Problemy obespecheniia ekonomicheskoi bezopastnosti slozhnykh sotsialno-ekonomicheskikh sistem [Problems of economic security of the complex socio-economic systems]. Moscow : ISP RAS [in Russian].

6. Maksimov, V. I. (2001). Kognitivnyi analiz i upravleniie razvitiiem situatsii: Materialy 1-i mezhdunarodnoi konferentsii v 3-kh tomakh [Cognitive analysis and situations development management: Proceedings of the 1st International Conference in 3 volumes]. Moscow [in Russian].

7. Maksimov, V. I., Kornoushenko, Ye. K., Kachaiev, S. V. (1999). Kognitinyie telhnologii dlia podderzhki priniatia upravlecheskikh reshenii [Cognitive technologies to support management decision-making]. Tekhnologii informatsionnogo obshestva - Information Society Technologies. Moscow : ICS RAS, № 2, pp. 50–54[in Russian].

8. Savchuk, O., Ladaniuk, A., Gritsenko, N. Kohnityvnyi pidkhid do modeliuvannia i upravlinnia slabo strukturovanymy orhanizatsiino-tekhnolohichnymy systemamy(sytuatsiiamy) [The cognitive approach to modeling and managing poorly structured organizational and technological systems (situation)]. eNUFTIR – Electronic National University of Food Technologies Institutional Repository ISSN 2310-8282 0020 – Retrieved from: http://enuftir.nuft.edu.ua/jspui/bitstream/123456789/1199/3/Ladanuk_2.pdf.

9. Yaldin, I. V. (2011). Kohnityvne modeliuvannia u prohnozuvanni stsenariiv stratehii stiikoho rozvytku intehrovanoi struktury biznesu [Cognitive modeling in predicting scenarios of integrated business structure sustainable development strategy]. Problemy ekonomiky – Economic Issues, №4, pp. 142–150 [in Ukrainian].

Література

1. Горелова, Г. В. Исследование слабоструктурированных социально-экономических систем: когнитивный подход : монография / Г. В. Горелова, Е.Н. Захарова, С. А. Радченко. – Ростов-н/Д. : Изд-во Рост. унта, 2006. – 334 с.

2. Камаев, В. А. Когнитивное моделирование социально-экономических систем : учеб. пособие / В. А. Камаев. – Волгоград: ИУНЛ ВолгГТУ, 2012. – С. 39.

3. Касти Дж. Большие системы: связность, сложность и катастрофы / Дж. Касти. – М. : Мир, 1982. – 216 с.

4. Кузнецов, О. П. Анализ влияний при управлении слабоструктурированными ситуациями на основе когнитивных карт / О. П. Кузнецов, А. А. Кулипич, А. В. Марковский // Человеческий фактор в управлении / под ред. Н. А. Абрамовой, К. С Гинсберга. Л. А. Новикова. – М.: Ком Книга, 2006. – С. 313–344.

5. Кульба, В. В. Проблемы обеспечения экономической безопасности сложных социально-экономических систем / В. В. Кульба, С. В. Ковалевский, Д. А. Кононов, И. В. Чернов, А. Б. Шелков. – М. : ИПУ РАН, 2000. – 127 с.

6. Максимов, В. И. Когнитивный анализ и управление развитием ситуаций / В. И. Максимов // Материалы 1-й международной конференции в 3-х томах/ под. ред. В.И. Максимова. – М., 2001. – 196 с.

7. Максимов, В. И. Когнитивные технологии для поддержки принятия управленческих решений / В. И. Максимов, Е. К. Корноушенко, С. В. Качаев // Технологии информационного общества 98. – 1999. – № 2. – С. 50–54.

8. Савчук, О. Когнітивний підхід до моделювання і управління слабо структурованими організаційно-технологічними системами (ситуаціями) [Електронний ресурс] / О. Савчук, А. Ладанюк, Н. Гриценко // eNUFTIR – Electronic National University of Food Technologies Institutional Repository ISSN 2310-8282 0020 – Режим доступу: http://enuftir.nuft.edu.ua/jspui/bitstream/123456789/1199/3/Ladanuk_2.pdf — Назва з екрану.

9. Ялдін, І. В. Когнітивне моделювання у прогнозуванні сценаріїв стратегії стійкого розвитку інтегрованої структури бізнесу / І. В. Ялдін // Проблеми економіки. – 2011. – № 4. – С. 142–150.

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