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## ANALYSIS OF THE MODEL OF EFFICIENCY OF DECISIONS ON THE IMPLEMENTATION OF THE SYSTEM OF SOCIAL AND ECONOMIC SECURITY

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## АНАЛИЗ МОДЕЛИ ЭФФЕКТИВНОСТИ РЕШЕНИЙ ПО РЕАЛИЗАЦИИ СИСТЕМЫ ОБЕСПЕЧЕНИЯ СОЦИАЛЬНО-ЭКОНОМИЧЕСКОЙ БЕЗОПАСНОСТИ

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*Abstract.* To maintain the security of the system in the meaning of its existence, it is necessary to complicate the influence of the rally element on the market mechanisms of risk management in all ways. The test of the essence of dynamic processes, in particular, the resistance, formed under the influence of disturbances of different nature, is considered to be a necessary part of formal procedures for solving a wide class of control problems in complex socio-economic systems. As a rule, the relevant tasks here are considered to be the development of a strategy of socio-economic political activity, the choice and study of the effectiveness of financial, economic and legal systems of regulation of various kinds of risks, forecasting trends in socio-political processes and others.

*Аннотация.* Для сохранения безопасности системы в значении ее существования необходимо всячими способами затруднять влияние митинговой стихии на рыночные механизмы управления риском. Тест сути динамических процессов, в частности, стойкости, образующихся под воздействием возмущений разной природы, считается необходимым звеном формальных процедур разрешения широкого класса задач управления в сложных социально-экономических системах. Как правило, соответствующими задачами тут считаются выработка стратегии социально-экономической политической деятельности, выбор и изучение действенности финансово-экономических и правовых систем регулировки разного рода рисков, прогнозирование веяний в общественно-политических процессах и ряд иных.

*Keywords:* socio-economic security, government, society, enterprise, employee, threat, security, interests, economics, analysis, system.

*Ключевые слова:* социально-экономическая защищенность, государство, общество, предприятие, работник, угроза, защищенность, интересы, экономика, анализ, система.

In the analysis of the model of efficiency of decisions on the implementation of the system of socio-economic security is proposed to predict the uncle of practical examples.

Example 1. Digraph in Figure 1. has been applied in the development of new ways of making decisions on the funding of scientific and technological research [1, p. 52]. As the basic characteristics are taken:

- 1 — the number of work places for scientists;
- 2 — the number of not enough trained researchers;
- 3 — the volume of poor-quality scientific products or harmful results of the application of the results of scientific and technical research;
- 4 — external and internal dangers to society, to overcome which will require the use of science and technology;
- 5 — social opinion in favor of the development of scientific research;
- 6 — budget constraints;
- 7 — the state budget of scientific research;
- 8 — the number of well-trained researchers.;
- 9 — the volume of benign scientific products or positive results of the application of science and technology.

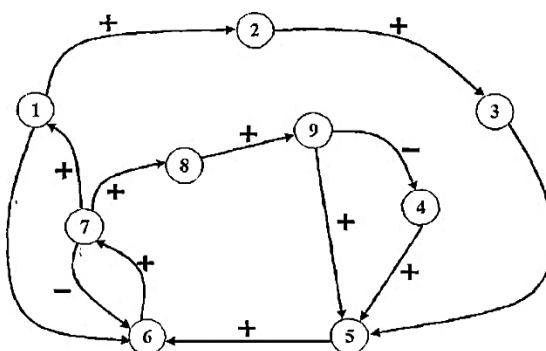


Figure 1. Model of analysis of problems of science and society [2]

Source: elaboration of author.

Example 2. Digraph in Figure 2. it became the basis for the analysis of electricity consumption problems. Basic characteristics of the model [3, p. 403]:

- 1 — energy consumption;
- 2 — the price of electricity;
- 3 — the position of the environment;
- 4 — population;
- 5 — the number of jobs;
- 6 — the number of enterprises;
- 7 — energy capacity.

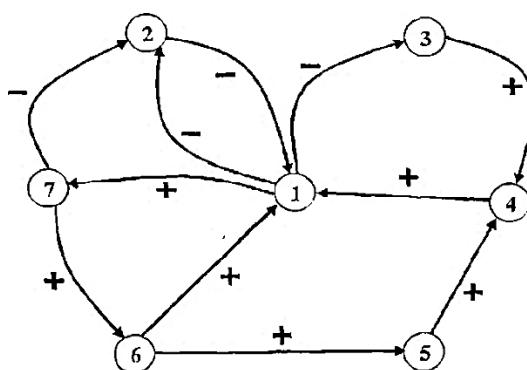


Figure 2. Model of analysis of problems of electricity consumption [1].

Source: elaboration of author

Example 3. Figure 3. the digraph corresponding to the model of analysis of the difficulty of disposal of solid waste (municipal waste) is given. Basic characteristics of the model [4, p. 171]:

- 1 — the population of the city;
- 2 — improving the criteria of life in the city;
- 3 — migration to the city;
- 4 — the number of treatment facilities;
- 5 — the number of diseases;
- 6 — bacteriological contamination per unit area;
- 7 — the number of garbage per unit area.

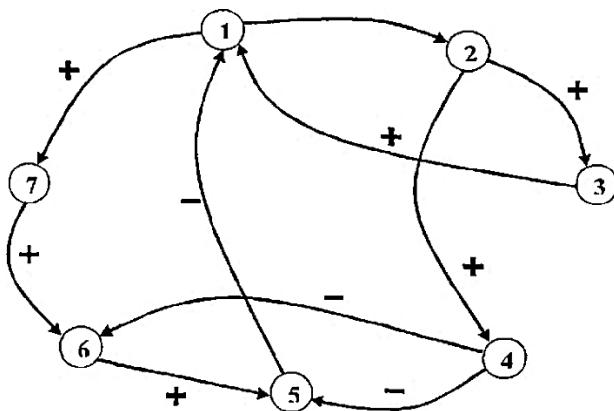


Figure 3. Model of analysis of the problem of disposal of solid waste [4].

Source: elaboration of author.

We will analyze the use of the methodology of sign digraphs in the case of the mechanism of regulation of environmental risk, based on the market allocation of quotas for pollution of the environment between potential pollutants. The sample used is taken from scientific literature [5, p. 327], where it acts as primetime probabilities of the proposed mathematical tools.

*Assumption 1.* Some space in which the system of limitation of the General emission of harmful waste in environment by all industrial enterprises of this space functions is considered.

*Assumption 2.* Any enterprise buys a pollution quota on the market, within the limits of which it has the opportunity to realize the emission of harmful waste associated with the production process.

*Assumption 3.* If the enterprise for any reason goes beyond the quota allocated to it, its work stops.

*Assumption 4.* In connection with the market mechanism of quota distribution, they have all chances to be considered as objects of purchase and sale, which can initiate a competition for the right to own quotas.

*Assumption 5.* Quotas can be considered as a generalized resource without splitting the quota according to the degree and types of contamination.

*Assumption 6.* The degree of limitation of the total emission is specified by the administration of the region and is not guided by the demand of the quota in the market.

As basic processes describing the system for its high-quality analysis are considered: the change of properties of the environment; change in living conditions change the risk of the emergency; the rise of industry; the change in the value of competition for quotas on pollution.

Characteristics that describe the underlying processes:

-Q — quality of life of the population;

- RO — population;
- W — number of working places;
- I — the degree of contamination of the environment;
- H — risk of emergency;
- N — number of enterprises;
- C — degree of competition;
- R — value of a generalized resource (quota);
- E — efficiency of the generalized resource;
- M — maximum level of harmful waste emission.

The model is arranged in the form of a sign digraph (Figure 4.).

Vertices correspond to the selected basic processes and their characteristics.

Arcs with appropriate symbols represent the interaction of processes defined by socio-economic, financial and natural laws. In place with this, the construction of the model must be provided short-term proportions between the base and generated pulses processes.

Let the time of influence transfer between the basic processes be equal to the length of the corresponding path between them in the sign digraph.

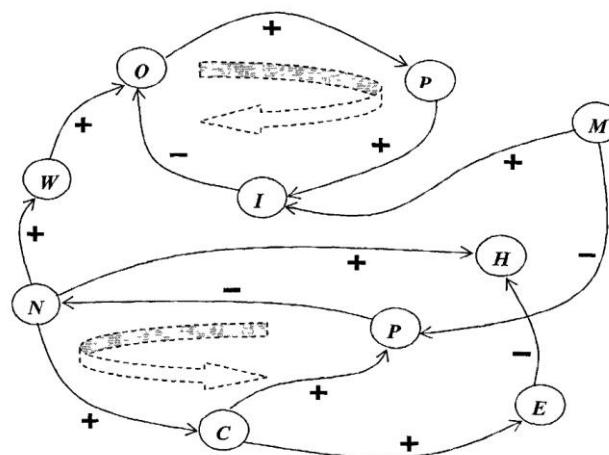


Figure 4. Environmental risk management model.

Source: elaboration of author.

In the presented model, all digraph cycles are odd, which presents certain reasons to assume the stability of the system. Since there is a bridge N, W, Q, the cycles have all chances to interact, which is likely the presence of linear resonance.

The characteristic polynomial of the block diagram of the presented model contains the following form

$$\chi(\lambda) = \lambda^4(\lambda^3 + 1)^2 \quad (1)$$

The only nonzero value is  $\lambda_1 = -1$ . This gives the implementation the most important criteria of impulse durability (all the coefficients of the characteristic equation are positive) [6, p. 535; 7, p. 17]. But, as shown in the applicable scientific literature [5, p. 396], the circumstances sufficient pulse stability not made.

This means that when a pulse occurs at any vertex of the cycle (N, C, P), a linear rise of the pulse module occurs at the vertices of the cycle (Q, PO, I), i. e., a linear resonance. This phenomenon can be interpreted in such a way: the fluctuations in the number of economic entities lead to fluctuations in the employment rate, which shakes the movement processes, and the growing amplitude of the fluctuations in the number of populations cause an increase in pollution of the

environment due to pollution. But the computational experience demonstrates a leisurely (linear) increase in the amplitude of oscillations.

Conclusion. Drawing up criteria to ensure the stability of the system is associated with the rupture or inverting any of the 2-arcs of the bridge.

Assumption 6. Society does not remain indifferent to changing the risk of danger.

In the framework of the presented model, this could mean an arc or arcs from the vertex H (Figure 5.).

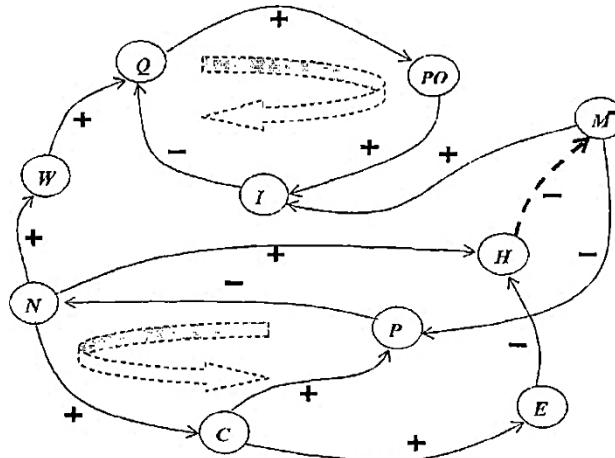


Figure 5. Modification of the model in the problem of environmental risk management.

Source: elaboration of author.

It is logical to imagine that an increase in the risk of an emergency would result in increased restrictions on total emissions. Figure 5. this situation corresponds to an arc (H, M) with a minus sign.

Thus, the digraph is observed even cycle N, C, E, H, M, P, N. This forms a question of absolute stability.

For the subsequent analysis it is necessary to build R-transformation with the center in the vertex N (Figure 6.).

According to the previously described provisions, it has a finite number of petals:

$$l_1: N, C, P, N; \quad \text{sign}(l_1) = -1; \quad n_1 = 3; \quad (2)$$

$$l_2: N, C_1, E, H, M, P_1, N; \quad \text{sign}(l_2) = +1; \quad n_2 - 1 = 6; \quad (3)$$

$$l_3: N, H_1, M_1, P_2, N; \quad \text{sign}(l_3) = -1; \quad n_3 - 1 = 4. \quad (4)$$

As a subgraph, the R-transformation forms a two-petal rose  $l_1, l_2$  for which the characteristic polynomial will be  $\lambda^8 + \lambda^5 - 1 = 0$ .

This polynomial will have a real root, less than  $(-1)$ . Thus, the interaction of cycles  $l_1$  and  $l_2$  will lead to exponential resonance. For elementary impulse processes starting at the vertex N, these cycles interact at the moment of time  $6k$ ,  $k = 1, 2, \dots$ . Order  $P_n(6k)$  not limited, which indicates resonance, in fact.

Conclusion from the analysis of the model. In order to preserve the security of the system in the meaning of its existence, it is necessary to complicate the influence of the rally element on the market mechanisms of risk management in every way. The test of the essence of dynamic processes, in particular, resistance, formed under the influence of disturbances of different nature, is considered a necessary part of the formal procedures for solving a wide class of management

problems in complex socio-economic systems. As a rule, the relevant tasks here are considered to be the development of a strategy of socio-economic political activity, the choice and study of the effectiveness of financial, economic and legal systems of regulation of various kinds of risks, forecasting trends in socio-political processes and a number of others.

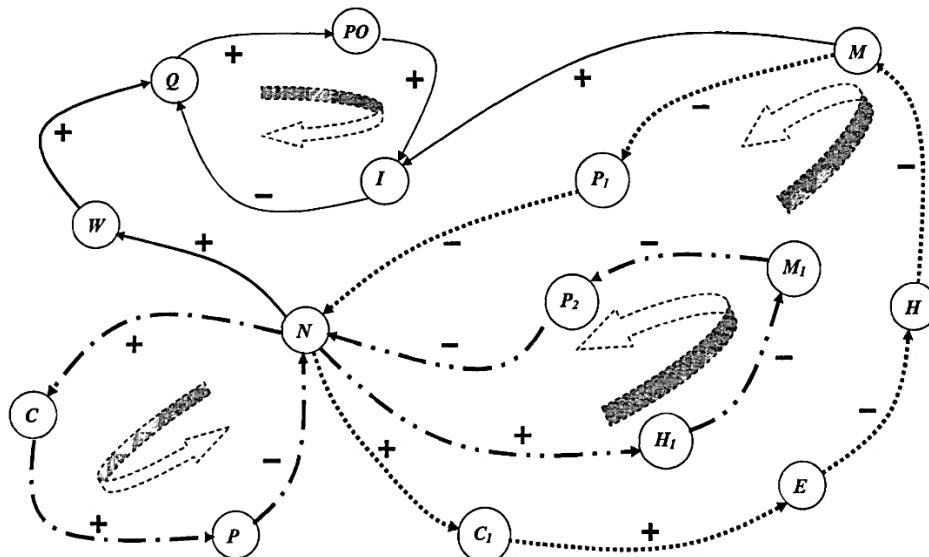


Figure 6. Approximation of rose petals in the model of environmental risk management.  
Source: elaboration of author.

It is important that most practical applications of the problems of this class are characterized by a low degree of accuracy of the initial data and high-quality character of the description of a number of dependencies, which makes it ineffective to obtain rigid quantitative conclusions on clear quantitative models. Under these conditions, the role of methods of analysis, allowing to talk about the dynamic processes and resistance on the basis of the information array on the structural features of the system under study, increases.

#### References:

1. Roberts, F. S. (1976). Discrete mathematical models, with applications to social, biological, and environmental problems. Prentice-Hall. 559.
2. Vishnevsky, A. A. (2017). Economic security and the modern view of its endurance. *Trade unions: problems, experience, recommendations*, 3 (57). 55-58.
3. Roberts, F. S. (1971). Signed digraphs and the growing demand for energy. *Environment a. Planning*, (3). 395-410.
4. Maruyama, M. (1963). The second cybernetics: deviation-amplifying mutual causal processes. *Amer. Scientist*, 5(2). 164-179.
5. Vladimirov, V. A., Vorobyov, Yu. L., Salov, S. S., Faleev, M. I., & Arkhipova, N. N. (2000). Управление риском: Риск. Устойчивое развитие. Синергетика. Moscow. Nauka, 429.
6. Avdiiskii, V. I. (2016). Экономическая справедливость и безопасность экономических агентов. Moscow. Finansy i statistika, 271.
7. Tikhonov, V. E., & Korneev, I. K. (1981). Устойчивость и качество линейных систем. Moscow. Mosk. in-t upr., 30.
8. Shvaiba, D. (2018). Structural stability and socio-economic security of the hierarchical system. *Bulletin of Science and Practice*, 4(6), 233-239.
9. Shvaiba, D. (2018). Socio-economic security of the hierarchical system. *Bulletin of Science and Practice*, 4(6), 248-254.

*Список литературы:*

1. Roberts F. S. Discrete mathematical models, with applications to social, biological, and environmental problems. Prentice-Hall, 1976. 559 p.
2. Вишневский А. А. Экономическая безопасность и современный взгляд на ее содержание // Труд. Профсоюзы. Общество. 2017. №3 (57). С. 55-58.
3. Roberts F. S. Signed diagraphs and the growing demand for energy // Environment a. Planning. 1971. V. 3. P. 395-410.
4. Maruyama M. The second cybernetics: deviation-amplifying mutual causal processes // Amer. Scientist. 1963. V. 5, №2. P. 164-179.
5. Владимиров В. А., Воробьев Ю. Л., Салов С. С., Фалеев М. И., Архипова Н. Н. и др. Управление риском: Риск. Устойчивое развитие. Синергетика. М.: Наука, 2000. 429 с.
6. Авдийский В. И. Экономическая справедливость и безопасность экономических агентов. М.: Финансы и статистика, 2016. 271 с.
7. Тихонов В. Е., Корнеев И. К. Устойчивость и качество линейных систем. М.: Моск. ин-т упр., 1981. 30 с.
8. Shvaiba D. Structural stability and socio-economic security of the hierarchical system // Бюллетень науки и практики. 2018. Т. 4. №6. С. 233-239.
9. Shvaiba D. Socio-economic security of the hierarchical system // Бюллетень науки и практики. 2018. Т. 4. №6. С. 248-254.

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