UDC 338.47+330.522.2

ENTROPY METHODS OF UKRAINIAN TRANSPORT-TECHNOLOGICAL SYSTEMS OPTIMIZATION

ЭНТРОПИЙНЫЕ МЕТОДЫ ОПТИМИЗАЦИИ РАБОТЫ ТРАНСПОРТНО-ТЕХНОЛОГИЧЕСКИХ СИСТЕМ В УКРАИНЕ

Svetlana Ilchenko

Ильченко С.В.

У статті проаналізовані та систематизовані традиційні та існуючі на сьогодні концептуальні схеми та моделі вирішення проблем нелінійного розвитку складних систем, якими є транспортно-технологічні системи. Обґрунтовані можливість та доцільність використання ентропійного підходу до проблем формування та розвитку ТТС в Україні. Проведені підрахунки та запропоновані розроблені математичні моделі для комплексного визначення ступеня підпорядкованості та дезорганізації ТТС.

Introduction.

For the construction of short-term and long-term plans and programs of transport system development, requires a comprehensive and deep analysis, the possibility of which only appears when using a combination of various analytical tools and approaches. The forward-looking estimates have to be made at different levels - starting with the definition of the aggregate demand for all kinds of transport services, and to specific internal routes. At the same time, the very understanding of the category «transport system» means the filling of it related total integrity, consisting of elements of the transport infrastructure and the infrastructure of the subjects of the transport, control systems, state workers, and also vehicles and equipment. The efficiency of such a system should be determined by the balance between the conflicting interests of the company and the demands of the economy of the country, as different manifestations of one and the same process.

A review of recent research and publications.

View of the economy from the efficiency of functioning and development of transport and its major sub-sectors, is the basis of the leading Ukrainian and foreign researchers works. This approach is reasonable and justified, that is confirmed by the results of the papers [1-8]. However, the rapid development of technologies, forming the technological mainstream, will only gain momentum, creating a «background noise» for well-constructed, understood and accepted models of development. The importance and urgency of approaches that take into account new factors have served **the purpose** of a choice of a research direction, the results of which are presented in this article.

The main material for the research.

Considering the transport system as a kind of complexity, in terms of its understanding, not as a simple sum of constituent elements and not as deterministic, not linearly emerging and developing open dynamic equilibrium of the system, the need for a shift to the groups of factors, the extent of the value and effect of which never before had such a decisive meaning as in the present time. System is treated as a complex, if it can be described in several levels. The more there are methods of consideration of a system, the more complex it is, the more sophisticated techniques are needed to describe it, that is the so-called algorithmic complexity.

Therefore, in relation to the transport system requires the theoretical and methodological foundations of the realities understanding, the search for new tools for forecasting and formulation of development strategies, a holistic view of it as a basic element of the national economy in all its complexity, scale, interconnectedness and interdependence.

Traditional theories of looking at the organization of business processes from the elementary composition, using a current and a well-known scheme: analysis - synthesis - planning - control. In spite of the fact that the methods of analysis and synthesis involve the study of the socio-economic phenomena as in parts (analysis), and as a whole (synthesis), for example, the comparison of the economic performance of individual enterprises and industry of the results of economic entities of all Ukrainian transport complex as a whole, providing a systematic, comprehensive approach to the complex multi element objects of the study, however, the existing approaches look at the organization as a structure, striving for order and stability, not focusing its attention on the elements related to chaos, randomness, although it is in this mess are the seeds of the future development and transformation.

The sequence of events should be considered runs through the sequence of bifurcations - select the same opportunities and the rejection of the other, using the two approaches: pessimistic, as a warning about the volatility and instability of the system, and is optimistic, as revealing the possibilities of future development. The challenge is to anticipate these bifurcation, manage their development, formation of risks (Fig. 1) [9].

The great strength of science lies in its ability to establish a link between cause and effect [10]. However, the non-deterministic complex multi-component systems can generate random behavior of changing the usual understanding of the cause-and-effect links associated with the nonlinearity and openness (global) world. And from these accidents it is impossible to get rid of the simple accumulation of large amounts of information. In addition, according to the statement of Jules Henri Poincaré, arbitrarily small uncertainty in the state of the system can grow with time and predictions of the distant future may become impossible [11].

To date, the existing conceptual frameworks and models of the problems solution of non-linear development of events can be conditionally grouped into three blocks:

1) self-organization;
2) dynamic chaos;
3) the concept of complexity, which lies at the junction of two of the first [12].

The concept of «self-organization» implies the existence of a structure and its evolution in a more organized form. With this in spite of the prefix «self», such a system still in need of external influence, as, in order to structure appeared and supported its existence and development, it is necessary to energy interaction with the external environment (the influx of energy (information) from the outside or the outflow of it from the system). As a result of the critical interacting components organize themselves in potentially evolving system, with a hierarchy of new properties, ability to resist entropic trends and adaptability to changing conditions, i.e., the possibility of the need to transform its structure, form the possible variants of behavior and to choose from them the best. Thus demonstrating the existence of flexible criteria of distinction and flexible reactions to external stimuli.

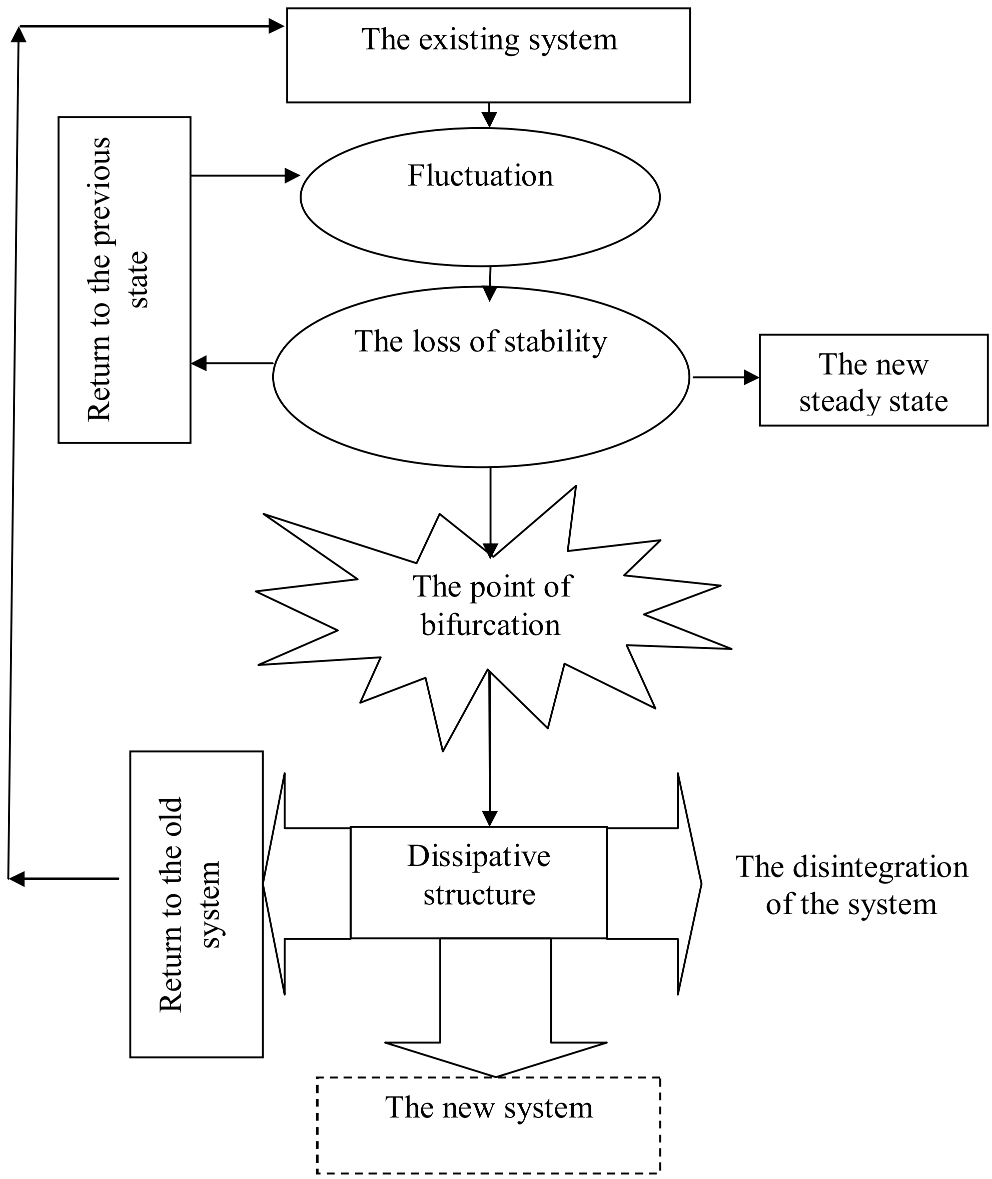

Fig. 1. The mechanism of complex systems development on the self-organization basis

Generalizing, we can summarize that in systems that are far from equilibrium, there are processes of self-organization, leading to the emission of many describing the system of values of a small number of the order parameters - the leading variables, to which arranged all the others. It is important to timely recognize the parameters of the order, which could play a dominant role in the dynamics of the whole system. Important here is the fact, that the use of the order parameter in the analysis of open systems evolution implies establishing functional linkages between the change and the change of external influence factors. G. Haken [13, 14] called order parameter informant order, because the implementation of the principle of subordination in the system and is established order. The evolution of this system is connected with the hierarchy of the information levels: initially the exchange of information is of a casual nature, then there is a competition and cooperation, ending with a new collective state, which is qualitatively different from earlier unordered status, i.e., the level of organization is determined by the level of information on which the system is located. The system, which themselves produce information for self-regulation and self-development, and is the most organized systems. The same understanding of self-organization of G. Haken was defined as the process of ordering (spatial, temporal or spatial and temporal) in an open system, due to the coherent interaction of many elements of its components.

Applying the above approach to the creation of the national transport sector, it is worth noting that the level of the transport system self-organization directly depends on the degree of control it from outside. From this point of view, consideration of the possibility of building a self-organizing system connected with the formation of (or the change) of its organizational-legal form, serving as amended of the control parameter as a new external conditions.

The second important point is the presence of the phenomenon of dynamic chaos in the system, defining the limits of predictability, or the forecast horizon - ending period of time, the dynamic forecast the behavior of the system is possible. A statement of this effect is caused by the fact that in the presence of the job initial state of the system arbitrarily small inaccuracies, it is rapidly increasing in time, leading to the unattainability of predictability in sufficiently large time intervals. That is for chaotic systems is theoretically possible to predict the future outcome, but only in cases, when the initial condition can be determined with absolute precision. Since the absolute accuracy is impossible to achieve, in practice, in the long-term behavior of the system remains unpredictable. In addition, as described above, the system may be subject to fluctuations (in this case not only the first), which even in small able to organize and lead to significant spikes in the development, causing chaotic and uncontrolled behavior of the entire system. Hence, it is necessary to timely recognize the parameters of the order and to take account of the control parameters, which could play a dominant role in the dynamics of the whole system.

And, finally, the third block, which displays the concept of complexity, as paradigms, including the process of self-organization, and the state of dynamic chaos in the system. The transport system is a complex system, subject to the laws of nonlinear dynamics, with its characteristic periods of instability, which, in turn, may lead to the emergence of new ordered structures. Those, in certain periods of time, becoming unstable, give way to new forms of order. That is with a further change of the governing parameters of the dynamics of the system will constantly make new local equilibrium state, which has once again become unstable. Therefore, in modern conditions of management decisions making of special value are the presence and the ability to use the system of knowledge and understanding of the peculiarities of complex dynamic systems, such as transport complexes, in the conditions of growing uncertainty, reducing the cycles of accumulation and renewal of knowledge and skills in a rapidly evolving information society.

Information and communication network of the world scale further increase the level of complexity. It is primarily about Teleworking, Telebanking and Teleshopping on virtual markets, firms, banks and shops, transcending the limitations of time and space. In the area of Electronic Commerce (e-Commerce) virtually sold establish business contacts, exchange of business proposals, as well as the transaction. World network, thus represent public and self-organizing complex systems with millions of consumers, on the one hand and persons and institutions engaged in the proposal, on the other. Nonlinear dynamics of these networks is characterized by an increase diversity of information, but also the possibility of information chaos. The chaotic nature of the economic phenomena creates big problems for the economic agents, who are forced to make decisions that are dependent on the unpredictable future [15].

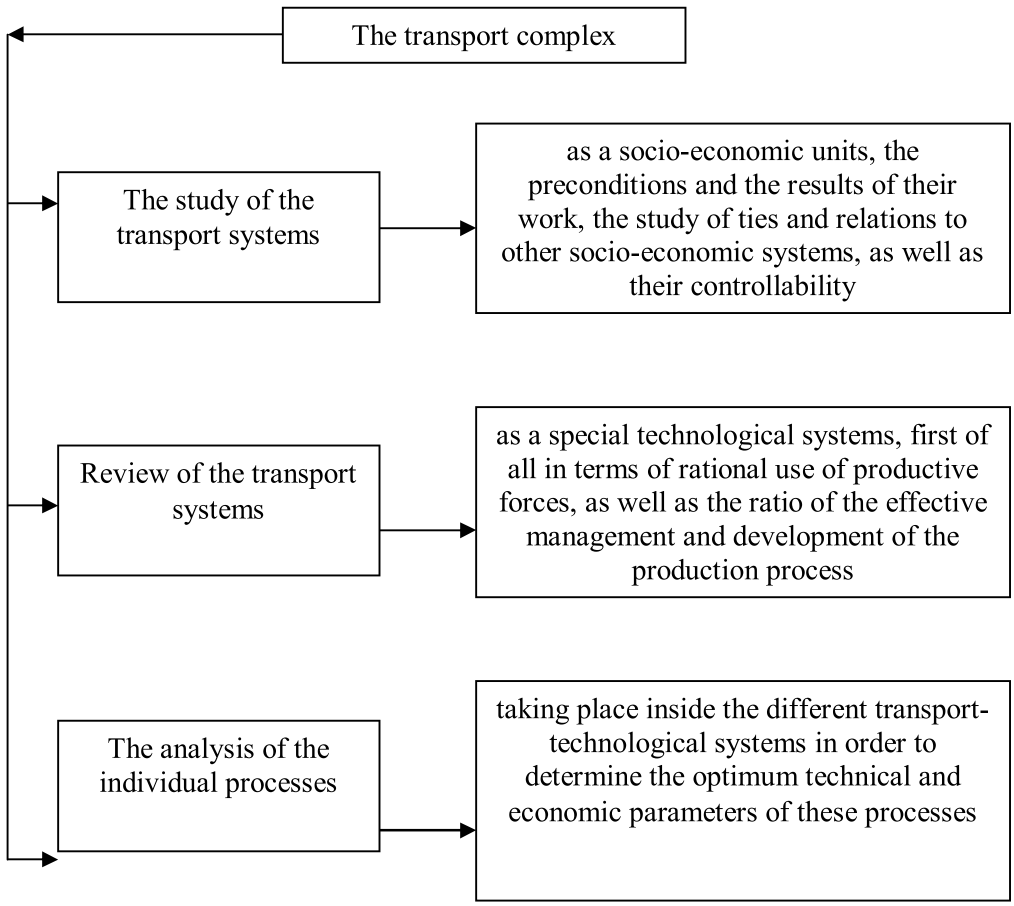

Fig. 2. Stages of the rationalization of a transport complex management on the basis of the system approach

The complexity of the system can be interpreted not only by the non-linearity of the development of events, but also through the definition of a huge number of elements, which have a large number of freedom degrees. This behavior cannot be predicted or extrapolated from the past. Deterministic description of the individual elements can be replaced by the evolution of the probability distributions. Conduct a quantitative analysis of random events, assessing the degree of possibility of their appearance, you can using the mathematical theory of probability.

Practice shows that the more often you receive event under the conditions of observation, the higher its degree of probability. This position is based statistical interpretation of probability, which considers not some random events, and random events mass, recurring nature. And although the behavior of a single element, or of some ensemble remains a random, but the cumulative interaction of a large number of accidents gives a possibility to estimate the probability of sustained behavior of their whole ensemble as a whole. Thus as a result of the interaction of many accidents there is a certain regularity and stability in the behavior or the functioning of the aggregate or system, which is called statistical regularity [16].

Returning to the transport sector, it should be noted that the examination of his as an integral organism on the basis of its systems diversity and conditions for their work, implies the following (Fig. 2).

As with the systemic approach focuses on the construction of the transport sector as a whole, all of the components considered in their relationship to the specified their essence.

With the use of a system approach assumes that the building starts with the setting of objectives for the entire system in the complex. Then there are different organizational structures and components that are relevant to each other in the framework of this system. Criteria for the determination of the components totality form the basis for selection of some of them. However, the hierarchical growth of the diversity of the element base and the structural composition of the system, as well as the length of the desired forecast is growing and its complexity. In turn, this diversity in the management of the dynamic transport system, where the main is the human factor, inevitably leads to the emergence of chaos, due to, first of all, availability of various purposes and values.

Any system without exception contain features of entropy and of antientropy, or negentropy, that is features of the disorder (chaos) and order, uncertainty and certainty, disorganization and organization of them [17]. The factor of entropy as a quantitative measure of uncertainty, disorder, disorganization (chaos) is universal. In the scientific literature there are several definitions of entropy, however, as for the topic of our study, let us focus on two of them - the definition of entropy as:

- measures of the uncertainty of any system behavior;
- measures of the information uncertainty, which provides information about a particular system.

Open system communicated with the external environment of matter, energy, information and due to this change its structure, improve the orderliness, the organization and reduce its entropy and increase the coordination and organization of their structure (that is its negentropy) mainly due to the increase of entropy in the environment.

In fact, for any change of an open system status and change its entropy $\Delta Э$ can be divided into two components:

$$\Delta Э = \Delta Э_1 + \Delta Э_2 \qquad (1)$$

where ΔЭ, is the change in entropy of the system through the exchange of (receiving) of the system with the external environment energy, material, information, and $\Delta Э_2$ there is a change of entropy as a result of the processes occurring within the system itself without the influence of the external environment. If the change $\Delta Э_1$ due to the impact of the external environment through energy, information, substance is directed toward the reduction of the non-equilibrium, creating new opportunities, the change in the $\Delta Э_2$ spontaneously is always directed to its growth, balance. For irreversible processes is always $\Delta Э_2 > 0$, and for the reversible - $\Delta Э_2 = 0$.

Because of the second law of thermodynamics for any systems, including open takes place $\Delta Э_2 > 0$, then the general decrease of entropy and increase the level of organization of open systems is possible only at the expense component of $\Delta Э_1 < 0$. It is obvious that to improve the organization of the open system it should be non-equilibrium, and therefore $Э < Э_{макс}$. It is known that non-equilibrium systems are more organized than the equilibrium and have less entropy [17].

Entropy is the main parameter characterizing the degree of the system organization, that is its chaotic nature or orderliness. The degree of the system organization is realized as the ratio of chaos and order, thus as a source of development. Order and chaos are the qualitative differences, which lie in the basis of development, and, therefore, can be used as a basis of harmony and its measures. However, the important point is the ratio, it is the chaos and order can create harmony, and not the preference of one of them. As a measure of chaos can be used entropy.

The mathematical content of entropy is expressed function

$$H = \sum_{i=1}^{n} p_i \; log_2 \, p_i \qquad (2)$$

where

H – the value of entropy of the system;

p_i – the probability of the i-th event, element of the system.

The properties of this function expresses the regularity of transition casual relationships (originating in the chaos) in connection deterministic and ordered. The symbol p in this function shows the probability of occurrence of the event i.

The universality of the entropy function is that it characterizes the organizational process, the process of transition from the individual to the whole. The analysis of the given function allows to reveal the internal structure, the organization of the studied system. Set a universal dependence of the entropy values on the ratio of its events or elements. If all events or elements of the functions are distributed equally probable or homogeneous, then the system does not have the structure, organization, and, therefore, is chaotic. The function of entropy at this maximum. If the probability density of the system of re-distributed - something more, something less, this testifies to the structuring of the system, its organization and order [18].

The same source states that in the world there are no systems in which all events or elements would be absolutely sect or uniformly distributed in space. Of course, that the real systems have entropy, located between the maximum and minimum value. The harmonious same value must be expressed ratio of chaos and order and be between the maximum and the minimum value of the entropy. For the characteristics of a harmonious state of the system function is used:

$$D = H / (H_{макс.} – H) \quad (3)$$

where H characterizes the measure of disorder, chaos system,

$(H_{макс.} - H)$ — the measure of the structural organization of the system.

The stability of the system is determined by the relationship of the measures values of order or disorder for the corresponding parameters for the method of Fibonacci and "Golden proportion". It is established, that in the phenomenon of "the Golden proportion" (geometric mean of the ratio of the "Golden proportion" (2/3 = 0,618 and 1/3 = 0,382)) are not only the fundamental proportions, but also the basic metric that can harmonize the many technical, economic, financial, social and other relations [18]. The entropy is equal to the quantitative measure of disorder only if postulate of equal probability events. As for the General case, when the not equal probability events entropy is equal to the sum of the measures disorder and order.

In order to be able to compare the system with a different set of elements, we introduce the category of relative entropy:

$$H_{отн.} = H / H_{макс.} \quad (4)$$

Determination of the $H_{макс.}$ it is expedient to make the following:

$$H_{макс.} = log_2 N \quad (5)$$

where N - the total number of discrete events, the elements of the system.

The division of relative entropy interval in the ratio of 0,382 : 0,618 is a characteristic of the harmonic state of the system, its entropy-harmonic norm of the systems organization (EHNSO).

Thus from this point of view harmonious system can be defined as such for which the characters are a number of signs, namely:

- coherent coupling, the unity of all elements of the system;
- is a dialectical unity and struggle of opposites, certainty and uncertainty, of order and chaos;
- measure, i.e., specific value of redundancy, the ratio of the level of order and disruption of the system;
- proportionality, expressed in the desire to complete a self-organizing system in its structure to the value of the «Golden section» order and chaos.
- equilibrium or the balance between order and disorder, between the organization and dislocation;
- rationality and clarity as the logical, orderly and organized by building a harmonious system;

- compliance or the appropriateness of the interconnectedness and the harmonious combination of all elements in a single system, where each is assigned a specific function.

Before considering the practical interpretation of the above arguments and determine quantitatively the degree of the structure of the Ukrainian transport complex management harmonization, we should note that the value of the relative entropy in the interval from 0 to 1, it should be divided into three ranges:

- from 0 to 0,382 is characterized by a high consistency and structuring, which require considerable efforts and internal stresses;

- zone of very low values of entropy, which can lead to a complete breakdown of the whole system;

- values of the relative entropy of 0,382 to 0,618 testifies to the fact that the system in the greatest degree is capable of self-organization, resource-saving and effective functioning;

- from 0,618 to 1,0 system has increased freedom, which the values of relative entropy is close to unity can go into chaos.

Table 1

The number of EDRPOU by types of economic activity

	on 01.01.11	on 01.01.10	on 01.01.09	on 01.01.08
Total	**1203492**	**1166517**	**1135929**	**1092657**
Agriculture, hunting, forestry	85253	85471	86191	86567
	on 01.01.11	on 01.01.10	on 01.01.09	on 01.01.08
Fishing, fish farming	2132	2064	1954	1836
Industry	127503	125303	124634	122781
Construction	91457	90402	90048	85820
Trade: repair of motor vehicles, household appliances and items of personal use	324368	313257	307760	299887
The activity of hotels and restaurants	22877	22340	22072	21718
The activity of transport and communication	**42642**	**40608**	**39079**	**37210**
Financial activity	18477	18629	19041	18401
Operations with real estate, leasing, engineering and granting services to entrepreneurs	177090	167626	158000	143914
Public administration	52172	51888	51485	50794
Education	46311	45541	43913	42592
Protection of health and the provision of social assistance	34699	33202	30653	28947
Provision of communal and individual services; activities in the sphere of culture and sports	178511	170186	161099	152190

Source: Statistical yearbooks of Goskomstat of Ukraine [19].

Look at the economic structure of Ukraine through the indicator of the number of various organizational-legal forms enterprises, according to the official data of State Statistics Committee of Ukraine:

Table 2

The number of EDRPOU by organizational-legal forms

	on 01.01.11	on 01.01.10	on 01.01.09	on 01.01.08
All over Ukraine	**523230**	**523727**	**516536**	**501984**
Farm	49514	49764	50126	50023
Private enterprise	285821	283697	278574	270331
Government enterprise	6661	6811	6975	7213
Municipal	15726	15994	16336	16636
Subsidiary company	19908	20408	20973	21648
Foreign enterprise	2247	2272	2307	2323
Joint-stock company	28748	30169	31100	31993
Organization, institution:	110074	108552	104024	101817
government	15926	15786	16035	16801
	on 01.01.11	on 01.01.10	on 01.01.09	on 01.01.08
municipal	66242	65308	61450	63910
private	950	907	887	859
other	26956	26551	25652	20247
Associations, corporations, consortia and concerns	4531	6060	6121	6 107

Source: Statistical yearbooks of Goskomstat of Ukraine [19].

We determine the relative entropy in a system with discrete elements, with the transform (2) in the formula of the type of:

$$\mathrm{H} = \sum_{i=1}^{N} \frac{K_i}{N} \, x \, log_2 \frac{K_i}{N} \qquad (6)$$

in which the probability is replaced by the attitude of the K_i / N, where

N – the total number of discrete events, the elements of the system;

K_i – the total number of i- th the events element of the system

Taking advantage of the property of addictively of entropy imagine a formula to determine the entropy of the system in the following form:

$$S = \sum_{i=1}^{N} S_i \qquad (7)$$

S_i – the entropy of subsystems;

N – the number of all subsystems of system elements.

The calculated data are presented in table 2.

Table 2

The relative entropy of economic activity dynamics through the number of EDRPOU by types of economic activity and their organizational-legal form

	on 01.01.11	on 01.01.10	on 01.01.09	on 01.01.08
The relative entropy, $H_{отн.}$				
All kinds of economic activities	0,155	0,156	0,156	0,157
The activity of transport and communication	0,171	0,169	0,167	0,166
On the organizational-legal form	0,12	0,11	0,11	0,11

The degree of the system organization is determined by the number contained in the system entropy. The analysis of the submitted data in the table shows that the economic system of the country, estimated through the structure of economic activity types and the current composition of the enterprises on their organizational-legal form, is characterized by a high consistency and structuring, which require considerable efforts and internal stresses. In the dynamics we observe extremely small, but all the same, the movement towards greater structuring by type of activity, but in respect of the transport enterprises and communication, as well as organizational-legal forms of enterprises is the same slow, but still doable transformation in the direction of providing large degrees of freedom. And even though the ability to self-organization, resource-saving and effective functioning on their basis is still very far away, statistics show slow progress in this direction.

Try to quantify the degree of Ukrainian economic system isolation/openness. It is obvious that in this case it is appropriate to use the ratio of:

for open systems – $H_1 < H_2 < .... < Hi$ (8)

for isolated systems– $H_1 \geq H_2 \geq .... \geq Hi$ (9)

Into an application to the data obtained with very high accuracy of the Ukraininan economic system can be described as open. However, all processes even the process of self-organization and self-development occur with the energy dissipation, which with time may convert such systems in entropy, from which it follows that the isolated system, it's not only the system does not interact with the environment, but also those which, in this environment does not find conditions sufficient for self-development. Therefore, they vary in the direction of increasing entropy, up to the complete degradation and the collapse of the [20].

Note three important features. The first is the fact, that used to calculate formula of Claude El. Shannon operates the category of «information» without filling its semantic content, degree of usefulness or uselessness of the value and importance for the whole system and its users. The second peculiarity consists of the fact that the settlement of this technique is possible only for equilibrium systems with discrete statistical probability distribution, which minimizes the expediency of its use, since in reality reversible processes, i.e., finding of the system in a state of equilibrium, is not observed, because every economic and social process takes place in time, and time is inherent in the property of irreversibility. On the other hand, methodologically acceptable fix reversible processes, but only in cases, when a state change, which is the system under consideration, is irrelevant to the original from the point of view of the studied parameters. And the third specific feature - it is a record of the time factor. As mentioned, in equilibrium systems this parameter is not taken into account, however, in irreversible processes it plays an essential role. Therefore, (1) require adjustments:

$$\Delta Э/t = \Delta Э_1/t + \Delta Э_2/t \tag{10}$$

where indicator $\Delta Э_2/t$ characterizes the global production of the whole system entropy.

To open system is characterized by an interchange with the external environment, i.e. the presence of incoming and outgoing streams. Therefore, the expression (9) can take the following values

at $\Delta Э/t > 0$ – the growth of internal entropy is not compensated by the inflow of negentropy, bringing the system in equilibrium state and as a result increases the growth of entropy;

at $\Delta Э/t = 0$ – the system is in a steady state with the constant increasing of entropy;

at $\Delta Э/t \leq 0$ – there appear conditions for development, the emergence of new structures, the growth of order.

Information entropy can be recorded and for the case of a continuous random variable *x* with distribution function *f(x):*

$$\mathrm{H} = -\int f(\mathrm{x})\, log_2\, f(\mathrm{x})\, dx \tag{11}$$

$$\text{at} \int f(\mathrm{x})\, dx = 1 \tag{12}$$

With the account of entered symbols in formulae (1) and (9) and in relation to the definition of the effectiveness work of transport-technological systems in the economy of the country in the entropy of the whole system is proposed to use the following mathematical model constructed with the account of external and internal factors:

$$\Delta Эттс/\mathrm{t} = -\int_A^B f(K_i\, L_j S_v)\; log_2\, f\left(K_i\, L_j S_v\right) dx\text{-}$$
$$\int_A^B f(C_k B_n D_u)\; log_2\, f\;(C_k B_n D_u)\, dy \qquad (13)$$

where K – valuation outside the transport of socio-economic factors (macroeconomic indicators of the country's economy, the level of inflation, demographic indicators, etc.), have a direct impact on the work of all transport-technological systems;

L - market factors, expressed through the dynamics of price changes in the conjugated product markets, fluctuations in the capital markets and labour.

S – the legislative-legal, assessed through the possible effect of their introduction for each separate kind of TTS;

i, j, v, k, n, u – the coefficients of elasticity in relation to each of the criteria;

C – the complexity of the process of transportation and handling of goods in terms of value;

B – the cost of the capital assets of each individual TTS;

D – intensive factor that is linked to the innovative development of the TTS and contributing to the reduction of time and terms of delivery and handling of goods.

y – the indicator of the volume of each type of TT system;

x- the volume of incoming flow;

A – the initial state of TT system, in time *t*;

B – the final state of CT system, in time *t*.

Conclusions.

According to the theory of deterministic chaos [21, 22, 23] the development of the system can be presented as a change of sustainable ordered states through periods of chaos (bifurcations) with the ever increasing complexity of these states, and it is chaos contributes to the self-organization of the system in the new steady state, under the influence of the governing factors. It should be noted that the well-known synergetic models allow only qualitatively at the conceptual level, to explore the influence of different internal and external factors on the degree of nonlinearity of the trajectory of the behavior of the transport-technological system economic parameters and the level of its development. It must be borne in mind that the very concept of development is a complex integrated process involving both advances and regress. Proposed in the article methodological approach to the evaluation of the degree of alignment and disorganization of TTS on the background of the general economic situation in Ukraine, gives the chance to make their quantitative assessment and to identify the factors and causes that contribute to the occurrence of a causal conditionality of the ongoing processes. German scientist Georg W. F. Hegel argued that no system can be completely regulated, self-agreed, and it means, and autonomous only by internal means.

Knowing that the non-equilibrium systems are more organized than the equilibrium and have less entropy, we can say that the complex TTS is a dynamic open system in nonequilibrium state, which at any moment can return to the equilibrium state, if the flows, supporting the non-equilibrium state, disappear. I.e., in order to TTS performed its functions, and thus contributed to the creation of the servicing welfare the needs of its employees and users of its services to the population, in addition to the internal prerequisites and conditions, there are certain external - economic, social, legal, political and other conditions or the control parameters. The value of which is further enhanced in the present rapid development of information and communication technologies and the formation of a new technical-technological background.

Since such a complex of transport-technological system can not be considered as a simple sum of its component elements, already from the very first stages of its development based on the principles of synergies with the emergence of unconditional it has emergent properties, the slightest fluctuations of the initial conditions or the growth of entropy is included in the system of flow can lead to unpredictable and uncontrollable consequences, opposition which in the initial stages, in the opinion of the author, and can serve as a proposed methodological approach.

Reference

1. Буркинский Б. В., Котлубай А. М. Украина в ВТО: проблемы и перспективы развития // Экономика Украины. Киев: Пресса Украины, 2009. — Вып. 10 (567). — С. 76 — 87.

2. Котлубай О. М. Україна в світовій морській торгівлі // Экономические инновации, сборник научных работ. ИПРЭЭИ НАН Украины — Одеса, 2009 — Вип. 39. — С. 7—18.

3. Бакаев А. А., Пирожков С. И., Евенко В. Л., Бакаев Л. А., Кутах Ю. Л. Международные транспортные коридоры Украины: сети и моделирование. — К.: КУЭТТ, 2003. — 493 с.

4. Примачев Н. Т. Экономические основы функционирования морского рынка транспортных услуг / Н. Т. Примачев и др. — Одесса: Артограф, 2004. — 320 с.

5. Цветов Ю. В. Основы организации транспортного обеспечения внешнеторговых связей Украины / Ю. В. Цветов и др. — К.: ОАО «ИКТП-Центр», 2000. — 276 с.

6. Чекаловец В. И. Эволюция мировой портовой системы и ее влияние на стратегию развития морских торговых портов Украины // Транспорт, 2003. — № 25-26 (245 — 246). — С. 61-66.

7. Кулаев Ю. Ф. Анализ транспортно-экономических связей Украины и оценка их эффективности / Ю. Ф. Кулаев, М. В. Воробьева // Системні методи керування, технологія та організація виробництва, ремонту і експлуатації автомобілів: Зб. наук. пр. — К.: НТУ, ТАУ, 2000. —. Віп. 10. — С. 150-154.

8. Дикань В. Л. Становление и развитие транспортной системы путем создания торгово-транспортной сети «DOOR-TO-DOOR» [Текст] / В. Л. Дикань // Вісник економіки транспорту і промисловості: Зб. наук. праць. — Харків: УкрДАЗТ. — 2007. — № 18. — С. 68 –70.

9. Горелов А. А. Концепции современного естествознания: [уч. Пособие, практикум, хрестоматия] / А. А. Горелов. — М.: Гуманит. изд. центр ВЛАДОС, 1998. — 512 с.

10. Кратчфилд Д. Хаос / Джеймс П. Кратчфилд, Дж. Дойн Фармер, Норман Х. Паккард, Роберт С. Шоу // В мире науки, 1987. — № 2. — С. 16 — 28.

11. Пуанкаре А. Теория вероятностей. / А. Пуанкаре. — М.: НИЦ «Регулярная и хаотическая динамика», 1999. — 280 с.

12. Подлазов А. В. Теория самоорганизованной критичности — наука о сложности / А. В. Подлазов // Будущее прикладной математики. Лекции для молодых исследователей. — М.: Эдиториал УРСС, 2005. С.404 — 426.

13. Хакен Г. Информация и самоорганизация. Макроскопический подход к сложным явлениям / Г. Хакен; [пер. с англ. Ю. А. Данилова]. — М.: Мир, 1991. — 240 с.

14. Haken H. Erfolgsgeheimnisse der Natur. Synergetik: Die Lehre vom Zusammenwirken. (rororo Sachbuch) / H. Haken — Reinbek bei Hamburg, 1995. — 314 с.

15. Майнцер К. Сложность бросает нам вызов в XXI веке: динамика и самоорганизация в век глобализации / Клаус Майнцер — Режим доступа к документу: http://spkurdyumov.narod.ru

16. Философия: Энциклопедический словарь / под ред. А. А. Ивина. — М.: Гардарики, 2004. — 1072 с.

17. Прангишвили И. В. Энтропийные и другие системные закономерности: Вопросы управления сложными системами / И. В. Прангишвили // Ин-т проблем управления им. В.А. Трапезникова. — М.: Наука, 2003. — 428 с.

18. Подлесных В. И. Теория организации: [учебник для вузов]. / В. И. Подлесных. — СПб.: Издательский дом «Бизнес-прессa», 2003. — 336 с.

19. Держкомстат України. Статистична інформація. [Електроннний ресурс] — Режим доступу до документа: http://www.ukrstat.gov.ua/

20. Алексеева И. Ю. Проблема интеллектуального суверенитета в информационном обществе / И. Ю. Алексеева // Информационное общество, 2001. — № 2. — С. 5 — 9.

21. Баранцев Р.Г. Синергетика в современном естествознании. / Р. Г. Баранцев. — Едиториал УРСС, 2003. — 144 с.

22. Николис Г. Самоорганизация в неравновесных системах. / Г. Николис, Н. М. Пригожин. — М.: Мир, 1979. — 412 с.

23. Хакен Г. Синергетика. / Г. Хакен. — М.: Мир, 1980. — 345 с.

Аннотация

Для построения краткосрочных и долгосрочных планов и программ развития транспортной системы, необходим всесторонний и глубокий ее анализ, возможность которого появляется только при использовании комбинации различных аналитических инструментов и подходов. При этом прогностические оценки должны быть произведены на разных уровнях – начиная с определения совокупного спроса на все виды транспортных услуг, и заканчивая конкретными внутренними маршрутами. В то же самое время само понимание категории «транспортная система» подразумевает наполнение ее связанной совокупной целостностью, состоящей из элементов транспортной инфраструктуры и инфраструктурных субъектов перевозки, системы управления, штата работников, а также транспортных средств и оборудования. Эффективность такой системы должна определяться балансом между противоречащими друг другу интересами общества и требованиями экономики страны, как различными проявлениями одного и того же процесса.

Взгляд на экономику с точки зрения эффективности функционирования и развития транспорта и основных его подотраслей, составляет основу работ ведущих украинских и зарубежных исследователей. Такой подход обоснован и оправдан, что подтверждают результаты трудов [1-8]. Однако ускоренное развитие технологий, формирующее технологический мейнстрим, будет только набирать обороты, создавая «фоновые шумы» для четко выстроенных, понятных и принятых моделей развития. Важность и безотлагательность подходов, учитывающих новые факторы, послужили целью выбора направления исследования, результаты которого представлены в данной статье.

Традиционные теории смотрят на организацию хозяйственных процессов с точки зрения поэлементного их состава, используя сложившуюся и хорошо себя зарекомендовавшую схему: анализ – синтез – планирование - контроль. Несмотря на то, что методы анализа и синтеза предполагают изучение социально-экономических явлений как по частям (анализ), так и в целом (синтез), например, сопоставление экономических показателей работы отдельных предприятий и общеотраслевых результатов хозяйствования всего транспортного комплекса Украины в целом, обеспечивая системный, комплексный подход к сложным многоэлементным объектам исследования, тем не менее, существующие подходы смотрят на организацию как на структуру, стремящуюся к порядку и стабильности, не сосредотачивая свое внимание на элементах, относящихся к хаосу, случайности, хотя именно в этом беспорядке находятся ростки будущего развития и преображения.

Информационные и коммуникационные сети всемирного масштаба еще больше увеличивают уровень сложности. Речь идет прежде всего о Teleworking, Telebanking и Teleshopping на виртуальных рынках, в фирмах, банках и магазинах, преодолевающих ограниченность времени и пространства. В области Electronic Commerce (электронной торговли) виртуально реализуются установления деловых контактов, обмен деловыми предложениями, а также трансакции. Всемирные сети, т.об., представляют собой открытые и самоорганизующиеся сложные системы с миллионами потребителей, с одной стороны, и лиц и организаций, осуществляющих предложение, - с другой. Нелинейная динамика этих сетей характеризуется повышением многообразия информации, но также и возможностью информационного хаоса. Такой хаотический характер экономических явлений создает большие проблемы для экономических агентов, которые вынуждены принимать решения, зависящие от непредсказуемого будущего.

Энтропия — главный параметр, характеризующий степень организованности системы, то есть ее хаотичность или упорядоченность. При этом степень организации системы реализуется как соотношение хаоса и порядка, т.об. являясь источником развития. Порядок и хаос представляют те качественные различия, которые лежат в основе развития, а, следовательно, могут быть положены в основу гармонии и ее меры. Однако важным моментом является соотношение, именно соотношение хаоса и порядка может создать гармонию, а не предпочтение одного из них. В качестве меры хаоса может быть использована энтропия.

Универсальность энтропийной функции заключается в том, что она характеризует организационный процесс, процесс перехода от единичного к целому. Анализ данной функции позволяет выявить внутреннюю структуру, организованность исследуемой системы. Установлена универсальная зависимость значения функции энтропии от соотношения ее событий или элементов. Если все события или элементы функции распределены равновероятно или однородно, то данная система не имеет структуры, организованности и, следовательно, является хаотичной. Функция энтропии при этом максимальна. Если же вероятность или плотность системы перераспределена — чего-то больше, чего-то меньше, это свидетельствует о структуризации системы, ее организованности и упорядоченности.