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Енергоентропія є «вищим» показником стану організації, розвиваючи ідеї ефективності та цін-ності. Інтегральність полягає в урахуванні рівня порядку в організації (інформаційної ентропії) разом із здатністю ефективно «вивільняти» енергію для корисної роботи. Універсальність забезпечується незалежністю від роду діяль-ності організації. Запропоновано формалізацію енергоентропії організацій. Відповідно до пропо-нованого підходу, енергоентропія визначається: приростом сумарної енергії і його співставленням з «ідеальним» варіантом; рівнем вільної енер-гії та інформаційної ентропією, яка відображає здатність структури організації забезпечува-ти певні результати. Основні параметри стану організації – вхідна та вихідна (вільна) енер-гія. Їх комбінація визначає приріст енергії, без-ліч можливих комбінацій – інформаційну ентро-пію. Ідентифікована схема зміни в часі основних «енергопараметрів» організації.

Представлені два основні варіанти динаміки приросту енергії, як підсумку комбінації вихід-ної і вхідної енергій, – рівномірне зростання і зростання з прискоренням (уповільненням). Проведені експериментальні дослідження, які полягали в розгляді формалізацій найбільш мож-ливих варіантів динаміки впливаючих параме-трів. Проаналізовано вплив різних комбінацій їх динамік (одночасне зростання/зниження, зростання/зниження з різною швидкістю) на динаміку енергоентропії. Встановлено, що збіль-шення частки вільної енергії не забезпечує відтік енергоентропії без зменшення ступеня невизначе-ності результатів, що виражається в зниженні інформаційної ентропії. Зроблено висновки щодо необхідної динаміки параметрів для забезпечен-ня життєдіяльності організації згідно енергоен-тропійной концепції

Ключові слова: інформаційна ентропія, віль-на енергія, ефективність енергообігу, структура організації, формування негентропии

CONSTRUCTING AND INVESTIGATING A MODEL OF THE ENERGY ENTROPY DYNAMICS OF ORGANIZATIONS

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1. Introduction

From the point of view of system methodology, an organization is a system that exchanges energy, informa-tion, and substance with the environment, where the uni-versal equivalent of any kind of resource – money – acts as energy. The existence of energy exchange determines the existence of the corresponding entropy, which in [1] was determined as the organization's energy entropy. The introduction of such a term was based on the need to clearly identify entropy, related to the energy exchange, as the organization is also characterized by the existence of information entropy. It should be noted that the term "organization" in this case implies generalization of orga-

nizations, enterprises, and companies of different spheres of activity.

This view of the organization, coupled with the universality of the law of energy conservation [2] and the idea of the existence of entropy (energy entropy) not only in physical systems [3], led to the formation of an energy-entropy concept of an organization. According to this concept, energy entropy acts as a characteristic of the state of energy turnover of an organization, being a universal tool to assess its operation and development efficiency.

An organization is a system, the state of which is changing rapidly, which affects energy entropy as an appropriate indicator of the state. According to thermodynamics, the change in entropy is of interest to assess the state of a system. Similarly for an organization, it is the dynamics of energy entropy that makes it possible to judge the real state of an organization and the emerging trends.

The relevance of the research in this area is determined by the lack of appropriate studies, the need for which is due to the inability of existing approaches to give a full and adequate assessment of the state of organizations under existing conditions. Energy entropy is the development and integrator of the ideas of efficiency, competitiveness, value, and sustainability, providing versatile and comprehensive evaluation, which is relevant for the management of modern organizations.

2. Literature review and problem statement

As previously mentioned, the idea of the universality of entropy as a measure of assessment of energy dissipation for systems of different nature was substantiated in papers [2, 3]. In recent decades, attempts were made to identify the essence and to describe the behavior of entropy for businesses and organizations.

The category "entropy" originates in thermodynamics [2]. Further development of science led to the emergence of information (structural) entropy as a measure of chaos (order), uncertainty. Within statistical physics, these two types of entropy became interconnected at the theoretical level.

For organizations and enterprises, the situation is opposite – first information entropy was used in the context of organization management [4–7]. In these papers, information entropy acts as a universal tool to assess the external environment of organizations in terms of uncertainty, as an addition (or opposition) to traditionally used methods of the probability theory. Moreover, the object in these studies is both organizations in general and their separate processes [5, 6].

It should be noted that one of the methods in the existing studies is a combination of information entropy with various mathematical (statistical) methods, for example, with regression analysis [7] and the game theory [8]. Thus, the use of entropy offers a great opportunity compared to traditional approaches. Information entropy becomes an indispensable tool in the design of systems of different natures: for example, in papers [9, 10], and the basis of the entropy approach is offered for the solutions for urban and regional systems. This applied development of the idea of information entropy is explained, among other things, by the inability of traditional methods of the probability theory and mathematical statistics to "cope" with the description of uncertainty.

Shannon's entropy is also indispensable in the study of self-organization processes and structures, regardless of the kind of systems, the examples of such papers can be in papers [11, 12].

When it comes to the energy aspect, the situation is the opposite. It is possible to state a practical lack of substantive research in this area related to organizations, except for only a few works. This situation is explained by the complexity of the essence of energy entropy for the systems of non-physic nature, as well as the inability to establish energy entropy in an experimental way.

Nevertheless, it is worth noting a series of publications [13–16] that have formed certain preconditions for the energy entropy concept of an organization, the main provisions of which are outlined in the form of their generalization and further development in papers [1, 17]

Papers [1, 13–17] propose the category of "energy entropy" as the "highest form" of the universal indicator of the state of organizations, developing the idea of "value" and the value concept of organizations [18–21]. Thus, according to [17], classic economic efficiency and the broader concept of "value" was changed into "energy entropy" as a criterion for efficiency and viability of an organization.

In article [13], the law of energy conservation was formulated and the basic categories of thermodynamics (energy, free energy, temperature, dissipation) are interpreted for social systems. In this case, energy entropy is defined as "a payment for a structure" or, otherwise, it can be formulated as energy consumption for the formation of a certain order in a system. In articles [14, 15], similar reasoning is presented for enterprises, in article [15], energy entropy determines the degree of "rejection", which, in fact, is a direct reflection of a viability degree, if to think in terms of [1, 17].

However, it should be noted that in these studies [15–18], the authors do not provide specific methods for determining energy entropy and describing its dynamics. The focus is on identifying the essence of energy entropy at a descriptive level and justifying the fact of its existence in the systems under consideration. This situation is explained by the need for "content" rather than "mechanical" interpretation of the second beginning of thermodynamics for systems of non-physical nature. This should serve as a foundation for further formalization

It was substantiated in paper [1] that energy entropy manifests itself in conjunction with information entropy at the organization level. Since it is impossible for organizations to clearly identify all variants of structures, it was substantiated in [17] that the structural entropy of organizations is transformed into informational entropy, reflecting a set of possible variants of state. Thus, the effectiveness of a structure is manifested in its results, and energy efficiency [17] and the order are interconnected, which is theoretically proved in research [16]. In addition, research [16] provides mathematical proof that if a system (regardless of its nature) has certain properties, it is inherent in entropy in a thermodynamic context. The authors also suggest that enterprises fall into this category of systems.

As previously noted, it is not the very importance of energy entropy that has the value for the analysis of a situation, but its dynamics. In paper [22], the given problem is addressed for open systems at the conceptual level. Since the energy entropy theory of organizations is just being formed, the issues related to the dynamics of energy entropy are not considered even at the conceptual level, leave alone in terms of determining the mechanisms of influence on this dynamic. Only article [13] contains a proof-free claim that at

an increase in the system's energy, energy entropy decreases (this statement referred, in particular, to social systems). This statement is controversial and requires a separate study, though.

According to classical thermodynamics, energy entropy increases over time, unless there is no energy outflow into the external environment, in other words, there is neg-entropy, which, according to Schrödinger, "feeds all living organisms" [23]. In [14], it was substantiated at the conceptual level that entropy outflow from an open system can only occur if the system develops progressively, which the organizations should actually aspire to. Thus, the viability of organizations is ensured by neg-entropy, and this is possible with their progressive development.

The above suggests that the versatility of energy entropy in terms of the scope of activity of organizations and its "integrity" in the context of accounting for information (structural) entropy determines the need for appropriate research into its dynamics. Such studies are aimed at forming the energy entropy theory of organizations based on the relevant concept.

3. The aim and objectives of the study

The aim of the study is to model the dynamics of energy entropy of organizations. This will help to determine, on the one hand, the factors of an increase in energy entropy; on the other hand, to establish the sources of its decrease for a specific organization under specific circumstances.

Achievement of the aim is related to a sequential solution of the following tasks:

– to formalize energy entropy of an organization in accordance with the energy entropy concept;

– to develop a model of dynamics of the energy entropy of an organization;

– to perform experimental studies of the model of energy entropy dynamics.

4. Formalization of the energy entropy of organizations

The energy entropy concept of an organization is based on the versatility of the energy balance, which can be represented in the form [11]:

$$U = A + \Delta U + Q = A + \Delta U + T \cdot S, \qquad (1)$$

where U is the total energy of an organization; ΔU is an increase in energy; A is labor; Q is the heat that is formed under the influence of T temperature and S energy entropy.

The above are the basic categories of thermodynamics, which have quite definite content for such specific systems as organizations [8]:

– "energy" U is the assets and resources of an organization;

– "work" A is the fulfillment of the basic function of a system (for example, product manufacturing or rendering a service);

– "increase in energy" ΔU is the increase in energy due to its arrival in an organization from outside (for the performed work, first of all);

– "heat" Q is energy consumption to maintain the system relations of an organization itself and its interrelations with the external environment (according to [13] – payment for a structure);

– "temperature" T is the relative indicator of the state of an organization compared to some ideal state [13, 15, 16];

– "entropy" S is the indicator of the state of an organization in the contest of its energy losses (dissipation) in the process of energy turnover.

Thus, energy entropy is a characteristic of the state of an organization in terms of efficiency of its energy turnover, which, in turn, is a result of the "arrangement" of the organization itself and construction of its relationships with the external environment. That is, energy entropy reflects at the energy level the order an organization and the part of the external environment the organization directly interacts with (consumers, suppliers, intermediaries, etc.).

To describe and investigate the energy turnover of an organization, (1) can be reformulated in terms of the "incoming-outgoing" energy flow [13], which more reflects the specifics of an organization as an energy-turnover system. Thus, in the process of operation, the organization uses a part of its energy U in the amount of E^{ex} (which can be considered free energy) and receives an influx of energy E^{in} as a derivative of the implementation of a product (service) of an organization. E^{ex} is directed to the execution of work A (that is A is equivalent to E^{ex}), E^{in} allows the formation of an increase in energy growth of energy ΔU. It should be noted that the E^{in} level should "overlap" the energy consumption level E^{ex}. For organizations as specific systems, work will be "useful" only when it ensures at least a return of spent energy.

Thus, the difference between the energy inflow and the outflow forms an increase in energy ΔU:

$$E^{in} - E^{ex} = \Delta U. \qquad (2)$$

The organization's energy entropy is expressed as follows [15], (which corresponds to the expression for entropy in thermodynamics):

$$S = \frac{Q}{T} = \frac{U - (A + \Delta U)}{T}. \qquad (3)$$

Temperature reflects the state of an organization compared to the ideal state, so take the following as an ideal state:

1) complete certainty (an organization reliably knows the importance of future results of its activities, which characterize the "state of an organization");

2) the maximum possible energy efficiency [13] ("return" from the energy invested in work in the form of the inflow of incoming energy corresponds to the highest possible level for a given area of activity).

That is why, a measure of energy efficiency of an organization in relation to information entropy, characterizing the order (and certainty) will be accepted as the temperature of an organization:

$$T = \frac{\mu}{H} = \frac{\mu}{-\sum_{k=1}^{K} p(A_k) \cdot \ln(p(A_k))}, \qquad (4)$$

where A_k is the variants of the state of an organization, $p(A_k)$ is the probabilities of these states; μ reflects the relative efficiency level (compared to the "ideal" level, the role of which

can be played by the desired resources efficiency level or by the one observed in more successful organizations of the considered scope of activity):

$$\mu = \frac{\eta}{\eta^*}, \tag{5}$$

$$\eta = \frac{U + \Delta U}{U}, \tag{6}$$

where η is the indicator of the efficiency of the organization's turnover; η^* is the indicator of the efficiency of the standard/ideal state. In fact, η^* assigns an ideal level of the energy increase for a special scope of activity.

As the organization activity result is manifested in the formation of energy flows E^{ex} and E^{in}, which determine ΔU, A_k is the event implying that E^{ex} and E^{in} accepted either certain values $E_k^{ex^*} \wedge E_k^{in^*}$, or ranges of values $\left[E_k^{1ex^*}, E_k^{2ex^*}\right] \wedge \left[E_k^{1in^*}, E_k^{2in^*}\right]$. This depends on the used approach to the interpretation of a kind (discrete, continuous) of random magnitudes E^{ex} and E^{in}. Thus, the temperature of an organization is:

$$T = \frac{U + \Delta U}{U \cdot \eta^* \cdot H}, \tag{7}$$

and energy entropy is

$$S = \frac{U - (A + \Delta U)}{T} = \frac{(U - E^{in}) \cdot U \cdot \eta^*}{U + E^{in} - E^{ex}} H. \tag{8}$$

Note that the ideal state assumes $H=0$ (complete certainty), which draws in 0 denominator in (7). However, on the one hand, this state of organizations is almost impossible (that is one can expect $H \to 0$, but not $H=0$). On the other hand, within the framework of the energy entropy theory of organizations, the value of temperature does not matter much, and the central indicator is energy entropy, which at $H=0$ (only of a theoretically possible situation) becomes equal to 0.

This relation between the organization's information entropy and energy entropy is consistent with the statistical physics approach, which confirms the validity of the stipulations of the energy entropy concept of organizations.

5. The dynamics of energy and energy entropy of an organization

Note that the above reasoning reflects a statistical view of the organization and their main goal is to establish the main influencing parameters, to describe energy entropy in a formalized way and to show its relationship with information entropy. However, the dynamics of the categories discussed above are important for organizations.

Introduce time index $t = \overline{0,T}$. Total energy of an organization is a result of its activities and is related to the previous state (Fig. 1).

Let us assume that at the initial moment $t=0$ energy of organization makes up U_0 (initial state), from which E_1^{ex} organization directs to performing work A_1, Q_1 is the boundary energy. Thus,

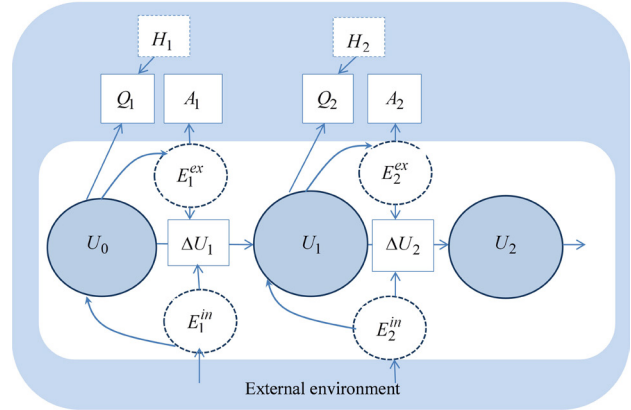$$U_0 = A_1 + Q_1 = E_1^{ex} + Q_1. \tag{9}$$

Fig. 1. The dynamics of the total energy of an organization

In response to executed work, an organization receives an influx of energy E_1^{ex}, which forms an increase in energy ΔU_1, thus, at moment $t=1$, energy balance is:

$$U_1 = A_1 + Q_1 + \Delta U_1 = U_0 + \Delta U_1 =$$
$$= E_1^{ex} + (E_1^{in} - E_1^{ex}) + Q_1 = U_0 + (E_1^{in} - E_1^{ex}). \tag{10}$$

Generalizing these judgments, we obtain

$$U_t = U_{t-1} + E_t^{in} - E_t^{ex}, \quad (t = \overline{1,T}). \tag{11}$$

Behavior U_t is determined by dynamics $\Delta U_t = E_t^{in} - E_t^{ex}$. As a rule, the basic variants of dynamics of the activity results of an organization are the following [24, 25]: uniform increase and growth with acceleration (slow down). These variants of an energy increase determine the corresponding variants of dynamics of the total energy of an organization:

$$U_t = w_1 \cdot t + U_0, \tag{12}$$

$$U_t = U_0 + w_2 \cdot t^2 + w_1 \cdot t, \tag{13}$$

where w_1, w_2 are the numerical coefficients reflecting the rate and acceleration of the process of changing the total energy.

For $t = \overline{0,T}$ (12) and (13) are the basis for an analysis of energy entropy dynamics. In the first case, an increase in energy is constant and equal to:

$$\Delta U_t = E_t^{in} - E_t^{ex} = w_1, \tag{14}$$

in the second situation

$$\Delta U_t = E_t^{in} - E_t^{ex} = U_t - U_{t-1} = 2w_2 \cdot t + w_1 - w_2. \tag{15}$$

However, not only a change in the total energy of an organization due to its growth affects the dynamics of energy entropy. That is why when considering a specific version of the dynamics of total energy, one should take into consideration dynamics E_t^{in}, E_t^{ex}, H_t.

So, at a uniform increase in the total energy of an organization:

$$S_t^{UG} = \frac{(U_t - E_t^{in}) \cdot U_t \cdot \eta^* \cdot H_t}{U_t + E_t^{in} - E_t^{ex}} =$$
$$= \frac{(U_0 + w_1 \cdot t - E_t^{in}) \cdot (U_0 + w_1 \cdot t) \cdot \eta^* \cdot H_t}{U_0 + w_1 \cdot t + w_1}. \tag{16}$$

In (16), E_t^{in} can be represented in the form of a certain share U_t, assuming that, for example, free energy E_t^{ex} makes up a share $0 \le g \le 1$ of total energy (i. e. an organization spends an established part of the total energy to perform work):

$$E_t^{in} = E_t^{ex} + w_1 = g \cdot U_t + w_1 = g \cdot (U_0 + w_1 \cdot t) + w_1. \qquad (17)$$

With this regard, (16) will take the form:

$$S_t^{UG} = \frac{(U_t - E_t^{in}) \cdot U_t \cdot \eta^* \cdot H_t}{U_t + E_t^{in} - E_t^{ex}} =$$

$$= \frac{(U_0 + w_1 \cdot t - g \cdot (U_0 + w_1 \cdot t) - w_1) \cdot (U_0 + w_1 \cdot t) \cdot \eta^* \cdot H_t}{U_0 + w_1 \cdot t + w_1} =$$

$$= \frac{(U_0(1-g) + w_1(t - g \cdot t - 1)) \cdot (U_0 + w_1 \cdot t) \cdot \eta^* \cdot H_t}{U_0 + w_1(t+1)},$$

$$t = \overline{1, T}. \qquad (18)$$

(18) describes the dynamics of the organization's energy entropy at a uniform increase in its total energy.

6. Experimental study of the impact of the dynamics of basic parameters on energy entropy

The resulting formalization of dynamics of energy entropy (18) acts as a model for experimental research, which is based on taking into consideration the most possible variants of dynamics of the main influencing parameters: information entropy and free energy. Different combinations of their dynamics (simultaneous growth/decrease, growth/decrease at different rates) can lead to different variants of dynamics of energy entropy. In addition, the variant of dynamics under consideration may be combined with different levels, such as a share of free energy.

Thus, the main task of experimental research is to determine what changes in the parameters that form energy entropy for an organization are for the better and which are not.

The information basis of the study was the data about the company that deals with transportation and logistics. The total energy of a company is estimated at 50 cond. units (as accepted, 1 cond. unit=UAH 1 mln.), that is, U=50. Free energy (that is, the resources that are directly engaged in the process of service rendering) are estimated at the level of 60 % of the total energy that forms the basic level g=0.6. An increase in energy can be accepted as constant and makes up on average w_1=2. "Ideal efficiency" of this business is estimated as η^*=2. Possible variants of the company's results and their probabilistic estimates form the basic level of information entropy H=2.

The possible negative impact of the external environment poses a threat of a gradual increase in information entropy H.

A company plans to implement a number of activities and evaluates their possible results, primarily in terms of their impact on a change in the state of a system (company). These activities, in particular, are aimed at: increasing the control over the volume of works and, accordingly, decreasing information entropy (marketing); increasing the level of free energy to g=0.7 (reorganization).

Taking into consideration the above, it is necessary to explore the behavior of energy entropy of a company in the

implementation and without the implementation of planned measures, as well as at the possible impact of the external environment on information entropy. The planning period under consideration T=10 (duration of time periods is 3 months – a quarter).

Fig. 2 shows the results of calculations based on (18) options for energy entropy dynamics for the company in question at the constant and descending level of information entropy H for different values of g. As Fig. 2 shows, at a uniform increase in total energy and a constant level of information entropy, energy entropy grows, while at a uniform decrease in H, it decreases. A higher value of g naturally contributes to a decrease in energy entropy.
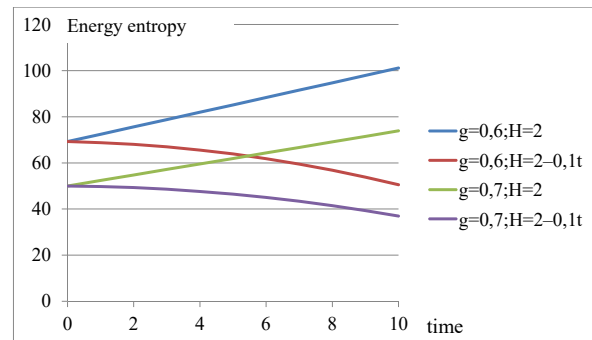

Fig. 2. Examples of energy entropy dynamics at a uniform increase in the total energy at constant and descending H for g={0,6;0,7}

Fig. 3 shows a graphic illustration of the results of calculation of dynamics of energy entropy at a fixed value of g, but at four variants of dynamics of information entropy H. This illustration is a clear example of how the "well-ordered" organization – in this case, a company after reorganization – and a decrease in uncertainty of its activity results (through effective marketing) makes it possible to "fight" energy entropy, tending to the natural growth at a gradual increase in the total energy of an organization.
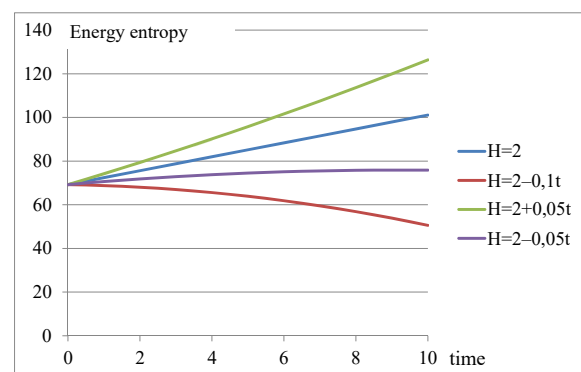

Fig. 3. Examples of dynamics of energy entropy at a uniform increase in the total energy at different dynamics H

Fig. 4 shows the results of calculations of dynamics of energy entropy while taking into consideration dynamics H and g at the same time. These calculations were made from the assumption that it is possible to have a stage-by-stage implementation of a range to reorganize and optimize the company's business processes, which will lead to a gradual increase in g (in this case, with the increase of 0.02 for each time interval).
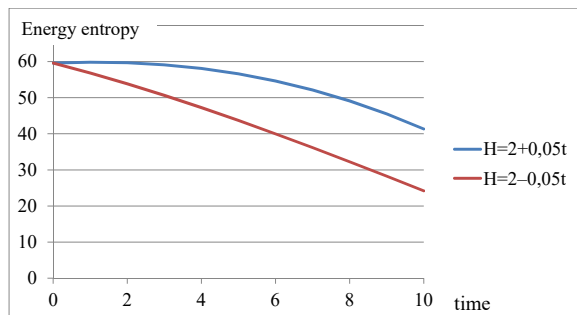
Fig. 4. Examples of dynamics of energy entropy at a uniform increase in the share of free energy g=0.65+0.02t at different dynamics H

The increase in g indicates an increase in energy turnover efficiency. That is, an organization gradually increases (in this example g=0.65+0.02t) a share of free energy, which naturally reduces the share of bound energy. The dynamics of information entropy for this example of two kinds include a uniform increase and a uniform decrease. At the same time, even an increase in efficiency in the context of energy exchange with the external environment (an increase in the share of free energy) in the initial period without increasing a degree of orderliness does not lead to a decrease in energy entropy. And only a significant level of free energy ensures positive dynamics of energy entropy at an increase in information entropy.

The information about the possible consequences of the environmental impact and the implemented activities, obtained in this way, will allow the company in question to predict its possible state in prospect.

7. Discussion of results of studying the dynamics of the energy entropy of organizations

Energy entropy is a category that is not directly subject to direct experimental research but is a specific integrated indicator of the efficiency of energy turnover of organizations as a special class of systems, established through computation. However, information about the parameters of the state of a system and their possible dynamics makes it possible to establish in practice the level and a change of energy entropy using the model. Integrity involves taking into consideration the level of order in an organization (information entropy) along with the ability to "release" effectively the energy for useful work. That is why the definition and the study of dynamics of energy entropy are possible only based on abstract models, such as (9), (16), (18).

Unlike existing studies, the formalization of energy entropy is proposed, which makes it possible not only to assess but also to study the behavior of energy entropy from different points of view. In this case, the study focuses on dynamics of energy entropy under the influence of a set of factors expressed at a certain level and dynamics of the system of parameters: "energy parameters" – total energy, its increase, the level of free energy and the "degree of orderliness" – information entropy.

Functional analysis (18) makes it possible to combine different variants of dynamics of these magnitudes and to model the behavior of energy entropy and, accordingly, the state of an organization.

Presented results of research into dynamics of energy entropy based on model (18), that is, under conditions of

a uniform increase in the total energy of an organization, demonstrated the complexity of the impact of the system of factors and dynamics of corresponding parameters, reflecting their level, on energy entropy, including leveling positive changes in an organization by negative dynamics of other processes. In addition, experimental studies demonstrated the practical use of the proposed model of dynamics of energy entropy to predict the state of an organization, taking into consideration the influence of external factors and the transformations of the system itself.

The proposed formalization of energy entropy is not so much a method for assessing energy entropy as a model for studying its behavior and dynamics. The obtained results do not contradict and prove the basic assumptions and judgments of various authors, in particular, [3, 14–16], about the potential behavior of energy entropy at the conceptual level (that is, without appropriate formalization).

The proposed results could be used for further theoretical research into energy entropy and practical study of its dynamics for specific organizations. First of all, the establishment of a certain critical level of energy entropy, the achievement of which is ruinous for an organization, as well as the corresponding values of influencing parameters forming this level, are of scientific and practical interest.

8. Conclusions

1. Formalization of energy entropy of organizations, which at the mathematical level reflects and complements the results, outlined in [1, 17], was proposed. According to the proposed approach, energy entropy is determined by an increase in total energy and its comparison with the "ideal" option; a level of free energy and information entropy that reflects the ability of the organization's structure to ensure certain results. Incoming and outgoing (free) energy is considered as the main parameters of the state of an organization. Their combination determines an increase in energy, a set of possible combinations – information entropy. The proposed formalization is a model that adequately reflects the influence of the system of parameters under consideration and does not contradict the classical understanding and formalization of entropy within thermodynamics and statistical physics.

2. The scheme of changes over time of the main "energy parameters" of an organization (total energy, free energy, and incoming energy) was identified. We determined two main variants of dynamics of energy increase as a result of the combination of outgoing and incoming energy (the main parameters that determine energy entropy) – a uniform increase and an increase with acceleration (slowdown). This model makes it possible to carry out experiments "what happens if…" both in theoretical and practical studies of energy entropy. These experiments, in the absence of the possibility to collect experimental data, are the only way to study the dynamics of energy entropy.

3. Experimental studies were carried out based on the developed model of dynamics of energy entropy. They implied consideration of formalizations of the most possible options for the dynamics of information entropy and a share of free energy. The effect of different combinations of their dynamics (simultaneous growth/decrease, growth/decrease at different rates) on the dynamics of energy entropy was analyzed. Conclusions about the need for comprehensive

measures to reduce energy entropy were made. Experimental research based on the information on the company operating in the transport and logistics sector revealed that an increase in the share of free energy does not ensure the formation of neg-entropy without reducing a degree of uncertainty of results, which are expressed in a decrease in information entropy. It was concluded that an increase in energy of an organization should be accompanied by an increase in the share of free energy and a decrease in information entropy. This approach will ensure the viability of an organization from the perspective under consideration in accordance with the energy entropy concept of organizations.

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