UDC 519.711:005
DOI: 10.15587/2706-5448.2020.215394

Bondar A.

MODELING THE PORTFOLIO STRUCTURE OF A PROJECT-ORIENTED ORGANIZATION BASED ON AN ENTROPY CONCEPT

The object of research is the sustainability and value of project-oriented organizations in the framework of the entropy concept. Ensuring the sustainability of project-oriented organizations should be carried out through the formation of their portfolio of projects. At the same time, in the short term, the entropy of the organization should correspond to a certain stability corridor. And with long-term planning, the implementation of projects should ensure an increase in the upper boundary of this corridor due to an increase in the level of the entropy barrier. The analysis of modern approaches to the formation of a portfolio of project-oriented organizations is carried out. The need for a new interpretation of the concepts of «value» and «sustainability» in the context of the entropic methodology of project management is determined. It has been established that the task of forming a portfolio of projects should be solved subject to ensuring the balance of «value-sustainability».

The research used the methods of system analysis and mathematical modeling. The concept of «sustainability of an organization» has received a new interpretation within the framework of the entropy concept, which defines sustainability as the ability to remain within the entropic barrier, which can be increased through the implementation of relevant projects. It is determined that «stability», measured by energy entropy, characterizes the state of the organization, and «value» is the result of its activities. Ensuring the balance «sustainability-value» is the essence of the main approach to project portfolio management of a project-oriented organization, that is, the achievement of certain results should not lead to an uncontrolled increase in entropy. The concept of «development project» has been expanded within the framework of the entropy methodology, which does not contradict existing approaches, but develops them, considering the result of development as an influence on entropy by influencing the parameters that form it.

A model for forming a project portfolio of a project-oriented organization has been developed. This model allows to determine the composition of the portfolio of projects of two categories – projects of current activity and development projects. Also, this model distributes them within the allocated time interval of the portfolio in order to balance the indicators of the state and results of the organization's activities. This approach ensures sustainability in an entropic context while achieving the required level of organizational value.

Keywords: *project-oriented organization, value-sustainability balance, portfolio of projects, entropy of the organization, entropy barrier.*

Received date: 28.04.2020
Accepted date: 11.06.2020
Published date: 31.10.2020

1. Introduction

The entropic concept of managing organizations transforms the classical concept of «sustainability». This transformation is explained by the essence of the entropy concept, within which entropy acts as a universal and integral indicator of the state of an organization. The modern vision of the «structure of the organization» involves the inclusion in its composition of structures associated with the controlled part of the external environment. The specifics of the turbulent environment of the organization as a system, the changing relationships with consumers and suppliers in the complex determine the need to replace «efficiency» and «competitiveness» with entropy. Entropy and the associated stability corridor reflect the state of the organization, and value – the results of its activities. Obviously, a project-oriented organization implements its activities through project portfolios. Therefore, it is relevant to study the formation of a portfolio that ensures the sustainability and value of an organization within the framework of the entropy concept.

2. The object of research and its technological audit

The object of research is the sustainability and value of project-oriented organizations in the framework of the entropy concept. Ensuring the sustainability of project-oriented organizations should be carried out by building their portfolio of projects. At the same time, in the short term, the entropy of the organization should correspond to a certain stability corridor. And with long-term planning, the implementation of projects should ensure an increase in the upper boundary of this corridor due to an increase in the level of the entropy barrier.

ISSN 2664-9969

3. The aim and objectives of research

The aim of research is to increase the sustainability and value of a project-oriented organization. To achieve this aim, it is necessary to solve the following objectives:

1. To formalize the contribution of projects to the value of the organization.
2. To study the contribution of projects of different categories to the energy entropy of the organization.
3. To develop a mathematical model for optimizing a portfolio of projects, provided that the balance «value-sustainability».

4. Research of existing solutions of the problem

Both project management standards and scientific research are devoted to the formation of a project portfolio. Thus, the standard [1] proposes portfolio management methods and includes three areas of expertise: strategic portfolio management, portfolio performance management and portfolio communications management. The works [2, 3] present classical and innovative approaches to the formation and management of project portfolios. The authors, in the classical assessment of the effectiveness of a portfolio of projects, define a system of evaluation criteria and formulate the function of the organization's goals in the space of specified criteria [4, 5]. Obviously, only those projects that bring the most value, satisfy resource constraints, and align with the strategic goals of the organization should be included in the project portfolio. At the same time, many researchers note [5, 6] that it is important when forming a portfolio to select projects not by one criterion of efficiency, but by a fairly large set of parameters: financial efficiency, social significance, etc. Works [7, 8] are devoted to optimization portfolio in accordance with the strategy of the organization and the need for long-term planning. However, these studies do not take into account the influence of entropy on a project-oriented organization, as a system that carries out its activities through the implementation of project portfolios. Some researchers note the need to take into account the entropy. So in [9] the article analyzes the relationship between entropy, organizational capabilities and corporate entrepreneurship. In [10, 11], a formalization of the energy entropy of organizations is proposed, the dynamics of the energy entropy of an organization is described, which made it possible to substantiate the value and stability of an organization in an entropic context.

Thus, the results of the analysis allow to conclude that there are no studies in modern works that take into account the influence of entropy on the stability and value of an organization.

5. Methods of research

During the execution of the work, general scientific and special research methods were applied:

– logical generalization method – for theoretical substantiation of the importance of the tasks and clarification of the key concepts of the study;
– system analysis – to assess the impact of various categories of projects on the value and sustainability of a project-oriented organization;
– mathematical modeling – to develop an optimal portfolio of projects, providing a balance of indicators of the state and performance of a project-oriented organization.

6. Research results

As noted above, entropy determines the sustainability of an organization to which each project contributes. But at the same time, the organization must form a certain value as an integral set of compliance with the goals in relation to the organization itself, its consumers and competitors, that is, a set of stakeholders.

The contribution of projects to energy entropy is estimated on the basis of the expression set forth in [12]. It is required to formalize the contribution of projects to the value of the organization. Let's use the approach that was proposed in [13–15], according to which the value of the project for the organization is determined by its compliance (and the corresponding contribution) with the goals.

Thus, each project (current activities and development) can be characterized by a set of indicators C_i^l, $i=\overline{1,n}$, $l=\overline{1,L}$ and C_j^l, $j=\overline{1,m}$, $l=\overline{1,L}$, which correspond to the set of goals of the organization. On the basis of this, relative assessments μ_i^l, μ_j^l of compliance with the goals are formed:

$$\mu_i^l=\frac{C_i^l}{C_l},\ \mu_j^l=\frac{C_j^l}{C_l}, i=\overline{1,n},=\overline{1,m}, l=\overline{1,L}. \quad (1)$$

These estimates allow to perform a primary analysis of the value of projects for the organization by comparing their integral estimates of value V_i, V_j:

$$V_i=\sum_{l=1}^{L} b_l\cdot\mu_i^l,\ V_j=\sum_{l=1}^{L} b_l\cdot\mu_j^l,\ i=\overline{1,n},\ j=\overline{1,m},$$
$$\sum_{l=1}^{L} b_l=1. \quad (2)$$

For an organization, its value provided by a portfolio of projects is formed as follows:

$$V=\sum_{l=1}^{L} b_l\cdot\frac{\sum_{i=1}^{n}C_i^l+\sum_{j=1}^{m}C_j^l}{C_l^V}, \quad (3)$$

wherein

$$\sum_{i=1}^{n}C_i^l+\sum_{j=1}^{m}C_j^l=C_l^{act},\ l=\overline{1,L}.$$

Taking into account the dynamics of all these characteristics:

$$V(t)=\sum_{l=1}^{L} b_l(t)\cdot\frac{\sum_{i=1}^{n}C_i^l(t)+\sum_{j=1}^{m}C_j^l(t)}{C_l^V(t)},\ t=\overline{1,K}. \quad (4)$$

Since not only the integral assessment of the organization's value is important, but also the results (local values) for each goal $l=\overline{1,L}$, the following values $V_l(t)$ should be introduced into consideration:

$$V_l(t)=\frac{\sum_{i=1}^{n}C_i^l(t)+\sum_{j=1}^{m}C_j^l(t)}{C_l^V(t)}, l=\overline{1,L}, t=\overline{1,K}. \quad (5)$$

Thus, (4) describes the dynamics of the organization's value, and (5) – the set of «local values» of the organization.

Model for the formation of the optimal composition of the project portfolio. Let the organization implement a set of projects of various categories, the characteristics of which determine the existing dynamics of the main indicators of its state and performance:

– the associated energy of the organization (in dynamics):

$$U'(t)=U'(t-1)+E^{in}{}'(t)-E^{ex}{}'(t);$$

– energy entropy (in dynamics) $S'(t)$;
– informational entropy (in dynamics) $H'(t)$;
– energy efficiency (in dynamics):

$$\eta'(t)=\frac{U'(t-1)+E^{ex}{}'(t)-E^{in}{}'(t)}{U'(t)},$$

where $E^{in}{}'(t)$, $E^{ex}{}'(t)$ – respectively, the dynamics of the incoming and outgoing energy. The indicated values are related by the ratio:

$$S'(t)=\frac{(U'(t)-E^{in}{}'(t))\cdot U'(t)\cdot\eta^{*}\cdot H'(t)}{U'(t)+E^{in}{}'(t)-E^{ex}{}'(t)}. \quad (6)$$

Let the value of the organization with the existing set of projects be characterized as $V'(t)$ at the achieved level $C'(t)$, and local values $V_l'(t), l=\overline{1,L}, t=\overline{1,K}$ at the achieved values $C_l'(t)$.

Thus, the organization's project portfolio is formed with projects already being implemented, therefore, in fact, the project portfolio is not formed «from scratch», but «completed» in such a way that the conditions described earlier are met.

Let's introduce the control parameters:

– selection of a development project from a variety of options:

$$x_i^{dev}=\{1,0\},\ i=\overline{1,n};$$

– selection of a project corresponding to the current activity from a variety of options:

$$x_j^{cur}=\{1,0\},\ j=\overline{1,m}.$$

At each moment of time, the energy entropy of the organization can be estimated as (7). Taking into account the boundaries of the stability corridor of the organization, the condition of limitation along the upper boundary $S^{\max}(t)$ naturally arises, which is formulated as follows (8), or in a short notation (9).

Let's note that in (21) $E^{in}{}'(t)$, $E^{ex}{}'(t)$ are included in an implicit form, causing the dynamics $U'(t)=U'(t-1)+E^{in}{}'(t)-E^{ex}{}'(t)$.

$$S(t,x_i^{dev},x_j^{cur})=$$
$$=\frac{\left(U'(t)+\sum_{i=1}^{n}\Delta U_i(t)\cdot x_i^{dev}-\sum_{j=1}^{m}E_j^{in}(t)\cdot x_j^{cur}-\sum_{i=1}^{n}E_i^{in}(t)\cdot x_i^{dev}\right)}{U'(t)+\sum_{i=1}^{n}\Delta U_i(t)\cdot x_i^{dev}+\prod_{i=1}^{n}\alpha_i^{\Delta n}\cdot\sum_{j=1}^{n}\left(E_j^{in}(t)-E_j^{ex}(t)\right)\cdot x_j^{dev}+\sum_{i=1}^{n}\left(E_i^{in}(t)-E_i^{ex}(t)\right)\cdot x_i^{dev}}\times$$
$$\times\left(U'(t)+\sum_{i=1}^{n}\Delta U_i(t)\cdot x_i^{dev}\right)\cdot\eta^{*}\cdot\left(H'(t)+\sum_{j=1}^{m}H_j(t)\cdot x_j^{dev}+\left(\sum_{i=1}^{n}H_i(t)+\sum_{i=1}^{n}\Delta H_i(t)\right)\cdot x_i^{dev}\right), t=\overline{1,K}. \quad (7)$$

$$\frac{\left(U'(t)+\sum_{i=1}^{n}\Delta U_i(t)\cdot x_i^{dev}-\sum_{j=1}^{m}E_j^{in}(t)\cdot x_j^{cur}-\sum_{i=1}^{n}E_i^{in}(t)\cdot x_i^{dev}\right)}{U'(t)+\sum_{i=1}^{n}\Delta U_i(t)\cdot x_i^{dev}+\prod_{i=1}^{n}\alpha_i^{\Delta n}\cdot\sum_{j=1}^{n}\left(E_j^{in}(t)-E_j^{ex}(t)\right)\cdot x_j^{cur}+\sum_{i=1}^{n}\left(E_i^{in}(t)-E_i^{ex}(t)\right)\cdot x_i^{dev}}\times$$
$$\times\left(U'(t)+\sum_{i=1}^{n}\Delta U_i(t)\cdot x_i^{dev}\right)\cdot\eta^{*}\cdot(H'(t)+\sum_{j=1}^{m}H_j(t)\cdot x_j^{cur}+$$
$$+\left(\sum_{i=1}^{n}H_i(t)+\sum_{i=1}^{n}\Delta H_i(t)\cdot x_i^{dev}\right)\le S^{\max}(t),\ t=\overline{1,K}. \quad (8)$$

$$S(t,x_i^{dev},x_j^{cur})\le S^{\max}(t),\ t=\overline{1,K}. \quad (9)$$

The organization's value at points in time $t=\overline{1,K}$ is:

$$V(t,x_i^{dev},x_j^{cur})=$$
$$=\sum_{l=1}^{L}b_l(t)\cdot\frac{\sum_{i=1}^{n}C_i^l(t)\cdot x_i^{dev}+\sum_{j=1}^{m}C_j^l(t)\cdot x_j^{cur}+C'(t)}{C_l^V(t)}. \quad (10)$$

Expression (10) takes into account the contribution to the organization's value formation of both existing projects in size $C'(t)$ and potential ones for inclusion in the portfolio in the amount of:

$$\sum_{i=1}^{n}C_i^l(t)\cdot x_i^{dev}+\sum_{j=1}^{m}C_j^l(t)\cdot x_j^{cur}.$$

In this case, «local values» are:

$$V_l(t,x_i^{dev},x_j^{cur})=$$
$$=\frac{\sum_{i=1}^{n}C_i^l(t)\cdot x_i^{dev}+\sum_{j=1}^{m}C_j^l(t)\cdot x_j^{cur}+C'(t)}{C_l^V(t)},\ t=\overline{1,K},\ l=\overline{1,L}. \quad (11)$$

Since value maximization is a natural criterion for optimization, the following is true:

$$Z=\sum_{t=1}^{K}\sum_{l=1}^{L}\left[\sum_{i=1}^{n}C_i^l(t)\cdot x_i^{dev}+\sum_{j=1}^{m}C_j^l(t)\cdot x_j^{cur}+C_l'(t)-C_l^V(t)\right]^2\to\min_{x_i^{dev},x_j^{cur}}. \quad (12)$$

In essence, (11) minimizes the total discrepancy (squared discrepancy) between the required value level in the form $C_l^V(t)$ and the actual:

$$\sum_{i=1}^{n}C_i^l(t)\cdot x_i^{dev}+\sum_{j=1}^{m}C_j^l(t)\cdot x_j^{cur}+C'(t).$$

At the same time, taking into account a certain set level of the minimum permissible value, a set of conditions is formed along the lower boundary of the value of the organization as a whole $V^{\min}(t)$ and for its individual components (local values) in particular $V_l^{\min}(t)$:

$$V(t,x_i^{dev},x_j^{cur})\geq V^{\min}(t),\ t=\overline{1,K},$$
$$V_l(t,x_i^{dev},x_j^{cur})\geq V_l^{\min}(t),\ t=\overline{1,K},\ l=\overline{1,L}. \quad (13)$$

It is also necessary to take into account the limitation on the resources of the organization:

$$R^g(t),\ g=\overline{1,G},\ t=\overline{1,T},$$

where G – the number of allocated types of resources:

$$\sum_{i=1}^{n}R_i^g(t)\cdot x_i^{dev}+\sum_{j=1}^{m}R_j^g(t)\cdot x_j^{dev}\leq R^g(t),\ g=\overline{1,G},\ t=\overline{1,T}. \quad (14)$$

To complete the model, it is necessary to enter conditions for the selection of projects (that is, at least one project must be selected):

$$1\leq\sum_{i=1}^{n}x_i^{dev}\leq N,$$
$$1\leq\sum_{j=1}^{m}x_j^{dev}\leq M, \quad (15)$$

where N, M – the maximum allowable number of implemented project.

Thus, (9), (12), (13), (14), (15), together with the conditions $x_i^{dev}=\{1,0\}$, $i=\overline{1,n}$, $x_j^{cur}=\{1,0\}$, $j=\overline{1,m}$, form a model for optimizing the composition of an organization's project portfolio, which ensures value maximization when conditions for sustainability and resource constraints are met.

Nevertheless, the presented reasoning in the process of forming the model considered a set of projects with conditionally equal life cycles, which in practice is not so common. Therefore, as previously mentioned, the model should ensure *not only the selection of projects, but also their placement within the portfolio review period*. To do this, the results presented above should be corrected with such an amendment.

So, as a control parameter let's consider $x_{i\theta}^{dev}=\{1,0\}$, $i=\overline{1,n}$, $x_{j\nu}^{cur}=\{1,0\}$, $j=\overline{1,m}$ in the same context, taking into account the amendments in the form of indices $\theta=\overline{1,K-T_i+1}$, $i=\overline{1,n}$ and $\nu=\overline{1,K-T_j+1}$, $j=\overline{1,m}$, which form *alternative options for the start* of projects of the two considered categories. Taking into account that K is the end of the portfolio planning period, the values $K-T_i+1$, $K-T_j+1$ characterize *the latest start of the project*, with the condition that its life cycle fits into the planning period of the portfolio K. Let's note that the introduction of these indices does not affect the characteristics of projects; changes in the beginning of projects affect the composition of their characteristics at the level of the organization as a whole.

So the value of the organization in this situation is expressed as follows ($t=\overline{1,K}$):

$$\mathrm{V}(t,x_{i\theta}^{dev},x_{j\nu}^{cur})=\sum_{l=1}^{L}b_l(t)\times$$
$$\times\frac{\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}C_{i\theta}^l(t)\cdot x_{i\theta}^{dev}+\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}C_{j\nu}^l(t)\cdot x_{j\nu}^{dev}+C'(t)}{C_l^V(t)}. \quad (16)$$

In this case, «local values» are:

$$V_l(t,x_{i\theta}^{dev},x_{j\nu}^{cur})=$$
$$=\frac{\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}C_i^l(t)\cdot x_{i\theta}^{dev}+\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}C_j^l(t)\cdot x_{j\nu}^{dev}+C'(t)}{C_l^V(t)},$$
$$t=\overline{1,K},\ l=\overline{1,L}. \quad (17)$$

The resource limit will take the form:

$$\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}R_{i\theta}^g(t)\cdot x_{i\theta}^{dev}+\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}R_{j\nu}^g(t)\cdot x_{j\nu}^{cur}\leq R^g(t),$$
$$g=\overline{1,G},\ t=\overline{1,T}. \quad (18)$$

Conditions for the selection of projects (that is, at least one project must be selected):

$$1\leq\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}x_{i\theta}^{dev}\leq N,$$
$$1\leq\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}x_{j\nu}^{cur}\leq M. \quad (19)$$

In addition, only one should be selected of the many options for a project from the point of view of its beginning (or none, therefore the sign «less than or equal»):

$$\sum_{\theta=1}^{K-T_i+1}x_{i\theta}^{dev}\leq 1,\ i=\overline{1,n};$$
$$\sum_{\nu=1}^{K-T_i+1}x_{j\nu}^{cur}\leq 1,\ j=\overline{1,m}. \quad (20)$$

Target function (21) is transformed into the following form:

$$Z=\sum_{t=1}^{K}\sum_{l=1}^{L}\begin{bmatrix}\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}C_{i\theta}^l(t)\cdot x_{i\theta}^{dev}+\\+\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}C_{j\nu}^l(t)\cdot x_{j\nu}^{cur}+\\+C'(t)-C_l^V(t)\end{bmatrix}^2\to\min_{x_{i\theta}^{dev},x_{j\nu}^{cur}}. \quad (21)$$

Expression and condition on the upper bound of entropy (7)–(9) are transformed into (22)–(24).

$$S\left(t,x_{i\theta}^{dev},x_{j\nu}^{cur}\right)=$$
$$=\frac{\left(U'(t)+\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\Delta U_{i\theta}(t)\cdot x_{i\theta}^{dev}-\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}E_{j\nu}^{in}(t)\cdot x_{j\nu}^{cur}-\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}E_{i\theta}^{in}(t)\cdot x_{i\theta}^{dev}\right)}{U'(t)+\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\Delta U_{i\theta}(t)\cdot x_{i\theta}^{dev}+\prod_{i=1}^{n}\alpha_{i\theta}^{\Delta\eta}\cdot\sum_{j=1}^{n}\sum_{\nu=1}^{K-T_i+1}\left(E_{j\nu}^{in}(t)-E_{j\nu}^{ex}(t)\right)\cdot x_{j\nu}^{cur}+\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\left(E_{i\theta}^{in}(t)-E_{i\theta}^{ex}(t)\right)\cdot x_{i\theta}^{dev}}\times$$
$$\times\left(U'(t)+\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\Delta U_{i\theta}(t)\cdot x_{i\theta}^{dev}\right)\cdot\eta^*\cdot\left(H'(t)+\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}H_{j\nu}(t)\cdot x_{j\nu}^{cur}+\left(\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\left(H_{i\theta}(t)+\Delta H_{i\theta}(t)\right)\right)\cdot x_{i\theta}^{dev}\right),$$
$$t=\overline{1,K}. \quad (22)$$

$$S(t,x_{i\theta}^{dev},x_{j\nu}^{cur})=$$
$$=\frac{\left(U'(t)+\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\Delta U_{i\theta}(t)\cdot x_{i\theta}^{dev}-\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}E_{j\nu}^{in}(t)\cdot x_{j\nu}^{cur}-\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}E_{i\theta}^{in}(t)\cdot x_{i\theta}^{dev}\right)}{U'(t)+\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\Delta U_{i\theta}(t)\cdot x_{i\theta}^{dev}+\prod_{i=1}^{n}\alpha_{i\theta}^{\Delta\eta}\cdot\sum_{j=1}^{n}\sum_{\nu=1}^{K-T_i+1}\left(E_{j\nu}^{in}(t)-E_{j\nu}^{ex}(t)\right)\cdot x_{j\nu}^{cur}+\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\left(E_{i\theta}^{in}(t)-E_{i\theta}^{ex}(t)\right)\cdot x_{i\theta}^{dev}}\times$$
$$\times\left(U'(t)+\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}\Delta U_{i\theta}(t)\cdot x_{i\theta}^{dev}\right)\cdot\eta^*\cdot\left(H'(t)+\sum_{j=1}^{m}\sum_{\nu=1}^{K-T_i+1}H_{j\nu}(t)\cdot x_{j\nu}^{cur}+\left(\sum_{i=1}^{n}\sum_{\theta=1}^{K-T_i+1}H_{i\theta}(t)+\Delta H_{i\theta}(t)\right)\cdot x_{i\theta}^{dev}\right),$$
$$t=\overline{1,K}. \quad (23)$$

$$S(t,x_{i\theta}^{dev},x_{j\nu}^{cur})\le S^{\max}(t),\ t=\overline{1,K}. \quad (24)$$

Thus, (18)–(21), (23) and (25) are restrictions on the possible values of variables (control parameters):

$$x_{i\theta}^{dev}=\{1,0\},\ i=\overline{1,n},\ x_{j\nu}^{cur}=\{1,0\},\ j=\overline{1,m}, \quad (25)$$

together, they form a model for optimizing the composition of a project portfolio of a project-oriented organization.

Let's note that the values of characteristics (in dynamics) of projects within the time cycle of the organization are formed as follows (Fig. 1).

That is, if the project $x_{i\theta}^{dev}$ starts at the moment $t=\theta$ (in the example $\theta=3$), then the values (for example, $E_{i\theta}^{in}$) corresponding τ_i are shifted by $t=\tau_i+\theta-1$ ($t=\tau_i+3-1$ for this example). Accordingly, the end of the project, taking into account its life cycle ending at the moment $\tau_i=T_i$, occurs at the moment $t=T_i+\theta-1$. Let's suppose that the period for considering the portfolio is $K=6$, then for the project under consideration ($T_i=4$) *its latest start* $\theta=K-T_t+1=6-4+1=3$ (Fig. 1).

So, it's fair:

$$C_{i\theta}(t)=\begin{cases}C_{i\theta}(\tau_i+\theta-1),\theta\le t\le T_i\\ 0,t<\theta,t>T_i\end{cases},\ i=\overline{1,n}, \quad (26)$$

$$C_{j\nu}(t)=\begin{cases}C_{j\nu}(\tau_j+\nu\text{-}1),\nu\le t\le T_j\\ 0,t<\nu,t>T_j\end{cases},\ j=\overline{1,m}. \quad (27)$$

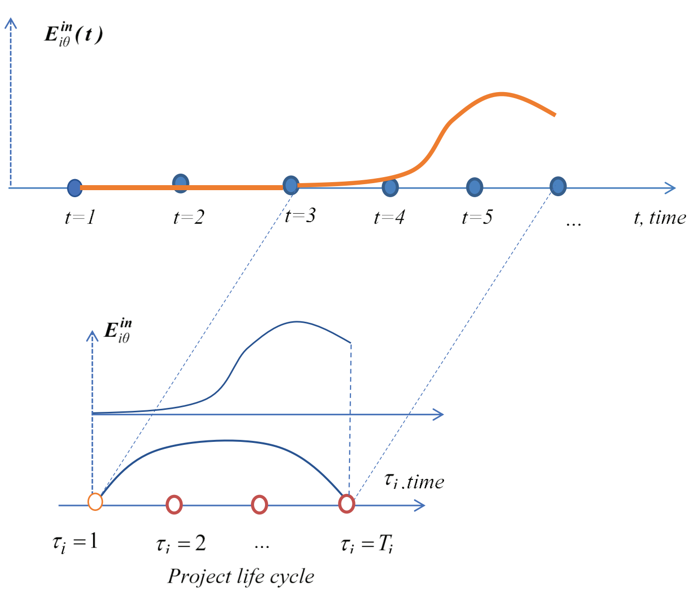

Fig. 1. Scheme of correlating the characteristics of projects with portfolio timeline

Expressions (26) and (27) allow comparing the indicators (in dynamics) in the time axis of the project with the time axis of the project portfolio and form dynamic dependencies for use in the developed model.

7. SWOT analysis of research results

Strengths. The classical approaches to ensuring the sustainability of organizations, based on economic prerequisites, in a modern turbulent environment are not effective, given that the nature of the impact on sustainability is much more complex. In modern works, a new approach based on the entropy concept is proposed, which, in turn, makes it possible to take into account the destructive influence of entropy when making decisions on the functioning and development of organizations. The proposed model for the formation of a portfolio of projects corresponds to the entropy concept and allows to optimize the composition of the portfolio, taking into account the impact of each project on the value and sustainability in an entropic context. This approach provides reliable modeling of the impact of projects on sustainability and value, and, therefore, the resulting decisions on the portfolio structure are reliable and correspond to the current state of the relationship between the organization and the external environment.

Weaknesses. The entropy methodology is at the very beginning of its formation, therefore, today there are no large-scale and diverse studies, primarily of a practical nature, that would fully demonstrate the influence of entropy on the organization and effective ways to combat it. Therefore, there is no possibility of comparing the proposed results with the results of other similar studies.

Opportunities. A new approach to examining the life of organizations on the basis of the entropy concept opens up broad prospects for both theoretical and practical research. A project portfolio that provides sustainability in an entropic context is consistent with an aggregated view of an organization's performance. A more detailed study of sustainability under the influence of each project, taking into account its life cycle, resource use, etc., is an opportunity to further develop the proposed results.

Threats. The main threat to the proposed results is the complexity of practical approbation due to the need to possess significant amounts of various information at various levels, which is not always possible.

8. Conclusions

1. The contribution of projects to the value of the organization is formalized as the degree of ensuring the achievement of the set goals, taking into account the dynamics of both target indicators and the results of project implementation.

ISSN 2664-9969

2. It has been established that the organization's projects belong to one of two categories – development projects and projects of current activities. The project of the current activity affects the entropy only during its life cycle. Development projects provide «leaps» in the entropy of the organization after implementation, which is formalized in the study.

3. A model for forming a project portfolio of a project-oriented organization has been developed, which allows to determine the composition of a portfolio of projects of two categories – projects of current activity and development projects. And also to distribute them within the allocated period of time of the portfolio in order to balance indicators of the state and results of activities, ensuring stability in the entropic context when the required level of value is achieved in an effort to maximize it.

The model takes into account the current composition of the organization's portfolio and the results of project implementation, which will be continued within the considered period of portfolio planning. The model is designed for two variants of projects:

1) for projects of practically the same duration (only the problem of forming the composition of the portfolio from many alternative projects is solved);

2) for projects of varying duration, which leads to the need to determine the beginning of the implementation of projects in the process of their selection (thus, projects are distributed within the portfolio planning period).

References

1. Project Management Institute (2013). *The Standard of Portfolio Management*. PMI, 189. Available at: https://www.pmi.org/-/media/pmi/documents/public/pdf/certifications/standard-for-portfolio-management-third-edition.pdf?v=95a98c16-aebd-4f01-9e21-4769fbad4891
2. Kendall, G., Rollins, S. (2003). *Advanced Project Portfolio Management and the PMO: Multiplying ROI at Warp Speed*. J. Ross Publishing, 448.
3. Kononenko, I. V., Bukreeva, K. S. (2010). Model and optimization method of projects portfolios of the enterprise for the planning period. *Eastern-European Journal of Enterprise Technologies, 1 (2 (43)),* 9–11. Available at: http://journals.uran.ua/eejet/article/view/2495
4. Bender, J., Sun, X. (2019). A Closer Look at the Factor-to-Specific Risk Ratio in Factor Portfolios. *The Journal of Portfolio Management, 46 (2),* 11–23. doi: http://doi.org/10.3905/jpm.2019.1.117
5. Qiao, X., Yan, S., Deng, B. (2020). Downside Volatility-Managed Portfolios. *The Journal of Portfolio Management, 46 (7),* 13–29. doi: http://doi.org/10.3905/jpm.2020.1.162
6. Martinsuo, M., Geraldi, J. (2020). Management of project portfolios: Relationships of project portfolios with their contexts. *International Journal of Project Management*. doi: http://doi.org/10.1016/j.ijproman.2020.02.002
7. Ciliberti, S., Gualdi, S. (2020). Portfolio Construction Matters. *The Journal of Portfolio Management, 46 (7),* 46–57. doi: http://doi.org/10.3905/jpm.2020.1.155
8. Gruszka, J., Szwabiński, J. (2020). Best portfolio management strategies for synthetic and real assets. *Physica A: Statistical Mechanics and Its Applications, 539,* 122938. doi: http://doi.org/10.1016/j.physa.2019.122938
9. Ceptureanu, E. G., Ceptureanu, S. I., Popescu, D. (2017). Relationship between Entropy, Corporate Entrepreneurship and Organizational Capabilities in Romanian Medium Sized Enterprises. *Entropy, 19 (8),* 412. doi: http://doi.org/10.3390/e19080412
10. Bondar, A., Bushuyev, S., Onyshchenko, S., Hiroshi, H. (2020). Entropy Paradigm of Project-Oriented Organizations Management. *Proceedings of the 1st International Workshop IT Project Management (ITPM 2020)*. Lviv. Available at: http://ceur-ws.org/Vol-2565/paper20.pdf
11. Bondar, A., Onyshchenko, S., Vishnevskyi, D., Vishnevska, O., Glovatska, S., Zelenskyi, A. (2020). Constructing and investigating a model of the energy entropy dynamics of organizations. *Eastern-European Journal of Enterprise Technologies, 3 (3 (105)),* 50–56. doi: http://doi.org/10.15587/1729-4061.2020.206254
12. Bondar, A. V. (2020.) Tsennost i ustoichivost organizatsii v kontekste entropiinoi metodologii upravleniia. *Österreichisches Multiscience Journal, 33.*
13. Onyshchenko, S. P., Arabadzhy, E. S. (2011). Formation of the optimal enterprise development program. *Eastern-European Journal of Enterprise Technologies, 6 (3 (24)),* 60–66. Available at: http://journals.uran.ua/eejet/article/view/2251
14. Onyshchenko, S., Leontieva, A. (2018). Modeling of the optimal composition of the enterprise technical development program. *Technology Audit and Production Reserves, 5 (2 (43)),* 36–41. doi: http://doi.org/10.15587/2312-8372.2018.146463
15. Onischenko, S. P., Arabadzhi, E. S. (2012). Value of the enterprises development programs. *Eastern-European Journal of Enterprise Technologies, 1 (12 (55)),* 9–11. Available at: http://journals.uran.ua/eejet/article/view/3611

Bondar Alla, *PhD, Associate Professor, Department of Logistic Systems and Projects Management, Odessa National Maritime University, Ukraine, e-mail: ocheretyankaalla@gmail.com, ORCID: http://orcid.org/0000-0003-2228-2726*