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JUSTIFICATION OF ORGANIZATIONAL CHANGES INCLUDING SPECIFICS OF HIERARCHICAL RELATIONS IN DEVELOPING ORGANIZATIONS

O. SHCHERBAK[1]

[1] Procter & Gamble

Introduction and study objective: the requirement to create an effective system of enterprise's innovation development brings forward issues of theory and methodology, including specifics of necessary organizational changes and cooperation within the company including management – employees' interaction. Thus, scientific ground for solution to these problems will facilitate the creation of organizational structures for efficiently functioning enterprises.

Hypothesis of scientific research. It is often assumed that the choice of effective and required methods of the enterprise's adjustment to the market environment would allow to systematize the organizational changes enabling performance increase of its economic activity.

The purpose of this study is theoretical and methodological justification of concept approaches and methods in organization change management of enterprise structures and functions during its adjustment to the conditions of economic environment.

Research methodology: application of the system analysis justifies 5 sets of hypothetical relations linking perceived power with perceived behavior of reward and penalty.

Furthermore, two-dimensional correlation, stepwise multiple regression and hierarchical multiple regression analysis help to construct a model of relevant organizational changes.

Results achieved: diagnostic methods were developed that determine external and internal conditions of the enterprise in order to choose the right change strategy; the methodology of evolution analysis of change efficiency was proposed. Additionally, high-quality econometric models were created for assessment of the impact of changes based on the enterprise's performance.

Conclusions: the proposed approach to justification of organizational changes enables the implication of methods designed to analyze the need for restructuring of organization culture, management style, employees' relations and takes into account specifics of hierarchical structure in a developing organization. Furthermore, new methods were developed to assess the effectiveness of management system at an industrial enterprise, including introduction of changes and their dynamics' assessment.

Keywords: organizational changes; hierarchical relationships; self-developing organization; life cycle stages of the organization; organizational structure.

Problem statement. Dynamic economic development determines increased scientific and practical interest in the appeal to use new, most effective instruments and methods for managing organizational changes at both macro and micro economic levels that predetermine the possibilities of organizational structures aimed at stimulating innovation development. The problem of efficiency improvement of organization change management in a relatively unstable business environment, by evolutionary (internal positive transformation) and revolutionary (mergers, acquisitions, integration,

disintegration) change types is highly relevant for current state of global economy.

An increased interest in change management during recent years is conditioned by the higher speed of changes in the external environment versus the speed of management system reaction to these changes. Therefore new tasks are conditioned by: 1) significant discrepancy between technological, production, organization capabilities and the requirements of market economy; 2) the need to change internal production processes and improve enterprise structure related to uncertain external circumstances; 3) no "ready-to-use" methods or recipes exist; quantity change analysis methods are poorly applicable to enterprise restructuring. At the same time spontaneous, insufficiently reasoned from theory and methodology point of view organizational changes lead to significant economic losses.

Furthermore, constantly raising speed of change (according to experts' evaluation, the intensity of economic life will grow by 2–2.5 times by 2025) will lead to the fact that the effective functioning of industrial enterprises will be determined by the dynamics of their adaptive responses to the external and internal environment. Change management is becoming an ongoing process among other company's functions, which proves the relevance of the studied issue.

Analysis of the latest topic-related publications and the unsolved part of the stated problem. Analysis of the theoretical foundations and practical experience of hierarchical relationships in modern organizations indicates that it is impossible to resolve issues in this area without developing new theoretical approaches, tools and methodological support to assess and analyze the effectiveness of organizational changes. These and similar issues are relevant and have not yet received a sufficiently complete and systematic reflection in the scientific literature, which has stimulated an increased demand for their solution. Scientific trend of recent years lies in the fact that the increasing number of scientific discoveries and breaks-through take place on the intersection of different scientific fields, and therefore the key potential of scientific development and paradigm shift, called to create the next era of scientific thought, lies in adjacent and at times even far-apart fields. Therefore, the most astonishing examples of cross-scientific findings are the Behavioral Economics, founded by Richard Thaler [1] on the basis of Economics and Psychology, which laid a new stage in the development of modern economic thought; as well as a model created at the junction of the Economics and Genetics – The Hierarchy Community Phenotype Model by Lem [2], Griffith, Sambrook [3], which formed a principally new concept of organization management, and others.

After a detailed study of currently existing organization structures, it is worth to note their likeness and one-directional approach, as well as their absence of flexibility and no clear connection to the company's goals. Even the most modern and progressive organization structures such as Team, Matrix, Network or Virtual, and even in case of their application in the innovation-oriented enterprises, are created based on only 2 criteria: professional requirements included into the structure roles and hierarchy interaction. Organization management issues that are currently studied by modern academics include: mediator role of the negative feedback to the leaders from their subordinates in the relationship between the quality of the leader-member exchange (Warren Watson, Larry Michaelsen [4]; Timothy R. Hinkin, Chester A. Schriesheim [5]), the evaluation of the effectiveness of the leader (Herman H. M. Tse, Ashlea C. Troth, Neal M. Ashkanasy, Amy L. Collins [6]); personal affects, discrete affects, emotional intelligence, emotional efforts and emotional climate as a result of the leader-leader exchange (Jae Uk Chun, Dongseop Lee, John J. Sosik [7]); the influence of group cohesion and leadership behavior on their subordinates' satisfaction in the organization (Gregory H. Dobbins, Stephen J. Zaccaro [8]); leadership self-awareness and its relation to the subordinate opinions adopted to the organizational hierarchy of an enterprise (Dan Moshavi, F. William Brown, Nancy G. Dodd [9]); the influence of the gender and age factors on the formation of a self-organized system (Dan Moshavi, F. William Brown, Nancy G. Dodd [10]). At the same time multi-dimensional nature of psychological characteristics of a person, and specifics of interpersonal interaction are disregarded, although these very criteria have the most influence on the organization reaching its goals.

Goals setting. The objective of this research is theoretical and methodological justification of concept approaches and methods of organizational change management in structures and functions attributed to the adjustment to the environment conditions and aimed to increase functioning efficiency of all economic system's elements.

Study results. In this research, I propose to prove a fundamentally new approach to Organization management through the model application of a progressive and dynamic organizational structure. The created model will represent an interactive revision of teams' setup that would correspond to specific projects and life cycle stage of an enterprise's development. (Fig. 1). This revision will cover a selection of such employees whose competencies and psychological qualities fit specific work types designed to help the enterprise reach its goals corresponding to its current life cycle stage. The model will also include an assessment of resources and possibilities available as well as limitations and possible threats.
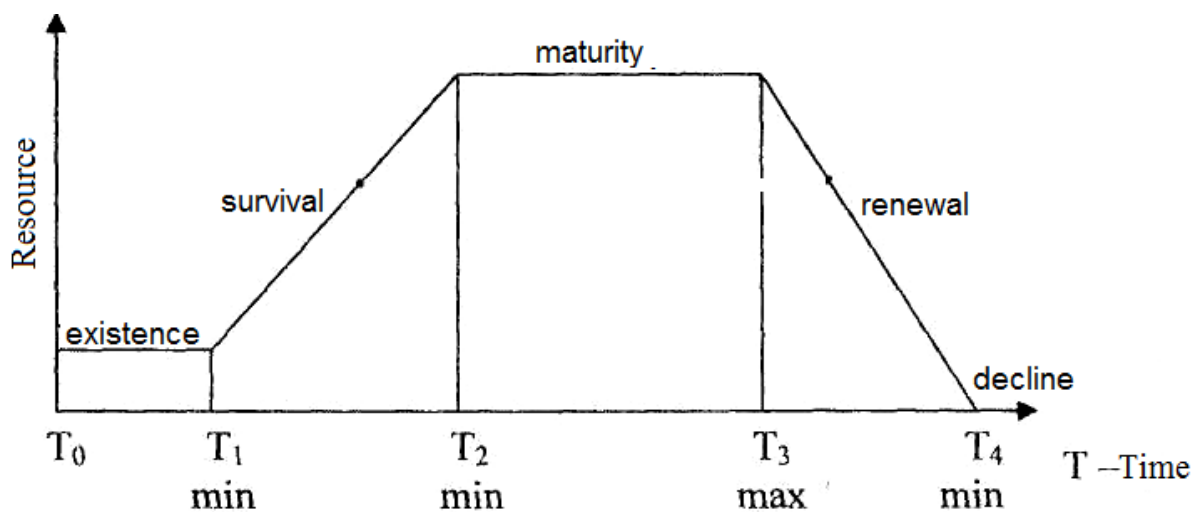
Fig. 1. **Organization life cycle stages**

At the initial time phase T0, resources of the organization cannot be equal to zero. The starting point of the organization creation (T0 – T1) coincides with the definition of its objectives. The goal is an anticipation of the results that the organization strives to achieve through its activity. The purpose of the business organization must meet the needs of its customers, solve socially significant problems that the society is facing. The basis of the organization's existence is the commercial idea, in other words, the vision of how it will generate economic value, and what will the income be. Profit should be considered as one of the criteria for success, and not as the end goal.

This model will have 5 standard options of the organizational structure/team for each phase of the enterprise's life cycle that will allow it to achieve the goal in the shortest possible time and at the lowest cost according to the stage of the life cycle:

Template 1 – Existence stage (goal: market entry speed-up),

Template 2 – Survival stage (goal: maximum market share and profit growth),

Template 3 – Maturity stage (goal: market leadership position retention),

Template 4 – Renewal stage (goal: negative economic trend exit and achievement of a new growth spiral),

Template 5 – Decline stage (reorganization / restructuring of an enterprise or its bankruptcy).

Each of the five templates are solved using the methods of minimax game theory, that is, simultaneous maximization of profit and minimization of labor costs required to perform a set of tasks to achieve the intended objective. This will be possible in case if each team member performs the most suitable for her/him type of work, while potential interpersonal conflicts are identified and eliminated, greatly increasing motivation and satisfaction from labor process.

Each model will contain the following components:

1. Description via SWOT analysis of resources available to achieve the goal of the given stage of the enterprise's life cycle and therefore associated external and internal obstacles / risks / threats (including the features of interpersonal interaction of different potentially conflicting employees with opposite / poorly compatible psychological characteristics);

2. Description of methods and means directed at achieving intended objectives and eliminating/minimizing obstacles and risks (including description of the types of work and management approaches required at each stage);

3. Employees' psychological characteristics ("Big Five") depending on the type of work described in p. 2.

Obtained results modelling depending on the company size and quantity output measures creation such as work time needed for each set of tasks, number of each type of employees and etc.

Variations are understood as deviations from certain system or environment characteristics at a set moment in time (t_1, t_2), $t_1 < t_2$. Environment changes (t) lead to a loss in the characteristics appropriateness (organizational design) of the system X (t). Appropriateness loss leads to the efficiency and sustainability decrease in the system. Building on that, the postulate of dynamic appropriateness is formulated: in order to maintain or increase the efficiency and stability of the system, a corresponding reaction of its internal characteristics in response to the changes in external environment is required. To achieve this, it is necessary to constantly identify and measure changes in the environment and develop responses to them. Change management is the process of forecasting and planning of future changes, evaluating forecasting and planning effectiveness and monitoring their implementation. Changes are usually associated with the development of the system (Fig. 2).
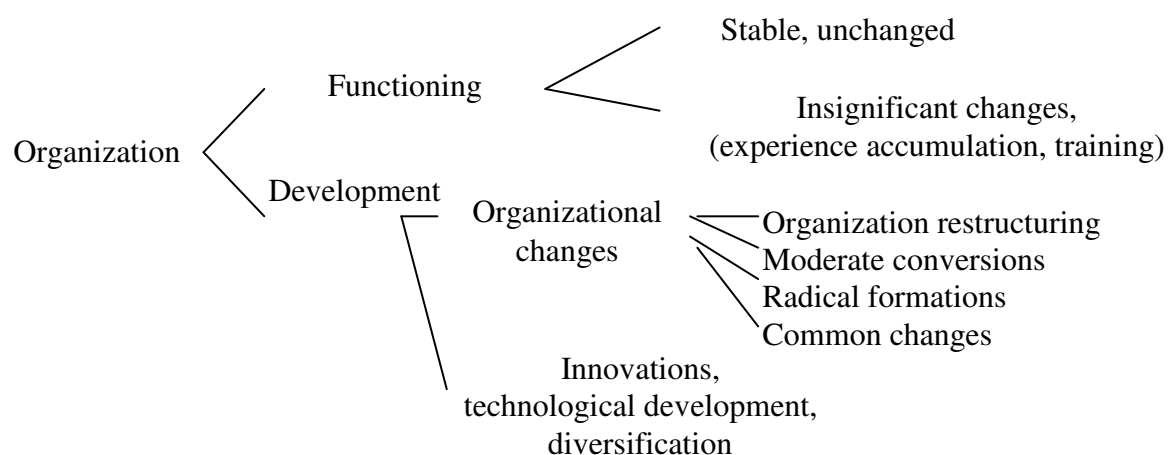
Fig. 2. **Relations of organization functioning, organization development and projected changes**

The nature of the change in I_ℓ depends on the volume of production q, price P, environmental conditions p_v, quality Q, primary cost Pr (Table 1).

Table 1

Connection between the nature of changes and enterprise reactions

Nature of the change	Reaction type	Characteristics
1. Market demand change	Changes of p_v, q, Q, p_r, product type	Passive or active
2. Tax Policy change	Changes of p_v, Q, enterprise size	By the variable input
3. Customer requirements change	Quality, marketing, production changes	Extreme
4. Competitors' behavior change	Price policy, strategy, volume, market changes	Strategic
5. Employees errors increase	Personnel retraining, selection, recruitment	Control

Depending on the time available as one of change resources, two schemes of change can be considered (Table 2).

Table 2

Characteristics of change conduction schemes at an enterprises

Characteristics	Rapid changes	Slow-pace changes
1. Planning changes	Clear (hard)	Vague (soft)
2. Change initiator	Manager (leader)	Team
3. Involvement level	Minor	Significant
4. Overcoming resistance	At any cost	Resistance minimization through consistent set of actions

The task of change management is to select such a vector of changes $I = (I_1, I_2 \ldots, I_n)$, which will give the desired (or maximum) effect $E_{(I)}$, with restrictions on consumed resources and costs.

The process of changes in the organization is a subject to a number of patterns:

1. Adequate design: the organization in its characteristics should be adequate to the characteristics of the external environment; if the environment has Nc elements and Rc ratios, and the system has Ns, Rs, respectively, then the adequacy of A is calculated as a multiplication of elements' affiliation functions and relations between the system and the environment.

2. Equilibrium preservation: any given system is in equilibrium, if problems arise in the organization, resources are redistributed so that equilibrium is restored. At the same time, the stability of the system is determined by its development, so from time to time, if the adequacy of the

system is changed, changes are made to the system aimed at innovation development.

3. Change effectiveness: the result of changes in R should exceed the costs of their implementation of the CT. These changes should cover key areas bringing maximum possible effect. For example, investments need to be done in those industries where their returns are the highest.

4. Feedback: in a stochastic environment, it is impossible to foresee everything, therefore, change management should be based on feedback about achieved results.

5. The law of energy conservation and transformation: stimulus for the organization transformation and development must be either internal changes (transformation of the potential into the kinetics of transformations) or external influence (market, environment, top management requirements).

6. Social inertia: the psychological conservatism of people leads to change resistance that must be overcome with the help of certain techniques.

The need for creativity and leadership: changes based on new ideas, creativity and leadership are the most effective ones. At the same time, in order to justify the effective implementation of changes in the enterprise, it is necessary to solve the optimization problem. If η is the level of changes, $0 \leq \eta \leq 1$, then two loss functions can be assigned to it: $C_{n1}(\eta)$ – implementation costs, $C_{n2}(\eta)$ – losses from the absence of changes in the organization. If these functions have, as practice shows, a type of exponent, then:
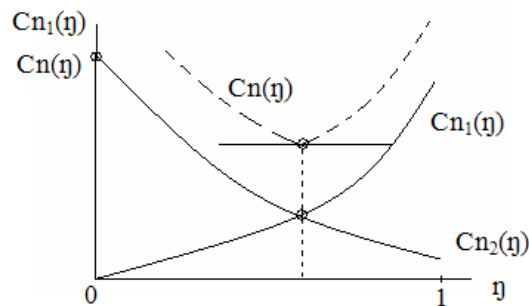
$$C_{n1}(\eta) = C_1\, e^{k1n}, \tag{1}$$

$$Cn_2(\eta) = C_2 \cdot e^{-k_2\eta}, \tag{2}$$

and optimal level of η_x is determined either by the point of curves intersection (Fig. 3), or by the condition that the derivative of the sum of these functions equals zero. From the condition of equality

$$C_1 e^{k_1\eta} = C_2 e^{-k_2\eta} \tag{3}$$

after logarithm we get:

$$\eta^* = \frac{\ln C_2 / C_1}{k_1 + k_2} \tag{4}$$

***Fig. 3.* Graphical representation of loss functions as a rationale for effective implementation of changes in the enterprise**

If in an enterprise $C1(0) = 10\ 000$ UAH, $C2(0) = 100\ 000$ UAH, $k_1 = 4.2$, $K_2 = 3.6$, then $\eta * = 0.29$, then the optimal change level should be equal to 0.29. This indicator was calculated for 48 surveyed enterprises. The introduction of changes is often a sequential process of transformation with resistance overcoming.

The main tools for choosing what changes should be implemented in the enterprise are: list creation of necessary changes, identification of time needed for their implementation, optimization of the structure and level of the enterprise's change characteristics. Changes may concern different areas *(k)* of organization's activities: organizational structure, technology, policy, culture, etc. and different types *(j)* of changes *Ukj* are possible. Therefore, the problem of choosing the optimal list is formulated as a choice of such a list of changes *Ukj*, that will give the maximum overall effect from strategic changes' implementation with the limited different resources consumed and the lowest costs possible. This task has been solved for three enterprises and the optimal change plans were received.

The task of choosing the optimal time for the changes' introduction is formed based on minimizing the function of total losses, depending on the time of change implementation. For example, with loss functions $Cn1 = 10 + 3t$, $Cn2 = 100e^{-2t}$ the optimum change time is $t = 2.4$ months. The third task allows to choose optimal strategy of changes' implementation considering their impact with the help of benchmark method. Change management becomes a strategically important area of management, allowing to solve tasks of an enterprise's management on a new basis.

For compliance assessment, uncertain measures of the system design *S* and environment complexity *Σ* were introduced. If the enterprise environment contains *Ec* elements, connected by *Nc* relations, and an enterprise uses *En* elements and *Nn* relations to reflect the state of the environment, then overall correspondence of enterprise management system to the environment can be estimated by their ratios multiplication.

Higher spread level of system performance's result E indicates lower correspondance of its management system to the work conditions. With a lower dispersion, the probability of enterprise management system achieving set goals is higher. Variance value σ_E^2 characterizes the extent to which system S is inadequate to the environment Σ. If a number of target indicators g_{ij} with assigned g_{ij} and average actual value g_{ij}^{ϕ} is available, then the measure of inadequacy can be considered as a distance between them. The higher $\rho_{3\phi}$ is, the greater is the inconsistency of N_y existing management process.

The correspondence of the management system will be characterized by the magnitude:

$$O = 1 - H. \tag{5}$$

For example, if $\rho_{3\phi} = 31{,}6$ and $\rho max = 100$ has $H = 0{,}316$, then $O = 0{,}684$, which means the system is consistent and organized for 68,4 % against its goal.

To assess the inconsistency of the management system, one should compare: actual S_a, expected S_e and conditioned by the goal achievement state of an enterprise Sg.

Since changes in the analyzed enterprises have quantitative nature, a method of selecting changes was developed, which aims to ensure an impact increase from their introduction. For example, the profit trend of NGO "Horizon" shows a positive influence on its profit from the introduced changes (Fig 4).
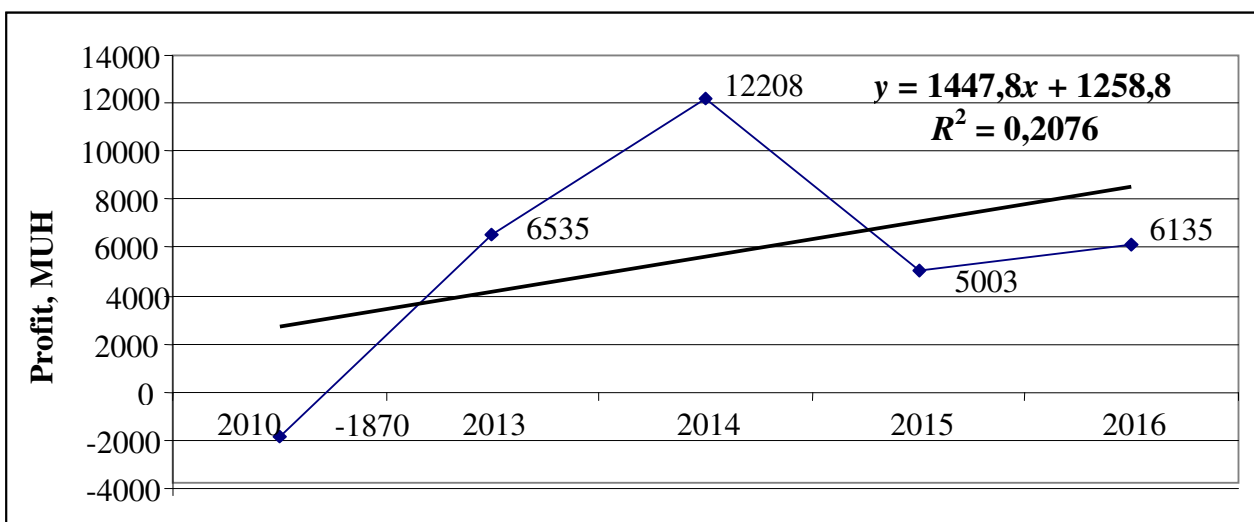

Fig. 4. **Profit trend of NGO "Horizon"**

In order to develop an effective strategy to manage changes within the enterprise, their possible implementation speed should be considered. According to the proposed classification of internal changes in the organization, a time continuum with three possible ranges of transformations' implementation is constructed: fast (under six months), moderate (0.5–1.5 years) and slow (over 1.5 years).

Transformations that can be realized within a shorter time horizon (with a rapid speed of change), find higher response rate among enterprises. In economic systems, system organization according to its goals represents a particular interest. Change management is an effective mechanism for system's self-organization. There are several ways to translate the state of an enterprise into a strategy of change (Table 3).

Table 3

Characteristics of possible changes and methods of their implementation

Type of changes	Implementation methods
1. Business activity change	Change in the type of economic activity or even industry, diversification
2. Structural change	Decentralization, divisional restructuring, change of "profit centers", shift to matrix organizations. Network structure change
3. Technology change	Replacement of equipment, introduction of new technologies or new production systems
4. Leadership change	Creation of teams, redesign of work flows, redistribution of responsibility, delegation
5. Change in Organization Culture	Change in the value system of motivation, leadership style, behavior patterns
6. People change	Employees' additional training, their qualification improvement, competitive hiring, rotation

If boolean variable is introduced $x_i = 1 VO$ depending if i- instrument of change is included into the change list and e_i-effect of i-instrument is marked, then the task of optimal change list determination is stated as a choice of such changes that would maximize target function $G(x_i) = \sum_i x_i \cdot e_i \to \max$ by limited resources and reasonable cost level. The solution to this problem determines a set of previously substantiated required changes. Since changes should be implemented in a timely manner, it is advisable to consider task optimization of time spent on change implementation. The creation of a change strategy must be linked to the life-cycle curve of the organization (Figure 5).
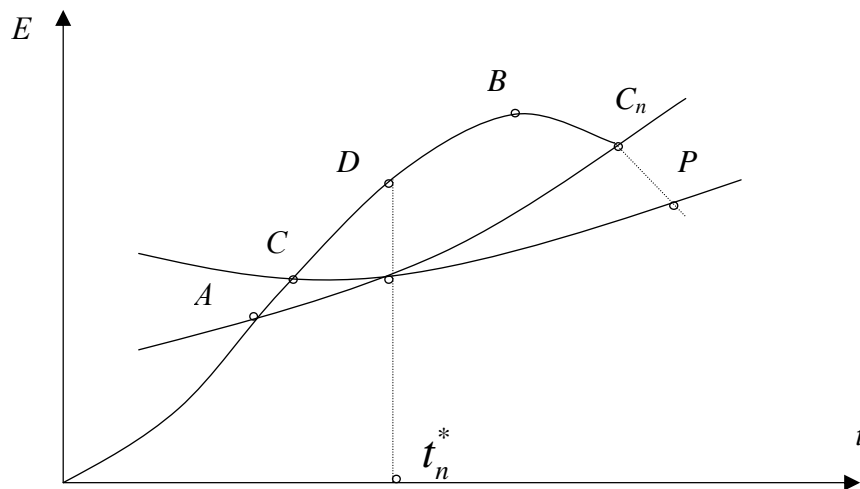
Fig. 5. **Losses and costs evolution from change implementation according to the organization's life-cycle curve**

If, after point *A*, the enterprise's performance is approaching point *B*, then the increase of losses C_n connected to the inefficient management might happen, at the same time the ability to adapt *P* is starting to decline. During the life cycle, the organization's management system changes, becomes the more rigorous and bureaucratic the closer it approaches its maturity. Therefore, the earlier the adaptation to the environment begins, the lower losses will be. The objective function of choosing the moment of change will represent a sum of two loss functions: delay in required changes introduction and costs of a forced quick reaction to environment changes.

An analysis of the state of NGO "Horizon" showed that the NGO is located in the proximity to Point *D*, and the changes have timely manner. In the process of choosing change instruments, a new task of necessary changes approval and synergy effect generation appears. If the intensity of the means of change is marked as *Uj*, then the effects of changes in the two NGO divisions can be expressed by the overlapping chart of two bell-shaped curves (Figure 6).

If $U_j < U_{12}$ for the 1st division and $U_j > U_{21}$, then n effect from the change is low. Within the range of (U_{12}, U_{21}) high outcome for the 1st, as well as for the 2nd division is in place. In this range of changes' intensity, resistance will be the lowest, and therefore synergy effect from the work of 2 divisions has high probability.
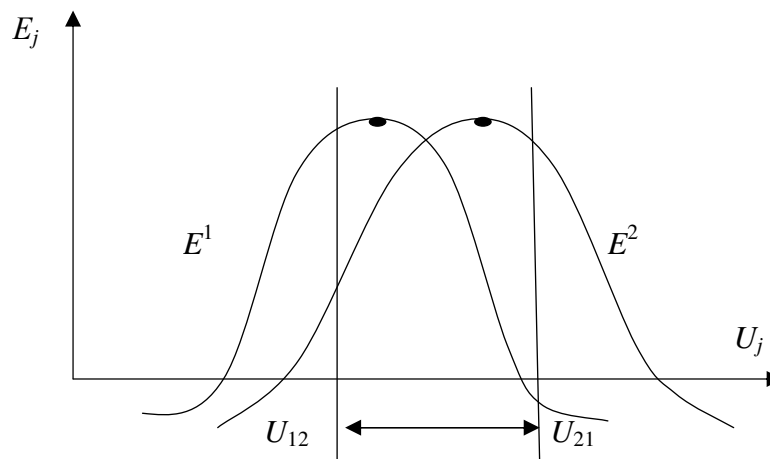
Fig.6. **Graph of necessary changes coordination and synergy effect**

Since change strategy establishment involves choosing the most effective way to reach the intended objective of an enterprise, it is necessary to carry out an analysis of the degree to which the existing organizational structure and functions of an enterprise correspond to the above mentioned development goals. Although changes more often have qualitative rather than quantitative nature, their results still can be assessed by the values of output variables. If reforms and changes are in place, they can be expressed using the artificial variable x_{2i}, which can take two values:

$$x_{2i} = \begin{cases} 1, & \text{if changes take place,} \\ 0, & \text{if no ochanges} \end{cases}$$

Then we can observe output dependence, for example, profit y_i from x_{2i}, in the following form:

$$y_i = \beta_0 + \beta_1 x_{2i} + e_i. \tag{6}$$

In the equation (6) when $x_{2i} = 0 \; E(y_i) = \beta_0$, and $x_{2i} = 1 \; E(y_i) = \beta_0 + \beta_1$, changes lead to an average result improvement, determined by the coefficient β_1. Using statistical data of NGO "Horizon" for 2011–2016, we can calculate model's parameters (6) using the method of the least squares: $\beta_1 = 2,55$; $\beta_0 = 0,35$, thus the equation has the following mode: $y_i = 0,354 + 2,548x_i$.

The model indicates that the ongoing changes enable an average profit increase of 2.55 million UAH per year and therefore are positive.

If one more growth factor is introduced – production volume x_{1i}, then we can build a qualitative model of the following mode:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + e_i. \tag{7}$$

In this case profit growth y_i is determined by x_{1i} (extensive growth) and x_{2i} (intensive growth), which can be divided according to the rules:

	x_{1i}	x_{2i}	Result
S_1	var	0	$E(y_i) = \beta_0 + \beta_1$
S_2	0	1	$E(y_i) = \beta_0 + \beta_2$
S_3	0	0	$E(y_i) = \beta_0$

Finally, it is possible to study the impact of changes on NGOs profits. A scatter forecast gives the following value: $y_i + 1 = 5.97$ million UAH – if no changes are made, and $y_i + 1 = -2.67 + 0.072 \times 120 + 0.95 \times 1 = 6.92$ million UAH – if changes' introduction at NGO "Horizon" is continued. A qualitative assessment of changes effectiveness can be approached from a different angle, using methods of testing hypotheses (test theory). If two samples are in place y_{1i} and y_{2i}, which characterize NGO's performance prior to changes' implementation (y_{1i}) and (y_{2i}) after it, then between average values of samples $\bar{y}_1$ *and* $\bar{y}_2$ we receive the difference $\Delta\bar{y} = \bar{y}_2 - \bar{y}_1$, that can be related to change results.

Based on the results achieved, it is possible to propose two hypothesis: 1) H_1: difference $\Delta\bar{y} > 0$ is determined by change impact with reliability $p = 1 - \alpha$; 2) H_0: difference $\Delta\bar{y} > 0$ is determined by random factors. Hypothesis testing was carried out using a mean difference test and proved H_1 credibility.

Finally, in order to execute the developed methods of monitoring and changes implementation, an expert system based on the stated principles is proposed. It covers constant analysis of the market environment change, competitors' activities and internal changes reflected by deviations of key indicators. The identified needed changes are displayed on the screens of personal computers of company's leadership and serve as a base for their decision making.

Conclusions and proposals. Alternative goals revision that correspond to the chosen direction of company's business activity, allows to justify scenario choice of possible future behavior of the organization, considering external environment. In order to evaluate the effectiveness of implemented changes, two components were identified: 1) costs of changes' implementation; 2) profit increase as an output of the implemented changes.

Based on the methods proposed in the study, in-process measures of the optimal change management at an enterprise were identified: changes' list

determination, their implementation sequence justification and timeliness intervals assessment.

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