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## Optimising Models of Management by Organizational Changes

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# Optimising Models of Management by Organizational Changes

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**Abstract.** Principles of management by changes at the enterprise are considered and the evolutionary model of changes is constructed. The primary goals of optimum control by changes at the enterprise are put, formalized and solved, examples of decisions are resulted. Examples of practical application of the developed models in practice are shown.

## 1. Introduction

The modern world of business quickly varies, the competition, complexity of technologies grows, the period of removability of production decreases, often reaction of firms to changes of the external and internal environment is late. This situation demands new management methods changes of the enterprises for an establishment of adequacy to an environment and stability increases. In management practice the well-founded choice of evolutionary changes (structure and functions) or revolutionary changes (merges, absorption, associations) the enterprises is necessary.

Since 90th years this scientific problematics began to develop quickly. Theories of changes of type E (rigid methods of changes of the enterprise) have been created and type About (soft methods) [1], are developed methods of re-structuring of the enterprises (U.Bridges, D.Kotter, V.Burkov, V.Irikov), private models of process of changes (Whether, Gejnz, Adams, V.Doliatovskiy) [2], organizational transformations (B.Karloff, H.Vissema, L.Grejner, I.Adizes), technologies of reengineering (M.Hammer, D.Champi, E.Oyhman) [3], are offered methods of evolutionary operation of business (D.Kasti, V.Doliatovsky, Y.Gamalej) [4]. However many works on management of changes have descriptive character, there is no mathematical toolkit of a substantiation of a choice of qualitative and quantitative characteristics of changes for real conditions of the enterprise. In work problems of a well-founded choice of these characteristics on the basis of definition of criteria of a choice of changes and restrictions are put and solved.

## 2. Principles of management of changes

Each enterprise functions and develops in the certain environment, co-operating with it. Certain balance  $R_e$  and  $R_o$  between an environment of the enterprise and its internal characteristics – a technological level, dynamics of management, qualification of the personnel, organizational culture, rates of increase, turnover (fig. 1) is thus established.



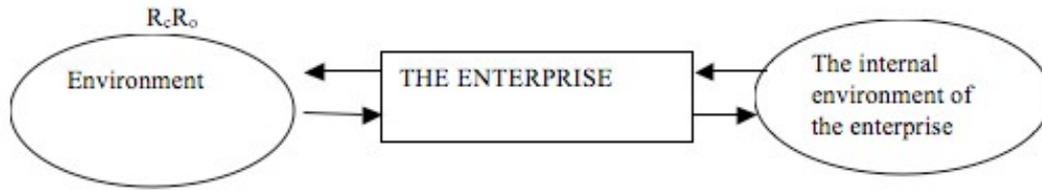


Figure 1. Mutual relations of the enterprise and environment.

At changes of characteristics of environment  $R_c$  the internal environment should change also for achievement of their conformity. In the certain environment the system which design is adequate to this environment (fig. 1) successfully and steadily can function. On this basis it is possible to formulate the law of an adequate design: for maintenance of stability and efficiency of functioning of system its design should be adequate to environment characteristics.

But the environment changes in time; changes are understood as deviations of certain characteristics of system or environment in time moments  $(t_1, t_2)$ ,  $t_1 < t_2$ . Changes  $(t)$  lead environments to loss of adequacy of characteristics (design) of system  $H(t)$ . Adequacy loss conducts to reduction of efficiency and stability of system that leads to adequacy: for maintenance or increase in efficiency and stability of system change of its internal characteristics, thus not to lower adequacy level is necessary, it is necessary to increase expenses for enterprise changes.

Stability of the enterprise is understood as property of the enterprise to keep its resultants indicators in the set limits at changes of the external or internal environment. There are stability borders (the bottom limiting values of indicators) at which the enterprise loses stability. To remain above these borders, it is necessary to reveal and measure constantly changes of environment and to develop on them corresponding reactions. Management of changes is a process of forecasting and planning of the future changes for maintenance of stability, efficiency of the enterprise and monitoring of their indicators. In a situation

$$S = (Q \times F), \tag{1}$$

where  $Q$  – an enterprise condition,  $F$  – a condition of environment,

It is necessary to choose changes  $I_\ell$ ,  $\ell = I, L$ , firms corresponding to criterion function:

$$G = F(Q, F, Y, t) \rightarrow \max, \tag{2}$$

Where  $Y$  – criterion of efficiency at restrictions of resources and possibilities.

Character of change  $I_\ell$  depends from  $Q, F, Y, t$  and changes usually contact system development (fig. 2).

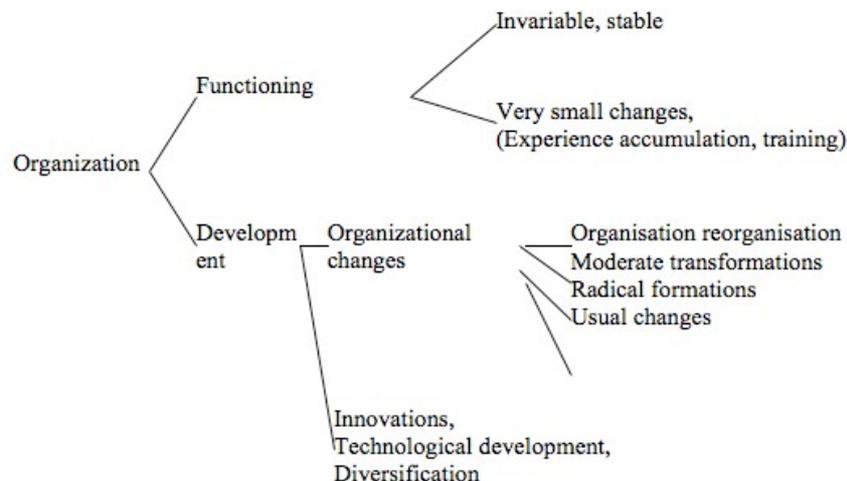


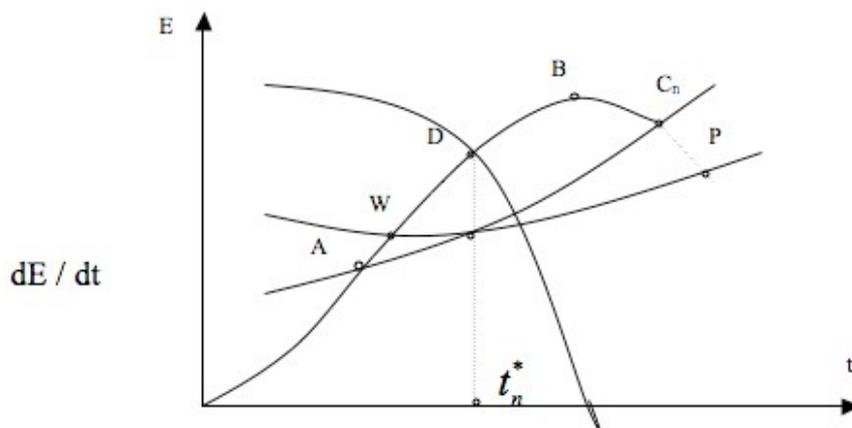
Figure 2. Communications of development and changes.

As organizational changes understand organisation changes in reply to change of environment. Really, at change of an environment the organisation should change the characteristics according to the law of progressive evolution: parameters, algorithm, functions, structure, an action principle, mission. Thus, two sources of changes are allocated: an environment and the internal environment of the organisation. And, if strategic planning is guided the problems defined by "rigid" aspects of environment strategic management analyzes also changes of the internal environment (style of a management, organizational culture, mutual relations in collective). Organizational changes cover five basic spheres of the firm.

### 3. Evolutionary model of organizational changes in enterprise

Changes in an organization environment act as defining factor of the further development of the firm. In this context two directions of development of the firm are allocated: evolutionary and revolutionary. Changes in the enterprises adhering to a principle of maintenance of dynamic balance with the environment, are discrete, but will always be co-ordinated with the general direction of changes in their environment. In absence of representations about the future position such enterprises are guided in a direction of changes in an external environment. In this case managers try to support efficiency of the enterprise by the step-by-step changes logically connected among themselves, it is good enough согласующихся with changes in an environment.

According to the S-shaped law of development of the enterprises [1,3], the system effectiveness at first quickly accrues to a point of an excess And (fig. 3), then occurs delay of growth E, there comes saturation and then recession follows. Therefore the most effective growth E is on a site the EXPERT, to an excess point that shows the schedule of change of a derivative  $dE/dt$ . After point D the derivative changes a sign. In a derivative it is equal to zero.



**Figure 3.** Changes of losses and expenses for change (S - the figurative law of development).

If after a point And the enterprise overall performance comes nearer to a point In the increase in losses  $C_n$  because of a poor control is possible, thus ability to adaptation P starts to fall. During life cycle the system of management of the organisation varies, at approach to saturation In becomes more bureaucratic. Therefore the earlier adaptation to Wednesday will begin, the there will be River losses less.

Owing to action of this law for constant growth of system effectiveness E it is necessary to begin process of change S1 to transform S1 in S2 with higher efficiency transition to more-shaped curve on site AB. Thus, transition on the basis of changes  $S1 \rightarrow S2$  characterises system evolution. Evolution is understood as process of consecutive positive changes of system.

Leading to continuous growth of its efficiency. Such principle of development by passage through crises at the points of bifurcations is characteristic, for example, for management evolution (fig. 4).

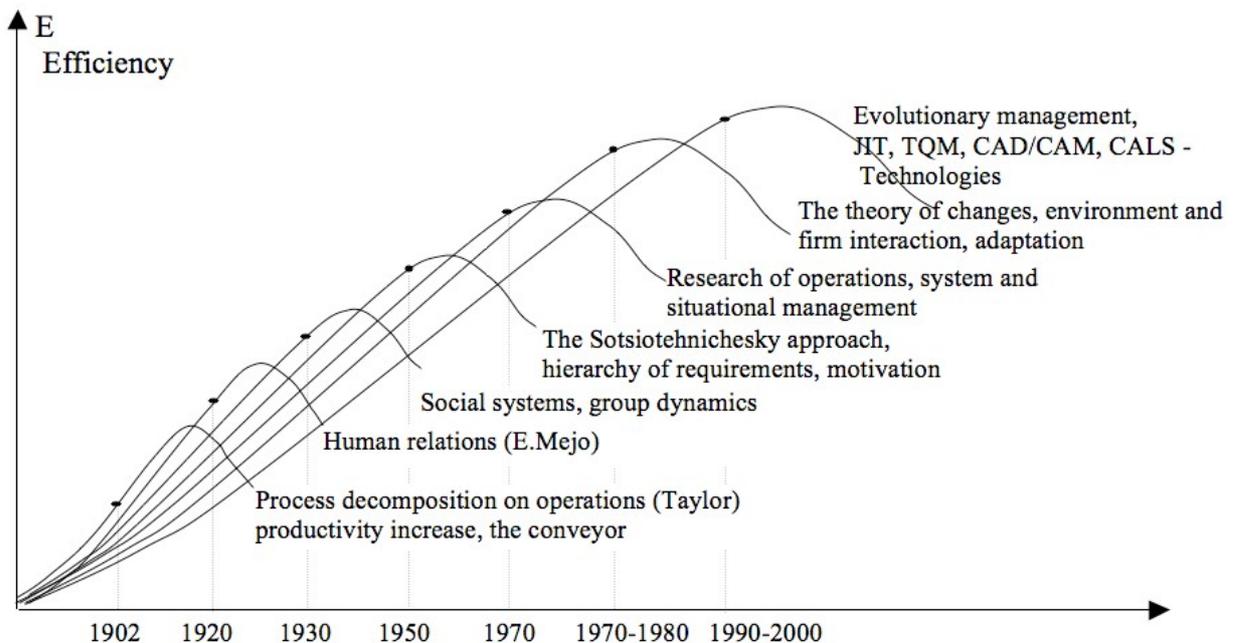


Figure 4. Evolution of management by consecutive changes.

#### 4. Problems of optimal management of organizational change processes

The problem of management of changes consists in a choice of such vector of changes  $I = (I_1, I_2, I_n)$  which will give wished (or maximum) effect  $E(I)$ , i.e. it is necessary to reach target  $E(I) = e_j \cdot I_j \rightarrow \max$  At restrictions

$$\sum b_{ki} \cdot I_j \leq B \quad (3)$$

$$\sum c_j I_j \leq C$$

$$I_j \geq 0,$$

Where  $b_{ki}$  - consumption of  $k$  resources for realization of  $j$  changes,  $B_k$  - total resources of  $k$  types,

$C_j$  - expenses on  $j$  change,  $S$  dop- admissible expenses.

And for a substantiation of effective application of changes at the enterprise it is possible to solve the optimization problem. If-level  $\eta$  changes,  $0 \leq \eta \leq 1$  to it can be two loss functions are associated:  $Cn_1(\eta)$  - expenses for realization of changes,  $Cn_2(\eta)$  - losses from absence of changes of the enterprise. If these functions look like an exhibitor as practice shows:

$$Cn_1(\eta) = C_1 e^{k_1 \eta} \quad (4)$$

$$Cn_2(\eta) = C_2 \cdot e^{-k_2 \eta} \quad (5)$$

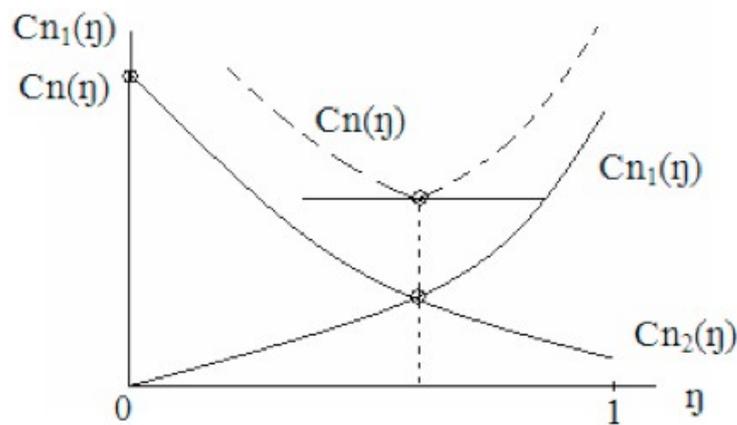
And an optimum level  $\eta^*$  is determined a point of intersection of curves (fig. 5).

Or a condition of equality to zero of the derivative sum of these functions:

$$\frac{dCn(\eta)}{d\eta} = \frac{d[Cn_1(\eta) + Cn_2(\eta)]}{d\eta} = 0 \quad (6)$$

From an equality condition  $C_1 e^{k_1 \eta} = C_2 e^{-k_2 \eta}$ , after logarithm, we get

$$\eta^* = \frac{\ln C_2 / C_1}{k_1 + k_2} \quad (7)$$



**Figure 5.** Graphic representation of functions of losses.

For example, if in firm  $C_{n1}$  ( $0 = 10$  t.usd.,  $Sp_2(0) = 100$  t.usd.,  $k_1 = 4,2$ ,  $k = 3,6$ ,  $\eta^* = 0,29$ , i.e. level of changes should be 0,29.

Changes can concern different spheres ( $k$ ) activities of firm: structures, technologies, politicians, cultures etc. also are possible various types ( $j$ ) of changes  $U_{kj}$ . Then the problem of a choice of the optimum list of changes is formed in a kind:

$$G(V) = \sum_k \sum_j e_{kj} \cdot u_{kj} \rightarrow \max \quad (8)$$

$$\begin{cases} \sum_k \sum_j \sum_i a_{ijk} \cdot u_{kj} \leq A \\ \sum_k \sum_j \sum_i c_{ijk} \cdot u_{kj} \leq B \\ u_{kj} \geq 0, \end{cases} \quad (9)$$

Where  $U_{jk}$  – specific expenses of  $i$  resources for  $j$  changes in a field of activity of the firm,

$C_{ij}$ -specific cost of a resource  $i$

$A$ -stocks of resources

$In$  - limiting expenses for changes

This task was solved for 3 firms and optimal plans for changes were obtained.

The problem of a choice of the optimum moment of time for introduction of changes is formed on the basis of minimization of function of total losses depending on time:

$$C_n(t) = [a + bt + C_0 e^{-dt}] \rightarrow \min \quad (10)$$

$$t_1 \leq t \leq t_2$$

$$a + bt \leq C_{don}$$

Having equated  $\frac{dC_n(t)}{dt} = 0$ , we will receive

$$t = \frac{\ln b - \ln d \cdot C_0}{d} \tag{11}$$

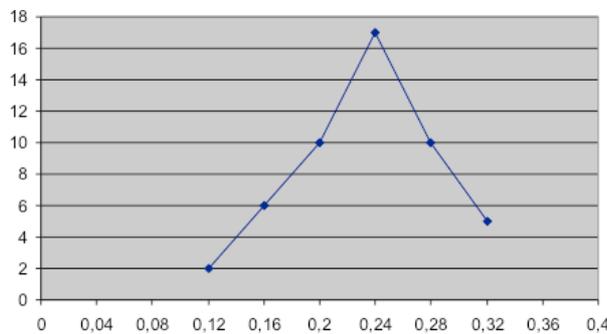
For example, at  $C_{n1} = 10+3t$ ; and  $C_{n2} = 100e^{-2t}$  we will get  $t = 2.4$  months

The third problem gives the chance a choice of optimum strategy of changes taking into account their synergy at use of technologies of benchmarking.

Management of changes becomes strategically important area of the management, allowing to solve problems of management of the enterprises on a new basis.

**5. Application of the formulated problems**

On the basis of formulas (6), (7) indicators of levels of changes of the surveyed firms are calculated. For 48 enterprises rough values of indicators  $\eta^x$  have been calculated. Their distribution constructed on the basis of sample, is resulted on fig. 6.



**Figure 6.** Distribution of the calculated indicators of level of changes at the enterprises.

Population mean of level of changes at the surveyed enterprises equally  $\eta^* = 0,228$  with a dispersion 0,013.

At formation of sequence of changes effects of combinations of strategic changes are defined, for example, in a matrix the best combinations are visible:

	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>4</sub>
I <sub>1</sub>	1	3	4	3
I <sub>2</sub>	2	4	3	2
I <sub>3</sub>	1	3	4	5
I <sub>4</sub>	0	4	1	3

Then, choosing the maximum values of consecutive combinations in a matrix, we form optimum sequence of introduction of changes:

I1 → I3 → I4 → I2

For the account of a synergy of elements of strategy at their combination in strategy the matrix of admissible combinations is under construction, possible strategy of changes get out: S1, S2, S3, ... for which effects taking into account factors of synergy Kij pay off:

$$E(S_k) = \sum K_{ij} (R_j - C_j) \tag{12}$$

The best is the strategy, satisfying to a rule:

$$\max_k S^* = \max_k E(S_k),$$

I.e. S3 which gets out for introduction.

### Conclusions

1. The law of an adequate design and a postulate of dynamic adequacy of the enterprise is formulated to environment.
2. The evolutionary model of the organizational changes, allowing to define optimum modes of changes of the enterprise is offered.
3. Were formulated problems of definition of an optimum level of changes, optimisation of the list of changes, a choice of the optimum moment of changes and optimisation of their sequence also are solved.

### 6. References

- [1] Jacobs R W 1994) Real-time strategic change: How to involve an entire organisation in fast and far-reaching change San Francisco: *Berrett-Koehler*
- [2] Doliatovskiy V, Kasakov A, Kohanenko I 2005 Methods of synergetic and evolutive economics in control. Monography.-Rostov-on-Don: *Ed. RSUE-OGI* 587 p
- [3] Wheatley M J, Tannebaum R, Yardley P Y and Quade K 2003 Organization development at work: conversations on the values, applications, and future of OD San Francisco: *John Wiley and Sons*
- [4] Doliatovskiy V, Zolotariyov V, Ivahnenko A, Gamaley Y 2006 Adaptive control of economic systems in distinct conditions-Rostov-on-Don: *Ed. RSUE* 298

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