Principles of integration of time-oriented thinking – factor of efficiency improvement under economy digitization condition – into operating structure

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Abstract. The present article is substantiating the need of organization-management paradigm transition from cost (value)-based to that oriented on lead time reduction. The authors are presenting and describing basic provisions and assumptions of this approach and issuing recommendations on transition to time-oriented thinking. The paper is reflecting the impact of lead time reduction on basic indicators of economic effect and company efficiency. The authors proposed an indicator of unit (department, team, project) efficiency assessment and methods of using it.

1. Introduction
Purpose of this investigation – analysis of impact of organization-management thinking change (stipulated by digital economy environment) exerted on economic efficiency of enterprises.

Basic tasks of investigation:
1. Definition of new organization-management paradigm complying with economy digitization process;
2. Elaboration of methods of enterprise transition to new organization-management paradigm;
3. Assessment of impact exerted by new thinking on enterprise economic efficiency;

Prediction of changes and prompt response to environment change are most important constituents of enterprise functioning and developing in condition of economy digitization and modernization. Intensification of external environment mobility and changeability requires comprehension of fact that time factor is becoming even more important constituent of competitive practices. Ability to undergo rapid changes is the basis of successful development and functioning of business under digital economy condition. We propose to change vector of thinking of enterprise managers and employees from cost (value)-based to time-oriented.

2. Time-oriented thinking postulates and implementation logic
Conventional (cost/value – oriented) thinking is oriented on production efficiency improvement through reduction of labor, finance and materials cost. New thinking is oriented on reduction of works and tasks lead time causing basic indicators improvement owing to time shortening. This is why we are identifying it as time-oriented (time-centric) thinking.
Problem of lead time reduction is not new. It was on separate occasions touched upon during various historical periods by K. Marx, [1], R. Suri [2] D. Sutherland [3], D. Jones [4] and other economists. Approaches elaborated by them (six sigma [5], lean production [6], concurrent engineering [7], SCRUM [8], QRM [9], agile manufacturing [10] etc.) are representing practical implementation of their investigations in the sphere of lead time reduction.

Basing on assessment of aforesaid approaches we defined the following **postulates (principles) of time-oriented thinking:**

1. It is based on productive/non-productive time proportion measurement and finding the ways of reducing thereof. Productive time is understood as time associated with order processing (including adjustment, transportation etc.). Non-productive time is time during which a particular order is not under processing. To lead time increasing non-productive factors we can refer: faults committed during primary order processing, low-quality supplies of raw materials; transport vehicles breakdown and search etc.

2. In our opinion, productive/non-productive time proportion shows what type of innovation [11] – organization-management or technological – will contribute to enterprise efficiency improvement. Authors elaborated a respective algorithm (figure 1).

   ![Algorithm of innovation type definition with time-oriented approach](image)

3. Transition to new thinking intends switch-over to network-based or unit-based (brigade, project) organizational structure consisting of units oriented to particular product (segment servicing, project implementation etc.). Employees-members of the unit (group) shall be capable to grasp collateral skills (specialties). Tangible incentive for unit (project group) employees shall be referenced with lead time reduction.

   At that, units shall have below characteristics:
   - adequateness of resources and authorities (resources are always at unit's disposal);
   - resources combinability;
   - resources multi-functionality;
   - completed sequence of order fulfillment operations.
4. Employment of system dynamics principles facilitates production process stabilization. There are four main principles of system dynamics [12]. In our opinion, aforesaid principles are applicable to the process of order fulfillment and may constitute the basis for measures intended to optimize resources utilization, decrease production process variability and sort out product priorities. While shaping the unit it is required to estimate economic effect resulting there from and to observe any requirements regarding resources (refer to item 3).

5. Concerted company strategy means time-oriented thinking of all company units at any level of the enterprise. Such way of thinking is also affecting the system of material requirements planning and cooperation with suppliers and consumers.

**Enterprise transition to new organization-management paradigm intends:** lead time assessment, innovation type definition (organization-management or technological), definition of key product and unit establishment, unit activity testing and scaling within the framework of enterprise. Logic of this approach implementation is shown in figure 2.

![Figure 2. Logic of implementation of time-oriented thinking as an organization-management innovation.](image)

3. **Impact exerted by time-oriented approach on efficiency**

In order to implement time-oriented approach it is required to plot the chart of time expenditures – i.e. to reconstitute the process of product manufacturing and to obtain information about actual time expenditures. Each employee submits information about actual time spent for his particular work and total time from order acceptance till its further dispatching. Based on information obtained, it is required to plot the chart (e.g. Gantt chart) where within the total (maximum) lead time it is required to identify productive and non-productive time. This correlation shall be further analyzed in order to identify the required innovations (figure 1). Next step – determination of costs associated with lead time increase and objective value of time expenditures reduction.

Time expenditures reduction can be correlated with cost indicators allowing to evaluate economic efficiency [13]. Cost indicators may be represented, firstly, by add-on sales or any other economic indicators achieved due to reduction of lead time of one executed order and, secondly, by reduction of costs and losses incurred by the enterprise due to long lead time. Types of economic effect are presented...
in Table 1. Some cases give direct quantitative evaluation (designated as “+”), in other cases, in our opinion, quantitative evaluation either requires special procedures or has limitations (designated as “+/-”).

| Types of effect obtained due to time expenditures reduction | Probability of quantitative evaluation of direct effect |
|------------------------------------------------------------|------------------------------------------------------|
| Increment in profit                                       | +/-                                                  |
| Increase in revenues                                      | +/-                                                  |
| Increase in output                                        | +/-                                                  |
| Decrease of work time expenditures                        | +                                                    |
| Salary fund saving                                        | +                                                    |
| Decrease of material costs                                | +                                                    |
| Reduction of production cost                              | +                                                    |
| Financial saving                                          | +                                                    |
| Decrease of management costs                              | +                                                    |
| Improved customer service                                 | +/-                                                  |
| Optimization of organizational structure                   | +/-                                                  |
| Decrease of indirect costs                                | +/-                                                  |
| Decrease of general and administrative expenses            | +/-                                                  |

Several examples displaying effect of time-oriented approach on enterprise performance improvement:

**Increment in profit and revenues due to:**
- reduced lead time;
- additional competitive advantages, particularly, potential of supplying the product manufactured according to individual order without lead time increase;
- ability to create market niche by prompt introduction of new products.

**Decrease of costs:**
- decrease of system (indirect) costs;
- lower material costs due to improved supplies management;
- lower direct and/or indirect costs per sales article.

**Quality improvement due to:**
- prompt feedback;
- decrease of manufacturing defects.

**Improvement of personnel organization and motivation** due to better psychological climate and team working

**Customer satisfaction improvement** due to prompt response at any stage of cooperation.

4. **Quantitative evaluation of process efficiency (unit performance)**

Time-oriented thinking provides, in particular, that basic indicator of unit (team, group, project) performance is represented by lead time reduction. For this purpose, let us define and fix initial (reference) time spent for order execution and compare it with current time \((K_0 = 1)\).

\[
K_i = \frac{t_0}{t_i}
\]  

(1)
where $K_t$ – lead time factor;
$t_0$ – reference lead time;
$t_i$ – current lead time;

Increment of ratio shows that team performance is satisfactory. Decreased or unchanged indicator means that it is required to identify time losses more thoroughly and to take measures enabling time cycle shortening.

Let us consider the results of new thinking implementation on the basis of lead time reduction in IT Company. The Company selected the structure in which every new product is developed by and individual unit (team). Initially, maximum time spent for product engineering design was 82 days (table 2).

| Main stages of order execution | Maximum time expenditures, days |
|-------------------------------|--------------------------------|
| Development of requirements specification | 3 |
| Approval of requirements specification | 2 |
| Design stage | 60 |
| Development and description of code | 11 |
| Testing, adjustment and quality assessment | 3 |
| Documentation | 3 |
| **TOTAL** | **82** |

Owing to time-oriented thinking approach the following results were gained within one year:
1\textsuperscript{st} quarter – average lead time is 82 days;
2\textsuperscript{nd} quarter – 70 days;
3\textsuperscript{rd} quarter – 51 days;
4\textsuperscript{th} quarter – 47 days.

Accordingly, $K_1 = 1$, $K_2 = 1.17$, $K_3 = 1.6$, $K_4 = 1.74$.
Additional orders gave the company extra profit (increment 18%).

Thus, thinking associated with reduced lead time ensures: increase of revenues, decrease of costs, more efficient organization, improvement of quality and customer satisfaction.

5. Conclusion

Companies under the condition of digital economy must promptly respond to environment variation. Traditional (cost-based) approach to management cannot provide company sustainable functioning and development in digitization conditions. Authors proposed to use new (lead time-based rather than cost-based) way of thinking. Enterprise switchover to new organization-management paradigm is implemented in a number of steps: lead time assessment, innovation type definition (organization-management or technological), definition of key product and establishment of units intended to manufacture the new product, unit activity testing and scaling within the framework of enterprise. Lead time factor is used for unit (team) performance assessment. Increase of this indicator verifies efficiency improvement. For company as a whole, reduction of lead time is displayed by: increase of revenues, decrease of costs, improvement of management, improvement of quality and customer's satisfaction.

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