DEVELOPING A METHODOLOGY FOR ASSESSING TECHNICAL AND ECONOMIC INDICATORS FOR EFFECTIVE CHANGE MANAGEMENT IN THE ENTERPRISE

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Abstract

Today, ongoing improvement of business processes is required to enhance the efficiency and competitiveness of the enterprise due to the high volatility of the market, increased competition, and scientific and technological progress. This article is devoted to challenges facing effective change management in industrial enterprises and aims to devise a methodology for effective change management. The significance of this research topic lies in the fact that there is still insufficient discussion of effective change management in industrial enterprises, especially those in which outsourcing services are diverted or are being diverted from the energy, automation, mechanics, and IT departments. As of now, change management only starts to shape itself into a distinct area of research and one of the leading approaches to its study is evaluating the enterprise activity on the basis of the Shewhart-Deming cycle. This paper examines different levels and approaches to change management. A methodology is developed to create effective change management aimed at helping calculate the economic efficiency of projects. Popular economic indicators were systemized and evaluated in terms of their applicability from a regional perspective. Training of specialists who will work in these changing conditions is another focus of attention.

Keywords: Change management, project management, levels of change management, the Shewhart-Deming Cycle.

I. Introduction

When companies need to improve their performance, they carry out an analysis of the projects to be changed. The most frequent changes concern processes and uses of new technology. Change management is an approach to prepare, equip
and support individuals to successfully adopt changes resulting in organizational success [XXII, VII]. Today, ongoing improvement of business processes is required to enhance the efficiency and competitiveness of the enterprise [XIII]. Many companies, especially those in which outsourcing services are diverted or are being diverted from the energy, automation, mechanics, and IT departments, engage in activities intended to enhance the efficiency and quality of their business processes. [IX, I].

On one hand, enterprises and, more specifically, their departments face a number of serious problems related to centralization, qualitative and timely consideration of various applications, requirements and documents. Moreover, there is also a concern about timely data processing and management relating to technological equipment, aggregates and their integrity, among other things [IX, I, XX].

On the other, training of specialists who will work in these changing conditions is also to be taken into consideration. This is why managers, engineers, specialists and even students should experience no difficulty in using the proposed approach [XX, XVII].

The significance of this article lies in the fact that effective change management needs improvement in enterprises. Change management only starts to shape itself into a distinct area of research [XXII].

The following common key indicators are used to calculate the economic efficiency of projects in different industrial enterprises specializing in various fields of technology: net present value (NPV) [XXIII], internal rate of return (IRR) [X], the payback period (PB) [XII], profitability index (PI) [V].

II. Methodology

II.i. Levels of Change Management

The key idea is that all changes are unique; hence three levels of change management [XXV]:
- Individual Change Management;
- Organizational or Initiative Change Management;
- Enterprise Change Management Capability.

Individual change management requires understanding of how people experience change and what they need to do for changes to be successful. Individual change management is based on disciplines such as psychology and neuroscience, which offer mechanism for implementing individual changes.

Changes occurring at the individual level often make it impossible for the project team to manage change on a person-by-person basis. Organizational change management involves the identification of groups and people who will change as the result of the project, and in what ways they will need to change.

Enterprise change management is a core organizational competency that ensures competitive advantages and develops the ability to adapt to the ever-changing world. The possibility to manage enterprise change is embedded into the roles, structures, processes, projects and leadership competencies of the organization.
In terms of enterprise agility, uncertainty, and maintenance of competitive advantage, dynamism, the goal enterprises is to increase production efficiency. Given a close relationship between the effective functioning of the organization and quality, changes taking place at the enterprise and their economic effects need to be investigated in more detail.

II.ii. Technical and Economic Indicators

The following economic indicators are used to calculate economic efficiency [XVIII]:
- Net present value (NPV) [XXIII, XVIII]:
  \[ NPV = \sum_{t=0}^{n} \frac{CF_i}{(1 + i)^t} - \sum_{t=0}^{n} \frac{I_i}{(1 + i)^t} \]
- Internal rate of return (IRR) [X, XVIII]:
  \[ NPV_{(IRR)} = \sum_{t=0}^{n} \frac{CF_i}{(1 + IRR)^t} - \sum_{t=0}^{n} \frac{I_i}{(1 + IRR)^t} = 0 \]
- Payback period (PB) [XII, XVIII]:
  \[ PB = \frac{I}{CF} \]
- Profitability index (PI) [V, XVIII]:
  \[ PI = \frac{\sum_{t=1}^{n} \frac{CF_i}{(1 + i)^t}}{\sum_{t=1}^{n} \frac{I_i}{(1 + i)^t}} \]
- Average annual net arrival;
- Average economic efficiency of investments;
- Productivity (P):
  \[ P = \frac{Q}{t} \]
Where \( CF \) = cash flow, rub;
\( I \) = investment, rub;
\( i \) = the discount rate, %;
\( n \) = duration of the project, years;
\( t \) = the current year valuation period \( n \), years;
\( IC \) = the value of the original investment, rub;
\( Q \) = actual production.
Interestingly, these indicators consider the effectiveness of investment projects at all stages of its life cycle.

When evaluating the effectiveness of a project, attention should be given to the external environment of entrepreneurship. Besides, it is important to understand the impact of political, social and technological factors on the indicators.
II.iii. Approach to Managing Change

Successful change implementation in an enterprise is a set of complicated processes and procedures, and today there is often need for change. The following are the major research approaches adopted to study change:

- The Shewhart-Deming Cycle *PDCA* (Plan - Do - Check - Act) [VI];
- The reengineering process [XVII].

The Shewhart-Deming cycle PDCA is a common method for continuous quality improvement.

**PLAN**: Design or revise business process components to improve results.

**DO**: Implement the plan and measure its performance.

**CHECK** (or **STUDY** [VI]): Assess the measurements and report the results to decision makers.

**ACT**: Decide on changes needed to improve the process.

Figure 1 show the Shewhart-Deming's PDCA cycle.

**Fig. 1**: The Shewhart-Deming Cycle
III. Results

A methodology is developed to assess technological and economic indicators influencing the enterprise’s technical and socio-economic environment. Table 1 shows a list of key indicators of the enterprise’s activity assessment.

Table 1: Analysis of technological and economic indicators influencing the enterprise’s socio-economic environment

| Environmental factors | Indicators (group of indicators) | Influence on external environment (subject to change) | Actor |
|-----------------------|----------------------------------|------------------------------------------------------|-------|
| 1 Economic environment | 1.1 Net present value | \[ NPV = \sum_{t=1}^{n} \frac{CF_t}{(1 + i)^t} - \sum_{t=t}^{n} \frac{I_t}{(1 + i)^t} \] | Possible income reinvestment |
|                       | 1.1.1 Refinancing | \( CF = \text{cash flow, rub}; I = \text{investment, rub}; i = \text{discount rate, \%}; n = \text{project length, year}; t = \text{current evaluation period, year}. \) |
|                       |                     | Relative income \( \Delta NPV = NPV - NPV_0 \) \( NPV_0 = \text{initial net present value}. \) |
|                       |                     | Refinancing (as of June, 2018): \( i = 7.25 \% \), \( i = 0.25 \% \), \( i = 1.75 \% \) |
|                       | 1.2 Profitability index | \[ PI = \sum_{t=1}^{n} \frac{CF_t}{(1 + i)^t} - \sum_{t=t}^{n} \frac{I_t}{(1 + i)^t} \] | Selection of the priority project |
|                       |                     | \( CF = \text{cash flow, rub}; I = \text{investment, rub}; i = \text{discount rate, \%}; n = \text{project length, year}; t = \text{current evaluation period, year}. \) | Owner |

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### Environmental factors

| Indicators (group of indicators) | Influence on external environment (subject to change) | Actor |
|---------------------------------|------------------------------------------------------|-------|
|                                 | Quantitative indicator                               |       |
|                                 | Qualitative indicator                                |       |

#### 1.3 Internal rate of return

\[
IRR = \frac{\sum_{t=0}^{n} \frac{CF_t}{(1 + IRR)^t} - \sum_{t=0}^{n} I_t}{(1 + IRR)^n}
\]

- \( IRR \): internal rate of return;
- \( CF \): cash flow, rub;
- \( I \): investment, rub;
- \( n \): project length, year;
- \( t \): current evaluation period, year.

#### 1.3.1 Tax level

\[
\Delta B = B_{i+1} - B_i, \quad \text{where}
\]

\[
B_i = C_i + H_i,
\]

\[
B_{i+1} = C_{i+1} + H_{i+1}
\]

- \( B \): revenues;
- \( C \): own capital;
- \( H \): taxes;
- \( H_i \): taxes from the previous stage;
- \( H_f \): federal taxes, \%;
- \( H_r \): regional taxes, \%;
- \( H_l \): local taxes, \%.

#### 1.4 The payback period

\[
P_B = \frac{I}{CF}
\]

- \( CF \): cash flow, rub;
- \( I \): investment, rub.

### 2 Political environment

#### 2.1 Available technology

Yes/No

- Available technology in accordance with the equipment lifecycle strategy [19–21].

### 3 Socio-cultural environment

#### 3.1 Productivity

\[
\Delta P = P - P_{\text{ideal}}
\]

- \( P \): productivity;
- \( P_{\text{ideal}} \): Region’s readiness to take.

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| Environmental factors | Indicators (group of indicators) | Influence on external environment (subject to change) | Actor |
|-----------------------|----------------------------------|------------------------------------------------------|-------|
|                       |                                  | Quantitative indicator | Qualitative indicator |
| 3.2 Indicators of the organizational structure |                                  | $P_0 = \text{initial productivity}$ | staff [22] |
| 3.2.1 Number of jobs | $\Delta RO_1 = O - O_0$ | $O = \text{number of jobs}$; $O_0 = \text{initial number of jobs}$ | Refresher training |
| 3.2.2 Number of persons participating in the project | $\Delta RO_2 = C - C_0$ | $C = \text{number of employees}$; $C_0 = \text{initial number of employees}$ | Owner |
| 3.2.3 Number of recent university graduates | $\Delta RO_3 = Cm - Cm_0$ | $Cm = \text{number of recent university graduates}$; $Cm_0 = \text{initial number of recent university graduates}$ | |
| 3.3 Working conditions | Share of expenses on attesting of recent university graduates, postgraduates and students; $K_{av} = D/d$ | $D = \text{employee income}$; $d = \text{number of days}$ | Owner |
| a) Average income | $K_m = \frac{Zp}{C}$ | $Zp = \text{sum of all salaries}$; $C = \text{number of workers}$ | |
| b) Median income | $TAT = \frac{S}{As}$ | $S = \text{sales revenue}$; $As = \text{average value of assets}$ | Energy efficiency in the enterprise [7, 22, 25] |
| 4.1 Level of product innovation | $KI = \frac{T_n}{T_p}$ | $T_n = \text{cost of new equipment}$; $T_p = \text{average annual cost of equipment}$ | Owner |
| 4.1.1 New technology implementation rate | $TAT_e = \frac{Q}{E}$ | $Q = \text{work}$; $E = \text{energy used}$ | |
| 4.2 Enterprise resources | $TAT_{ee} = \frac{S}{As}$ | $S = \text{sales revenue}$; $As = \text{average value of assets}$ | |
| 4.2.1 Level of energy efficiency | $W = \frac{Q}{E}$ | $Q = \text{work}$; $E = \text{energy used}$ | |
| 4.2.2 Current expenditure | |

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### Environmetal factors

| Indicators (group of indicators) | Influence on external environment (subject to change) | Actor |
|---------------------------------|------------------------------------------------------|-------|
| Efficiency                      | Quantitative indicator                                |       |
| 4.3 Information resources       | Qualitative indicator                                 | Owner |
| 4.3.1 Database                  |                                                      |       |

\[ T_c = \frac{TI}{TC} \]

\( TI = \text{income}; \quad TC = \text{costs} \)

### IV. Discussions

Steady increase in equipment intellectualization, sophistication of mobile structures and of the supply system topology, implementation of state-of-the-art monitoring systems and technical diagnostics require further improvement of research methods and of enterprise assessment, especially considering uncertainty and incompleteness of information.

Complicated processes, the effects of many factors as well as the existing multicomponent resources and the need to take reasonable and prompt decisions at any stage of enterprise equipment’s lifecycle imply the use of economic assessment methods, system analysis and evolutionary reengineering.

Furthermore, the following additional constraints are to be taken into consideration:

- Economic constraints in terms of limited grounds;
- Technological constraints relating to the tool and documentation database, skilled personnel, etc.;
- Temporal constraints concerning execution of actions and more.

All of these methods, supported by instrumental computer systems and used to improve management decisions with minimal expenditure of technology and money, should be based on top-quality master’s degree training.

### V. Conclusion

Change management is one of the most in-demand business management technologies today.

To remain competitive, many companies to their production.

International enterprises adapt and employ change management techniques on a wide scale, whereas Russian companies rarely find it necessary to stick to change management rules, which is a trend that needs to be reversed quickly.

The reorganization of the regional industrial infrastructure reorganization and the development of new technology trends highlighted the need to train a new generation of specialists and to ensure information and methodological support of innovative activities in the energy sector.

The project aims to promote a new, progressive Master’s program (Conceptual Design and Energy-Efficient Engineering) as part of partner universities’ curriculum to help students sharpen their engineering, academic and management skills in the...
energy industry, network companies, housing and communal services and related sectors [VII].

VI. Recommendations

This program targets university graduates who have successfully completed the four-year core technical education program.

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