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ALGORITHM FOR ASSESSING THE EXTRA-SECTORAL EFFECT OF IMPROVING ORGANIZATION QUALITY

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Abstract

Quality and efficiency of organizations' activity are closely related. Modern society imposes high standards on ecological safety, principles of corporate social responsibility. Managerial decisions of enterprises should aim not only at improvement of economic outcomes but also at receiving an environmental and social extra-sectoral effect. There are two sides in the interaction of organizations' interests as economic systems. It is the need for safe environment and issues aimed to enhance the quality and efficiency of enterprises' activity. Unity of their environmental and economic activities will allow reducing unproductive costs and satisfying social environmental interests. Economic and environmental organizational components have a key influence on social conditions. The article offers the approaches to assessment of quality and efficiency of organizations by the example of transport enterprises. Their activity is considered in conjunction with corporate social responsibility and growth of extra-sectoral effect of environmental safety. It is based on risks indicators, a risk-adjusted criterion of ecological and economic efficiency and an indicator of indirect environmental damage. The purpose of the article is development of an algorithm for assessing an extra-sectoral effect to enhance the quality of transport enterprises' work by the example of a transport enterprise – North Caucasus Railway – a territorial branch of JSCo «Russian Railways». The algorithm for assessing the extra-sectoral effect of improving the quality of organizations was developed on the basis of these indicators. Testing of the proposed algorithm has been carried out by the example of North Caucasus Railway – a territorial branch of JSCo «Russian Railways».

Keywords: Quality, efficiency, effect, assessment, organization, algorithm.

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1. Introduction

Quality of enterprises' activity is intrinsically linked with efficiency. The key to efficiency and quality improvement is changes of management processes which affect the following management functions: planning, organization, control, motivation of staff. Planning is the most important function of management, and different studies look for ways to enhance the quality and efficiency by improving the planning (Sokolov & Lavrov, 2015). Plans' structure, the composition of the organizational and technical activities and assessment methods are subjects of academic discussions. Economic efficiency and environmental safety are closely linked in today's world; planning of economic activity of enterprises should ensure this interrelationship. Thus, the issue of development of an assessment algorithm of an extra-sectoral effect to enhance the quality of transport enterprises' activity is a very urgent problem (Idigova & Mamadiyev, 2017).

2. Problem Statement

Methodology of quality management dwells on a process approach. An enterprise must be considered from the position of interrelated production processes which interact with one another. It means that the process component should be included in the planning function, taking into account during the planning such components as production processes of an enterprise, their elements, environmental components, social interests.

Today the above-mentioned management principles of companies' work quality fit in the scheme of corporate social responsibility of Russian enterprises. Practice of introduction of programs of corporate social responsibility suggests that an enterprise takes responsibility for its impact on society and is ready to keep a record of all planning actions. Devyatlovskiy and Pozdnyakova (2014) believe that corporate social responsibility (or business social responsibility) as a social phenomenon indicates increasing of the level of humankind's development. Kivarina (2014) believes that development and strengthening of Russian business will depend on how timely and adequately it considers the main principles of corporate social responsibility. Only in this case it can become a vehicle for positive changes in key social areas. Also, it can create and maintain decent working conditions of employed staff, achieving in that way sustainable development of the environment.

Thus, economic efficiency of enterprises activity and the quality of their work are ensured in conjunction of systematic and process approaches, that is, unity and inclusiveness of social, economic and ecological elements. Planning to enhance the economic efficiency of enterprises' activity is also provided on the basis of these elements.

3. Research Questions

Enforcement of environmental legislation is a very important task in the process of planning of quality and efficiency of enterprises work. The Constitution of the Russian Federation recognizes the right of every individual to safe environment, reliable information on environmental conditions and compensation for environmental injury caused to health or property of people. Federal Law 555-FZ, dated

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20 Dec. 2001, «On environmental protection» and the Constitution are the main environmental legislation in the Russian Federation.

Enhancement of quality and efficiency of enterprises' activity is related to changes in management processes, in particular, management functions. Planning as one of management functions is based on systematic and process approaches. It is aimed at providing the efficiency of enterprises' activity (Tereshina & Soroka, 2014). Such efforts will help ensure standards of quality and environmental management, increase corporate social responsibility and minimize unproductive costs (Liu, Yang, Chen, Zhang, 2011).

4. Purpose of the Study

The purpose of the article is development of an algorithm for assessing an extra-sectoral effect to enhance the quality of transport enterprises' work by the example of a transport enterprise – North Caucasus Railway – a territorial branch of JSCo «Russian Railways». Achievement of the purpose is related to the following objectives:

– to consider relationship among quality, efficiency, environmental safety and corporate social responsibility in transport enterprises;

– to develop assessment indicators of quality and efficiency of the transport enterprises work;

– to propose an algorithm for assessing an extra-sectoral effect of improving the quality of the transport enterprises work;

– to test the proposed algorithm by the example of a transport enterprise – North Caucasus Railway – a territorial branch of JSCo «Russian Railways».

5. Research Methods

To date, the assessment of quality and efficiency of enterprises' work is based on purely economic indicators. Economists identify impact and efficiency indicators (Štefancová, Nedeliaková, & López-Escolano, 2017). Absolute performance indicators (economic impact indicators) reflect quantitative assessment and can be expressed in value of money (physical terms). Relative indicators (efficiency indicators) are expressed as the ratio of the achieved impact to costs of its achieving. However, such approach to the efficiency does not take into account the contained environmental component (Marchetti & Wanke, 2019). Direct and indirect damage to the environment must be taken into account for assessment of enterprises' activity according to the suggested concepts (Kyriacou, Muinelo-Gallo, & Roca-Sagalés, 2019). Consequently, there is a need for a new set of indicators which could include the extra-sectoral effect that contains ecological and social components.

6. Findings

E^{EC} is the economic effect indicator of implementation of planned organizational and technical actions. It is an absolute performance indicator that is measured in rubles. This indicator can be calculated as the difference between reduction of the environmental damage before and after implementation of the planned action and costs of its implementation.

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The indicator «σ» is the ecological risks indicator of planned organizational and technical actions. This indicator was developed on the basis of ecological risk factors which had been received on the basis of weighted expert assessment. These risk factors can impact on the economic effect of future periods (Qing, Rengkui, Jun, & Quanxin, 2014). The indicator can be calculated as the weighted value of expert assessment results of different risk factors which are adjusted for experts' competence (Rezer & Fedotov, 2014).

The indicator «C^{EC}» is the risk-adjusted criterion of ecological and economic efficiency of planned organizational and technical actions. It is a relative indicator which can be calculated as a ratio of the economic effect of actions implementation to required costs of the implementation. This indicator is the basis for decisions of the plan formation, for comparison of economic efficiency of different alternative actions.

I_D is the assessment indicator of indirect environmental damage of planned organizational and technical actions.

Values of parameters of forecasting errors are assessed by two measures: capital and operational costs for implementation of organizational and technical actions (Mezhokh, 2014). The assessment indicator of economic risk of capital costs increase is calculated by the formula (1):

$$x_1 = \frac{\sum_{k=1}^{n} p_k w_k q_k}{n} \quad (1)$$

x_1 – the assessment indicator of economic risk of capital costs increase for planned organizational and technical actions;

p_k – probability of increase of the capital costs of a planned organizational and technical action which is assessed by the expert k;

w_k – impact of increase of the capital costs of a planned organizational and technical action which is assessed by the expert k;

q_k – the qualification coefficient for the expert k;

n – number of experts.

Similarly, the assessment indicator of economic risk of the operational costs increase can be calculated by the formula (2):

$$x_2 = \frac{\sum_{j=1}^{b} p_j w_j q_j}{b} \quad (2)$$

x_2 –the assessment indicator of economic risk of operational costs increase;

p_j – probability of operational costs increase of a planned organizational and technical action which is assessed by the expert j;

w_j – impact of increase of the operational costs of a planned organizational and technical action which is assessed by the expert j;

q_j – the qualification coefficient for the expert j;

b – number of experts.

Application of the indicators x_1 and x_2 in the calculation is similar to application of the ecological risk indicator: indicators of risk-adjusted capital and operational costs of planned organizational and technical actions can be calculated by formulas (3) and (4):

$$A = K + x_1 K = K(1 + x_1) \quad (3)$$

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$$B = O + x_2 O = O(1 + x_2) \quad (4)$$

A – risk-adjusted volume of capital investments, in rubles;

B – risk-adjusted volume of operational costs, in rubles;

K – present capital investments for a planned action, in rubles;

O – present operational costs for a planned action, in rubles.

Thus, an economic effect can be represented as a difference between ecological and economic components. It can be obtained by the following formula (5):

$$E^{EC} = S_1 - S_{2(plan)}(1 + \sigma) - A - B - P \quad (5)$$

E^{EC} – the indicator of an economic effect of implementation of planned organizational and technical actions, in rubles.

P – sum of environmental charges for the period of the organizational and technical action, in rubles.

There is the basic criterion that used for planning efficiency assessment. This allows the main question such as «Should the action be added to the plan?» to be answered (Macheret & Kudryavtseva, 2016). It is calculated by the formula (6):

$$C^{EK} = \frac{E^{EC}}{A+B+P}, \quad (6)$$

C^{EK} – the risk-adjusted criterion of ecological and economic efficiency of planned organizational and technical actions.

The planned decision will be efficient if: $S_1 - S_{2(plan)}(1 + \sigma) - (A + B + P) > 0$. It means that environmental damage of enterprises activity is less than incomes of the company.

What are the conditions under which $S_1 - S_{2real} > A + B + P$? Obviously, such proportion is possible when $S_1 - S_{2(plan)}(1 + \sigma) > (A + B + P)$.

The inequality is a condition of efficiency of planned organizational and technical actions. If the difference between damages before and after implementation of the planned action exceeds the costs, an enterprise and society will win (Salgiriev & Akhmadov, 2013). An enterprise will be exempted from environmental damage payments, will eliminate excessive emissions. Therefore, the resulting savings can be directed towards investments in new productive capacity, infrastructure construction, etc., which will provide additional profits (Han, Ouyang, & Wang, 2018).

An additional criterion of a choice between two or more actions for inclusion is the assessment indicator of indirect environmental damage of the planned organizational and technical action. Indirect environmental damage must be calculated for each planned organizational and technical action. For today there is a way of indirect environmental damage determination which is represented by the formula (7):

$$I_D = \sum_{ij}(ED_{ij} + TC_{ij} + PC_{ij} + RC_{ij} + IEC_{ij} + C_{ij}) \quad (7)$$

I_D – the assessment indicator of indirect environmental damage of the planned organizational and technical action, in rubles;

ED_{ij} – economic damage as a result of a negative factor j of pollution i, in rubles;

TC_{ij} – transaction costs of a negative factor j of pollution i, in rubles;

PC_{ij} – costs to prevent external pollutions and consequences elimination of a negative factor j of pollution i, in rubles;

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RC_{ij} – costs for research, analysis, identification and control of pollutions and dangerous factors, in rubles;

IEC_{ij} – economic damage from indirect environmental externalities (transit pollution factors), in rubles;

C_{ij} – costs of economic agents, which are exposed to pollution i, in rubles.

The indirect damage manifests itself in reduced working capacity, diminished animal populations, increase in morbidity and other factors. Assessment of this damage is necessary in accordance with the Russian Federation railway transport environmental policy. The authors of the article suggest assessing indirect damage of organizational and technical actions.

The developed algorithm for assessing the extra-sectoral effect of organizations quality improving is represented in Figure 01.

Thus, it can be seen in Figure 01 that organizational and technical actions in the planning of quality and efficiency of enterprises activity include a few steps of control. This provides economic efficiency and ecological safety of planning.

The quantitative assessment of economic efficiency of planned organizational and technical actions is in line with a certain level of social and ecological and economic safety. Definition of the level of social and ecological and economic safety is an important part of quantitative assessment of planning results (Barrientos et al., 2016). Values of the C^{EC} indicator are included in the plan for each action. Table 01 reflects values of social, ecological and economic efficiency of planned organizational and technical actions including their descriptions (Vasilenko, Drozdov, Kuzina, & Tagiltseva, 2018).

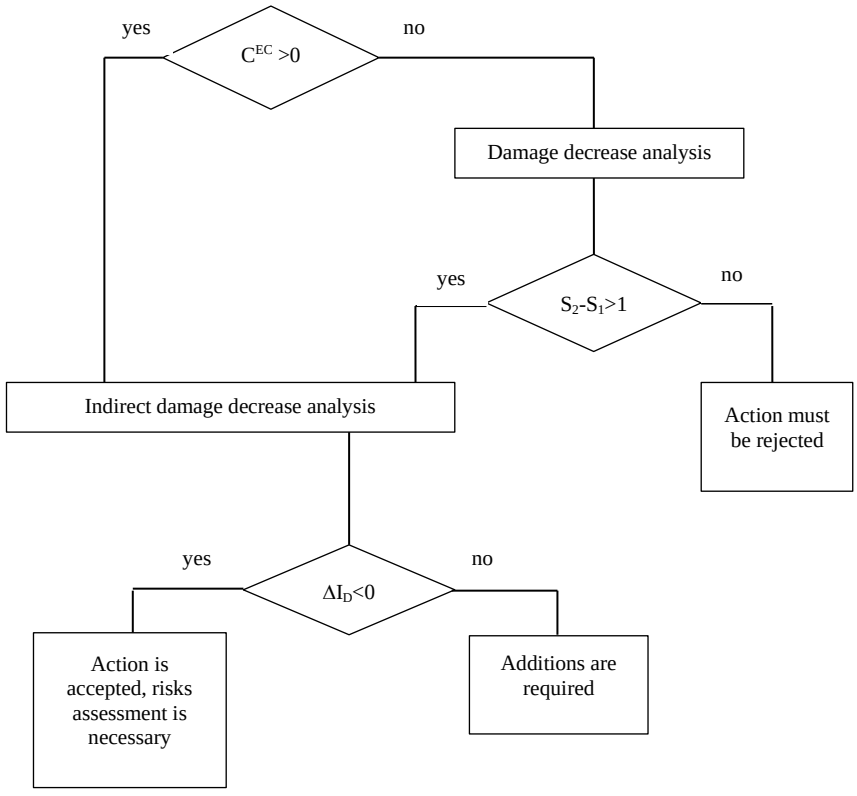

Figure 01. Algorithm for assessing the extra-sectoral effect of improving organizations quality

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Table 01. Levels of social, ecological and economic safety of the planned organizational and technical actions

C^{EC} Value	Level of safety	Description	Recommendation
$C^{EC}<0$	Negative	The planned organizational and technical action destroys the environment. It cannot be added to the plan	The action cannot be added to the plan. It must be replaced by alternative one
$0< C^{EC} <=0.25$	Extremely low	The planned organizational and technical action has an extremely low level of efficiency	The planned organizational and technical action and its financing require a major revision. The action should be cancelled or replaced
$0.25< C^{EC} <=0.5$	Low	The planned organizational and technical action has a low level of efficiency	The planned organizational and technical action must be reviewed. Alternatives should be deeply analyzed
$0.5< C^{EC}<=0.75$	Middle	The planned organizational and technical action has a middle level of efficiency	The decision regarding ecological and economic aspects of the planned organizational and technical actions can be made from the results of consultation with the experts
$C^{EC}>0.75$	High	The planned organizational and technical action has a high level of efficiency	The planned organizational and technical action does not require any changes. A slight adjustment of funding system is possible

Plan form 1 has been developed on the basis of the model of indicators of planning and assessment. It is a general informational form of planned organizational and technical actions. It represents the calculated indicators. Testing of the proposed algorithm has been carried out by the example of North Caucasus Railway – a territorial branch of JSCo «Russian Railways» in plan form 1. This is represented in Table 02.

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Table 02. The form of enhancement of quality and efficiency of the railway transport enterprises activity (by the example of North Caucasus Railway – a territorial branch of JSCo «Russian Railways»)

Name of an action	**Costs (thousands of rubles)**	**S1-S2 (thousands of rubles**	**C^{EC}**	**$\Delta I_D>0$**	**Level of social and environmental safety**	**Results**
Acquisition of containers for any type of waste	5120.7	7537.8	0.47	Yes	Low	Refining owing to safety low level
Using of environmentally safe dishes in trains	1722.1	2974.6	0.73	Yes	Middle	Accepted
Introduction of environmentally safe oils for train wheel pairs	12711.2	24731.3	0.94	Yes	High	Accepted
Acquisition of second category oils for rails maintenance	8217.4	14716.5	-0.79	No	Negative	Rejected. An alternative action is to be suggested

The last organizational and technical action destroying environment must be rejected and replaced by an alternative one which would be ecologically and socially safer and more efficient. The value of the indicator of planning of social and ecological and economic safety is extremely low in the first action; consequently, efforts to refine it should be taken.

7. Conclusion

Thus, interrelation of quality of enterprises' work, the efficiency of activity, ecological safety and business social responsibility have been considered in the scientific article. The assessment indicators of extra-sectoral effect of quality improvement of work of transport enterprises have been developed. The algorithm of assessment has been represented and tested by the example of North Caucasus Railway – a territorial branch of JSCo «Russian Railways».

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