Balanced management of innovative risks in the process of innovative development

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Abstract. The article considers the issues of balanced management of innovative industrial risks as a mechanism to increase the efficiency of organizations innovative development. The place of this complex of management measures in the overall management system in the process of introducing innovations in the face of uncertainty and risks is determined. An augmented model of balanced management is proposed taking into account the innovative nature of company development and the risk factor. The role of innovative industrial risks is defined as a limitation of innovative development, and a method for effectiveness assessment of their balanced management by assessing the complex level of system survivability is developed. Thanks to this method, it is possible not only to assess the quality of the innovative industrial risks management system, but also to identify ways for its improvement and development.

1. General statement of the problem
The modern development of complex economic systems requires organizations to have complex and timely risk management increasingly more. This is due, first of all, to the need to reduce the increasing level of uncertainty that arises in the process of continuous innovations and complexity growth of the processes occurring in the systems.

Each innovation that is introduced by the organization has a dual effect on it, on the one hand, giving rise to an impulse of innovative development, on the other hand, causing indignation in the system itself, which leads to risks [1]. Since within the framework of innovative development there is a continuous introduction of innovations, which is not always coordinated, its implementation is accompanied by the emergence of a whole complex of innovative risks. The most dangerous of these is innovative industrial risk.

Innovative industrial risk arises because of uncoordinated and unbalanced implementation of innovative projects. Its development is accompanied by the emergence of multiple stochastic effects that have a negative effect on the innovative processes implemented by economic systems, reducing their effectiveness. In this regard, the implementation of the balanced management of innovative industrial risks in the process of innovative development of complex economic systems becomes particularly relevant.
Balanced management is currently associated with the scientific works of D. Norton and R. Kaplan, including balanced scorecard developed by them [2]. The set of tools proposed by the authors, in fact, is a new complex approach to managing various processes, including those accompanied by an increasing set of risks and designed to reduce the existing and potential uncertainty of decision-making under the existing restrictions.

2. Analysis of recent achievements and publications

The emergence of a new approach to management was largely due to sudden changes in the development conditions associated with the increasing need for specific limited resources. That is why it is the theory of constraints, developed at the end of the 20th century by E. Goldratt, that created the preconditions for the formation of a new approach to management based on a balanced scorecard.

In the framework of this theory, when forming or transforming a management system, it is proposed to concentrate organizational resources on eliminating restrictions that do not allow the organization to effectively develop. The effective functioning and development of the system, in his opinion, depends on how effectively and competently the interaction of the system elements is built among themselves. Moreover, he argues that systems are similar to chains or even interweaving of chains and the operation of the entire system depends on the weak links [1]. The management methodology is based on finding and managing key system constraints. Such limitations in modern conditions of development are innovative industrial risks that arise during the innovations implementation. They not only distract part of the resources necessary for innovation, but also increase the level of uncertainty and creates the risk of deviations from the normal course of the production process due to incidents and emergencies.

Another precondition for the emergence of a new approach to balanced management was the study of W. Edwards Deming, which showed the limitations of the approach to assessing effectiveness only through economic indicators. Since in most cases this leads to loss of interconnection with many business processes in the organization and to loss of performance in a long-term outlook.

Modern studies of balanced management and balanced scorecard used in its implementation show that it not only makes it possible to continuously monitor and adjust the activities of organization to achieve its strategic goals, but also allows deeper integration of the organization strategic guidelines with operational and tactical tasks, the solution of which allows to increase development effectiveness. Along with this, it is worth noting that the balanced scorecard underlying the balanced management system is not without flaws (see table 1).

### Table 1. Advantages and disadvantages of a balanced scorecard

| Advantages | Disadvantages |
|------------|---------------|
| Provides the ability to monitor and adjust the development strategy of the organization | The difficulty of balancing selected key performance indicators of the organization |
| Covers the main aspects of the organization activities and their interaction with each other | Resistance of employees to innovations in the organization |
| Allows motivating employees of the organization to achieve strategic goals | Increased information processing costs |
| The use of BSC is aimed at increasing the value of the organization, that is, balanced management focuses on creating additional value. | No risks faced by the organization are taken into account |
| Continuous monitoring and evaluation of the management system performance provides the | The issue of determining cause-effect relationships and indicators balancing in the system remains insufficiently developed |
organization management with analytical data for the subjects to achieve their strategic goals

In addition, disadvantages include insufficient attention to assessing the state of the environmental and social component of the organization development, as well as the exclusion from the system of issues related to assessing the security of the economic system. In conditions of increasing uncertainty, this leads to a decrease in the objectivity, complexity and effectiveness of this monitoring system and the management approach based on it.

3. Formulation of objective and statement of study problems
This study is devoted to the problem of determining the place of risk management in the balanced management of the organization and the formation of a balanced management system of innovative industrial risks in the framework of sustainable innovative development of the company. At the same time, it is important to determine the interconnection of the components within the framework of the company balanced management model; determine the role of risk management in this process, as well as identify those limitations, the impact on which will allow to improve the efficiency of the processes under consideration.

4. The main research material
As noted above, the classical model of balanced management does not take into account a number of issues related to the growth of development uncertainty. This means that the balanced scorecard, as an instrument of balanced management, also does not take into account factors such as innovative changes and risk, which dramatically reduces the effectiveness of its use in modern conditions [4].

To eliminate these weaknesses, a balanced management model was developed in the framework of this study, taking into account the innovative nature of modern development, as well as the probability of unforeseen events (figure).

Figure 1. A model of balanced management in the light of the innovative nature of the company development and risk factor
As can be seen in the figure, the balance of management is influenced not only by the four classical organization development components, but also by the social and environmental component[5]. In addition, it is well known that in the strategic terms it is the innovative activity that is implemented in the development process that is the source of effective change in all of the mentioned areas. And risk management allows to ease restrictions associated with the uncertainty of the results of this activity and increase the likelihood of achieving the desired result.

Thus, risk management is a tool to improve the balance of management, increase its effectiveness by reducing the uncertainty of decision-making.

In the course of the study, it was determined that one of the most large-scale in the meaning of the consequences is innovative industrial risk, which is accompanied by a violation of the normal course of the production process, causing damage to life, health and property of employees, organizations and third parties in view of inconsistency and imbalance of innovative activities.

The nature of innovative activities carried out at the enterprise is rarely univocal. Currently, the introduction of innovations in “packages” is quite common. A “package”, as a rule, includes interconnected innovations that can cause innovative industrial risks, therefore, the balanced management of innovative industrial risks allows us to provide the necessary conditions for successful innovative development of the economic system.

It is proposed to evaluate the balanced management effectiveness of innovative industrial risks in work using an integrated assessment of the survivability of the economic system, based on determining the consequences of possible innovative industrial risks.

In the framework of the study, we will determine survivability as the ability of the system to adapt to new functioning conditions, withstand disturbing actions without violating the implementation of the main function. In other words, the survivability of the system enables it to ensure the achievement of the goal in case of stochastic effects of innovations implementation. In relation to economic systems, we will understand survivability as the ability of industrial and economic facilities to perform their basic functions, despite the damage of individual elements caused by emergency circumstances (even with an acceptable loss in the quality of their performance), and in the future to implement the optimal recovery strategy, taking into account the limitations.

The method proposed below is a complex assessment of seven blocks of indicators, each of which characterizes a separate side of the studied object. The first 4 blocks of this method were considered in previous works of the authors [1,6], the rest are given below.

5 block of indicators. Effectiveness of the consequence elimination system

\[ SP = \frac{Te}{Tn}, \]

where \( SP \) is the effectiveness of the consequence elimination system, \( Te \) is the amount of time spent on the elimination of the consequences of the accident (resulting from the exercises), in minutes, \( Tn \) is the estimated amount of time spent on the elimination of the consequences of the accident, in minutes.

The permissible value of this indicator is 0.8.

\[ SP_{e} = \frac{Me}{Mn}, \]

where \( SP_{e} \) is the economic efficiency of the consequence elimination system, \( Me \) is the estimated amount of resources spent on the elimination of the consequences of the accident of a given facility, in rubles, \( Mn \) is the estimated amount of money spent on the elimination of the consequences of the accident for similar facilities, in rubles.

The permissible value of this indicator is 0.8.

\[ RE = \frac{SP_{t}}{SP_{r}}, \]

where \( RE \) is the speed of implementation of the system of measures to eliminate the consequences, \( SP_{t} \) is the effectiveness of the consequence elimination system for the given object, resulting from the
exercises, SPr is the effectiveness of consequence elimination system for this object, calculated for the object of this type.

The permissible value of this indicator is 1.

6 block of indicators. The level of environmental protection of the facility

\[
EP_e = \frac{M_e}{M_n}
\]

where \( EP_e \) is the economic efficiency of the environmental protection system, \( M_e \) is the amount of funds spent on environmental protection of a given facility, in rubles, \( M_n \) is the estimated amount of funds spent on environmental protection for similar facilities, in rubles.

The permissible value of this indicator is 0.8. It is recommended to calculate the indicator for each production unit separately, and then determine the average value of the indicator for the facility, taking into account the importance of production unit.

\[
EP = \frac{Q_r}{Q_p}
\]

\( EP \) is the effectiveness of the environmental protection system, \( Q_r \) is the amount of hazardous substance entering the environment as a result of the accident, \( Q_p \) is the amount of the substance that can be stopped by the facility protective systems (taking into account the possible number of protective systems failures).

The valid value is 0.8. It is recommended to calculate the indicator for each substance and production unit separately, and then determine the average value of the indicator for the facility, taking into account the importance of production unit.

\[
PP = \frac{T_e}{T_n}
\]

where \( PP \) is the speed of changes perception in environmental legislation, \( T_f \) is the amount of time required to implement the legislative framework for environmental safety for the facility, in days, \( T_r \) is the estimated minimum amount of time needed to implement the legislative framework for environmental safety (established by state regulatory authorities), in days.

The permissible value of this indicator is 0.8.

7 block of indicators. Speed of consequence elimination of the emergency (H)

\[
SL = \frac{T_l}{T_a}
\]

\( SL \) is the speed of consequence elimination of an emergency (H), \( T_l \) is the time of arrival of evacuation services, in minutes, \( T_a \) is the time of spread and manifestation of negative consequences of the emergency (H), taking into account all the features of the facility itself, in minutes.

The permissible value of this indicator is 1. It is recommended to calculate the indicator for each type of accident separately, and then determine the average value of the indicator for the facility.

\[
E_{Pe} = \frac{\Delta M_d}{\Delta M_{rs}}
\]

where \( E_{Pe} \) is the economic efficiency of response speed increase, \( \Delta M_d \) is the change in the value of the means of indicated total damage achieved by response speed increase for a certain period, in rubles. \( \Delta M_{rs} \) is the change in the amount of resources spent on response speed increase for a certain period, in rubles.

The permissible value of the indicator is 1. Which means that changing the amount of resources to increase the response speed leads to a considerable change in the indicated damage value. It is recommended to calculate the indicator for each type of accident separately, and then determine the average value of the indicator for the facility.

\[
E_{Per} = \frac{\Delta M_d}{\Delta M_{rsr}}
\]

where \( E_{Per} \) is the economic efficiency of the response, \( M_{dr} \) is the change in the value of the means of socio-economic damage, reduced due to the changes of the evacuation costs for a certain period, in rubles. \( \Delta M_{rsr} \) is the change in evacuation costs for a certain period, in rubles.

The permissible value of the indicator is 1. Which means that changing the value of evacuation costs leads to a considerable change in the indicated damage value. It is recommended to calculate the
indicator for each type of accident separately, and then determine the average value of the indicator for the facility.

After determining the values for each block of indicators, in order to find the integral value of the survivability level, it is necessary to assign a significance coefficient to each indicator, depending on the industry specifics of the organization, its territorial, climatic location and other conditions for the activities implementation, as well as the features of the ongoing processes. Integral value will allow to determine the general level of effectiveness of the innovative industrial risk management system, and values for separate blocks will allow to determine the directions for optimizing the balance of innovative industrial risk management. That, in turn, will allow to increase the effectiveness of the balanced management of innovative industrial risks in the economic system, and hence its innovative development as a whole.

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