Environmental constituent of the petrochemical complex sustainable development

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Abstract. This article studies the ongoing processes of environmental safety formation in the context of sustainable development of companies. It is hypothesized that during changes most companies in the petrochemical industry of the Republic of Tatarstan underestimate the need for a comprehensive modernization of the environmental component of sustainable development. In conditions of disturbances and uncertainty in the external environment it leads to increased entropy and loss of effectiveness of discrete measures to improve the environmental safety of enterprises. The study carried out an analysis with a depth of study of more than five years, which is characterized by the emergence of economic and social risks of a global nature and reveals the degree of their influence on the environmental safety of a complex strategically important for the republic. In conclusion, it is concluded that increasing systematicity in environmental safety management under conditions of uncertainty leads to an increase in the rate of sustainable development and the effect of production activities.

1 Introduction

Modern researchers of sustainable development systematically note that for its successful implementation it is necessary not only to continuously change the economic parameters of economic facilities, but also to constantly improve the environmental and social components. At the same time, it is extremely important that the development and interaction of these components be of equal importance, implemented comprehensively and in a coordinated manner [1,7].

Due to this, the restrictions that arise from the principles of sustainable development should be aimed at finding incentives for the development and implementation of new materials, organizational processes, design, cyclical waste processing and the transition to a circular economy. Therefore, sustainable development needs to be analyzed from three different perspectives: environmental, social and economic. Thus, sustainable environmental development means taking into account the maximum loads on the ecosystem and preserving biodiversity, environmental quality, as well as the ability to preserve and self-heal at a level that ensures the safety of human life and health [2,13]. In turn, the goal of social sustainable development is to improve the level and quality of life of the population. If we analyze this

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component from the point of view of an individual enterprise, this means creating favorable working conditions, reducing injuries and accidents, professional development of employees, accumulation of human resources, improving the quality of products and services provided, etc. through the development and implementation of innovations [3,11].

Taking into account these provisions, it can be assumed that such a development is oriented in several directions or components. According to the classical doctrine of sustainable development, there should be three such fundamental directions: an environmental component, an economic component and a social component. The combined development of all three directions should lead not only to the successful implementation of sustainable development, but also form the prerequisites for a new type of industrial relations based on energy and resource-saving technologies, leading to the formation of a new type of closed-cycle economy. At the same time, it is important to understand that the basis of sustainable ecological development is an increase in the efficiency of the processes of conservation and self-healing of the environment, improving its quality, reducing the load on all its indicators and characteristics [2,13]. In order to ensure sustainable social development, it is necessary to activate all available factors to ensure favorable working conditions while reducing the negative impact of uncertainty and risks, forming prerequisites for the multiplication of human resources, the effectiveness of professional development, including through the innovative activities of the company [3.11].

In this regard, in the context of existing uncertainty, it is extremely important to strengthen environmental and social components, since otherwise this will lead to a slowdown in the pace of sustainable development and a decrease in operational efficiency.

2 Materials and methods

When conducting a study of the state of sustainable innovative development of the petrochemical complex of the Republic of Tatarstan under conditions of uncertainty, the following methods were used: statistical analysis, system analysis, comparative analysis. The use of a statistical method makes it possible to study the dynamics and rate of change in the parameters of the analyzed phenomenon [4,9].

The study of the stated topic seems necessary to be carried out on the basis of a study of practical material. The petrochemical complex of the Republic of Tatarstan was chosen for the study. When studying the quality of its sustainable development under conditions of uncertainty, the following methods of analysis were used: statistical, systematic and comparative. The application of the statistical method reveals the direction of sustainable development, the quality of changes in its environmental component and involves the study of the dynamics and rate of change in the parameters of the analyzed phenomenon [4,9].

The use of systems analysis methods allows not only to decompose the petrochemical complex under study, but also to synthesize general algorithms for increasing the environmental efficiency of the processes of introducing changes in the conditions of sustainable development [5,12]. The use of the comparative analysis method contributes to the formation of an effective set of measures to increase the environmental safety of the development of companies. [6, 14]

3 Results and discussion

In modern research of the sustainable development of economic entities, there are several approaches to determining the priority of changing one of its three components: environmental, social and economic. At the same time, in the practical implementation of these principles when carrying out business activities, most organizations assign priority to

economic efficiency, without observing proportionality or at least proportionality in the development of other components of sustainable development [8, 18]. In our study, we will analyze the environmental focus of innovative changes in the petrochemical complex and to determine the trend in the sustainable development of these companies. The study of innovative changes carried out by companies within the framework of sustainable development will be carried out based on data presented in official sources of the State Statistics Committee of the Russian Federation (Table 1) [10, 19].

Table 1. Data on the number of enterprises implementing innovative changes in the field of ecology in the petrochemical complex of the Republic of Tatarstan by industry, 2017-2021.

2017	**Total**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**B1**	**B2**	**B3**
Oil and natural gas production	12	1	6	6	6	6	7	1	9	4	1
Petroleum products production	13	2	6	9	7	4	6	1	10	4	
Production of plastics and synthetic resins in primary forms	5	1	1	2	3	3	4	0	4	3	0
Production of soap and detergents, cleaning and polishing products	2	2	2	1	1	2	1	1	2	1	1
2019	Total	A1	A2	A3	A4	A5	A6	A7	B1	B2	B3
Oil and natural gas production	14		12	14	1	14	1	12	11	13	12
Petroleum products production	14	5	8	14	7	5	7	6	12	8	4
Production of plastics and synthetic resins in primary forms	5	3	4	5	4	3	3	1	1	4	1
Production of soap and detergents, cleaning and polishing products	2	1	1	1	1	2	2	2		1	2
Transportation of oil through pipelines	37			32		5	11		1	12	
2021	Total	A1	A2	A3	A4	A5	A6	A7	B1	B2	B3
Oil and natural gas production	16	4	6	12	9	8	7	4	6	6	4
Petroleum products production	13	5	8	13	6	6	6	8	8	5	3
Production of plastics and synthetic resins in primary forms	11	5	5	10	6	6	6	4	8	7	1
Production of synthetic rubber in primary forms	1	1	1	1	1	1	1	1	1	1	1
Production of soap and detergents, cleaning and polishing products	4	1	3	2	2	2	3	2	2	1	3
Transportation of oil through pipelines	13	1	7	10	0	1	2	8	10	4	0

At the same time, it is important to highlight the areas of environmental development within the framework of the implementation of programs for sustainable innovative development of companies, which are shown in Tables 2, 3, taking into account the identified possible deviations and uncertainties [15, 16].

Table 2. Symbols of directions of environmental development during the production (a) and during the use (c) of goods and services.

Increasing environmental safety in the production of goods and services	**Their designation**
Replacement of materials and raw materials with safer ones	A1
Recycling	A2
Reducing environmental pollution	A3
Reducing CO_2 emissions	A4
Reducing material production costs	A5
Reducing energy costs	A6
Conservation of resources	A7

Table 3. Symbols of directions of environmental development during the use of (in) goods and services.

Increasing environmental safety in the process of using goods and services	**Their designation**
Replacement of materials and raw materials with safer ones	B1
Recycling	B2
Reducing environmental pollution	B3

According to Tables 1-3, the present conditions show a slight increase in most areas of environmental investment; it is worth noting the emergence of new industries that are making changes in the field of ecology (pipeline oil transport - 2019, 2021, production of synthetic rubber in primary forms - 2021). However, according to the data in the same table, the changes are not comprehensive, which leads to the loss of the possible environmental effect from the introduction of innovations.

Let us consider the periods under study in more detail. Examining the changes that took place in 2017 (Figure 1, 2), we can conclude that the intensity of environmental innovation in the petrochemical complex of the republic is low, most of the areas being studied are applied unsystematically and are isolated in nature. However, this period of time when studying the total number of changes in the industry also does not reflect the high activity of enterprises, which may be due to the consequences of the crisis of 2014-2015. On the other hand, in some areas of environmental change there is a fairly high share already in 2017. For example, in the field of reducing environmental pollution and replacing raw materials with safer options. The first case, in our opinion, is explained by the impact of government agencies on enterprises, and the second by an attempt by companies to increase their competitiveness in the global market. It is worth noting that even with a small number of innovative changes, some companies engaged in the production of synthetic rubber retain a large share of environmental innovations.

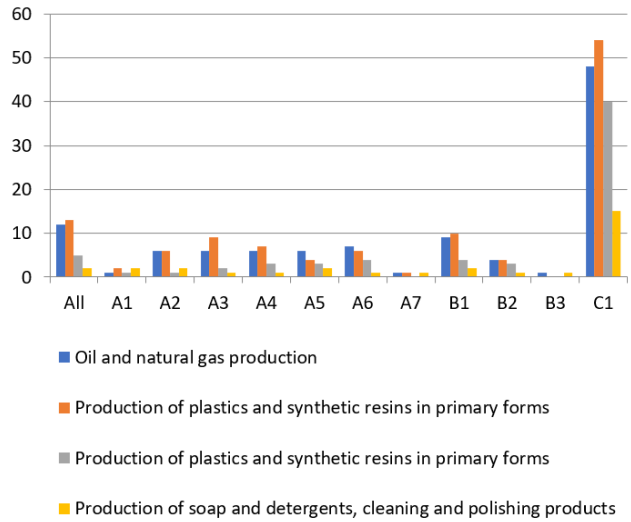

Fig. 1. Number of organizations that carried out innovations aimed at improving the environment by type in 2017.

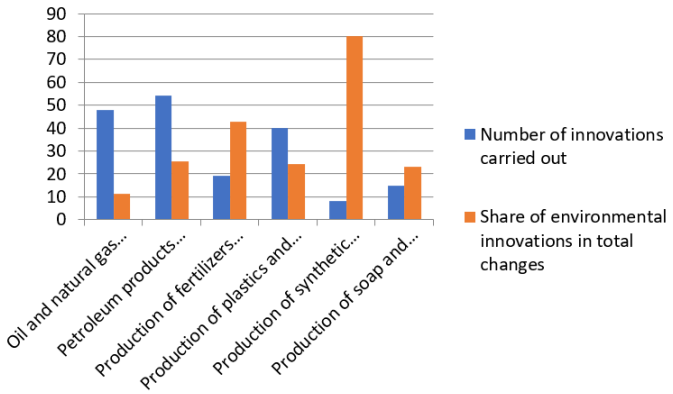

Fig. 2. Share of environmental innovations in the total number of changes by type in 2017.

Analyzing the changes in 2019, one can note a significant increase in the implementation of environmental innovations compared to the previous period (Figure 3, 4). This is explained by a period of growth in the economic activities of enterprises and changes in the ability of companies to implement sustainable development policies. It is worth noting that the growth is quite uniform; the use of environmental innovations in the production of synthetic rubber in the field of reducing environmental pollution, as well as the growth in improving environmental safety in the field of oil and gas production, stands out separately. This continues to reflect the impact of government instruments and the focus of the complex's products on increasing competitiveness in the international market.

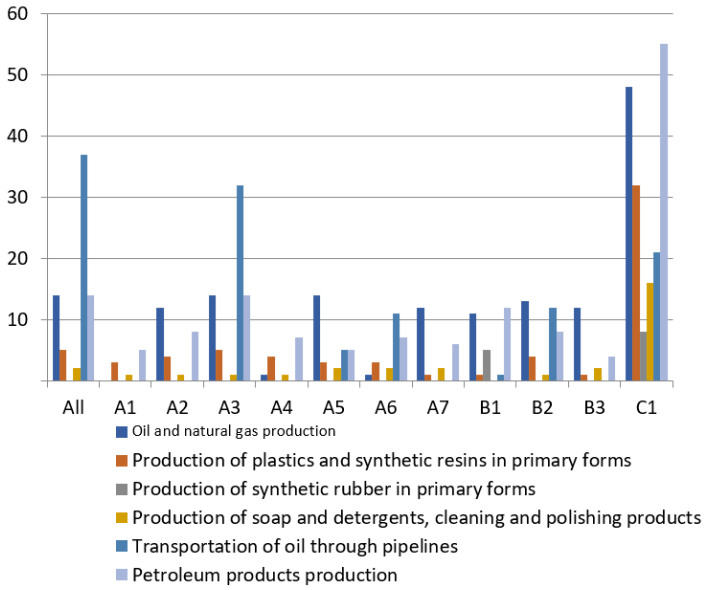

Fig. 3. Number of organizations that carried out innovations aimed at improving the environment by type in 2019.

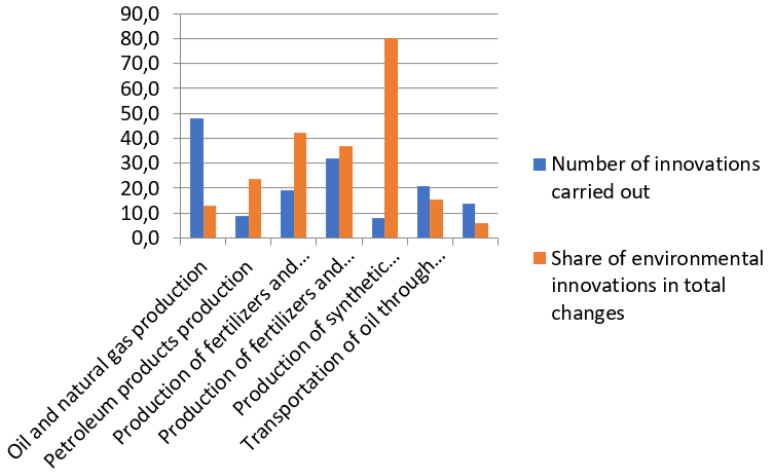

Fig. 4. Share of environmental innovations in the total number of changes by type in 2019.

When conducting similar studies in 2021, it can be noted that there is a noticeable reduction in the implementation of environmental innovations. This is due to the epidemiological situation that developed during this period and the general change in global production processes. Among all areas, environmental changes stand out in the field of oil and natural gas production, production of petroleum products, as well as their transport. The share of their environmental innovations reflects a fairly stable level in most areas, however, some tend to decrease compared to 2019 data and return to the 2017 level (Figure 5, 6).

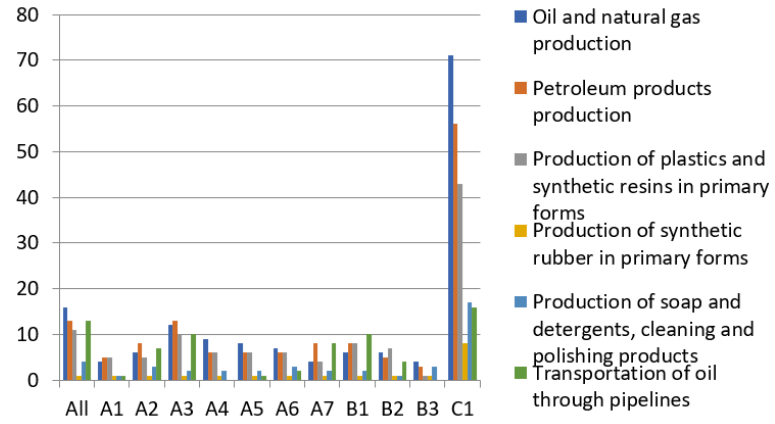

Figure 5. Number of organizations that carried out innovations aimed at improving the environment by type in 2019.

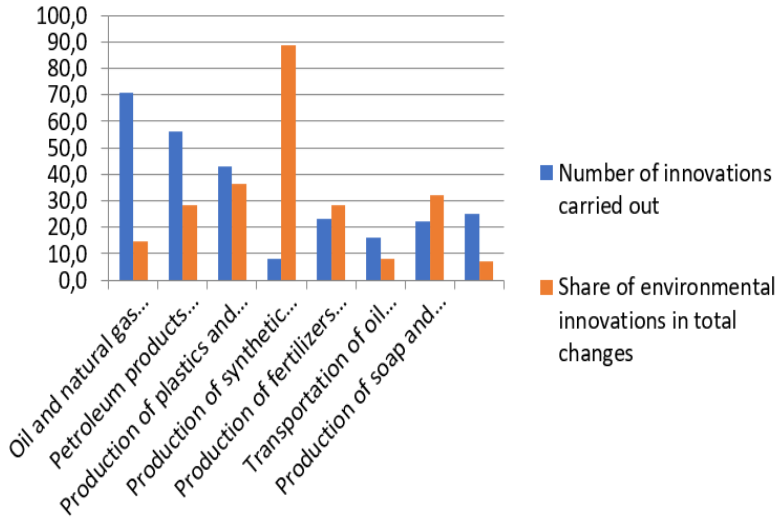

Fig. 6. Share of environmental innovations in the total number of changes by type in 2021.

In conclusion, it is worth noting that the study reflects the non-systemic and discrete nature of the environmental innovations being introduced in the complex under study. This leads to the fact that when disturbances appear (for example, epidemiological restrictions, etc.), enterprises reduce the number of environmental measures, an asymmetry arises in the transformation of the components of sustainable development: environmental, social and economic in favor of the latter, and the pace of this development slows down.

4 Conclusion

Thus, it is necessary to develop and implement integrated approaches to ensure the environmental safety of the petrochemical complex of the Republic of Tatarstan. Their development should be based on the generally accepted concept of sustainable development. At the same time, in our opinion, the introduction of such measures to increase consistency

in environmental safety management under conditions of uncertainty leads to an increase in the pace of sustainable development and the effect of production activities. [20, 21].

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