Conceptual foundations of the mechanism of management of enterprise interaction with environment

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Abstract. The environment plays an important role in shaping the living conditions of local communities, and the state of the environment determines the opportunities for achieving the goals of sustainable development. The purpose of the article is to provide further development of the conceptual foundations of the mechanism of management of enterprise interaction with environment. The authors formed an approach to structuring the mechanism of management of enterprise interaction with environment, considering economic, environmental, and adaptive components. For practical approbation of individual components of the proposed mechanism in a part of the instrumental block the ways of decreasing the negative impact of the enterprise on level of pollution of the atmosphere as of a component of environment were considered. The constructed correlation and regression model for determining the impact of individual pollutant emissions on the overall state of air pollution formed a basis for identification of two most significant types of emissions (carbon monoxide emissions and emissions of non-methane volatile organic compounds). Based on the analysis of ME “Zhytomyrvodokanal” data, whose activities are related to the waste generation and management and which, at the same time, provides environmental services, the measures were proposed to decrease the corresponding emissions from the enterprise activities.

1. Introduction
The modern world is characterized by the emergence of a significant number of challenges that affect the living conditions of the population, determine the prospects for socio-economic relations development both within a country and around the world. One of the most important challenges are those related to the ecology and the environment state. Recent decades have been characterized by rapid industrial development and, at the same time, deteriorating environmental conditions. The growth of production, negative anthropogenic impact, transportation – these and other factors cause significant negative impact on the environment, which, in turn, leads to worsening ecology condition, climate changes, negative impact on people’s living conditions and health. It is worth noting that such negative trends are significantly intensifying and becoming a hazardous situation for humanity. All this necessitates the implementation of economic entities functioning mechanisms built on the principles of sustainable development. The implementation of the sustainable development concept provides
an opportunity to harmonize the economic aspects of the business entities functioning with ecological and social components that determine the impact on the environment.

The environment determines the conditions of living and activities of local communities, significantly influencing the set of parameters that are related to the sustainable development goals (SDGs). In particular, the state of the environment directly determines the possibilities of achieving such sustainable development goals as SDG 2 “Zero hunger”, SDG 3 “Good health and well-being”, SDG 6 “Clean water and sanitation”, SDG 7 “Affordable and clean energy”, SDG 12 “Responsible consumption and production”, SDG 13 “Climate action”, SDG 14 “Life below water”, SDG 15 “Life on land” [1]. It is clear that the state of the environment affects the achievement of other sustainable development goals, but those mentioned above depend on the parameters of the environment greatly.

Like other UN member states, Ukraine has joined the process of implementing the sustainable development goals. In the process of consultations at both the national and regional levels, the SDGs were adapted to the realities of Ukraine.

This confirms the need for urgent implementation of measures aimed at reducing the negative impact of economic entities on the environment. It is expedient to implement this task through the mechanism of management of interaction with environment.

The mechanism of management of enterprise interaction with environment is a set of methods, levers, tools, and means of influencing the processes of interaction of the entity with environmental factors. The formation of such an effective mechanism determines the possibility of reducing the negative impact of economic entities on the environment, as well as the introduction of the concept of sustainable development in the enterprise activity. Therefore, the formation and development of a mechanism of management of enterprise interaction with environment is an important scientific and practical task, the success of which affects the future of society as a whole.

2. Literature review
The importance of a defined set of problems in terms of ensuring the harmonious development and safe living conditions of society, reducing the negative footprint of economic entities on the environment leads to significant scientific interest in this field of research, which has grown significantly in recent years.

An important role in the formation of theoretical foundations of environmental management and sustainable development is played by the study of previous scientific achievements. In particular, the study of J. F. Molina-Azorin et al. [2] focuses on the relationship between environmental management, human resource management, and “green” human resource management based on the analysis of scientific publications. Researchers identify the need to distinguish between the concepts of human resource management and “green” human resource management and emphasize the importance of involving individual employees in the overall environmental policy of the enterprise. The research of S. Roohy Gohar M. Indulska [3] is devoted to the peculiarities of achieving the goals of sustainable development through business process management. The paper analyzes the publishing activity in the scientific literature on the role of information systems and business process management in ensuring the sustainability of business entities. The authors analyze the level of development of the concept of green business process management in the scientific literature.

Peculiarities of the company’s interaction with the environment are the subject of environmental management research. V. Pechancová et al. [4] determine that the implementation of environmental management systems and “green” tools is becoming an urgent task for economic entities, due to both legislative and social factors. The authors study the peculiarities of the implementation and realization of environmental management systems at the enterprises of the Czech Republic with a key emphasis on medium and large enterprises.
P. T. Huong et al. [5] determine the features of the implementation of “green innovations” in the context of environmental management and investigate the impact of the implementation of such innovations on the activities and performance indicators of the enterprise. Scientists have proven that there is a relationship between the implementation of environmentally friendly measures and the efficiency of economic entities.

In the research of M. Lemkowska and D. Wiśniewska [6] the features of the combination of environmental insurance and environmental management systems are considered using correlation analysis.

G. Jilani et al. [7] emphasize the need to apply both a complex and individual approach. Researchers have identified the relationship between corporate social responsibility and the environmental behavior of individuals on the example of Pakistan. The main attention is paid to the non-business component, in particular, the formation of pro-environmental behavior of students under the influence of corporate social responsibility.

An important role in the set of issues of environmental management and management of interaction with environment is played by waste management. In particular, a group of authors led by G. Salvia [8] consider the peculiarities of stakeholders interaction in the waste management process on the example of Kenyan city Kisumu. The authors apply the attention-based view from organization theory to define the key problems in the relevant sphere and ways of their solving. I. Kolodiichuk and V. Kolodiichuk [9] examine the waste management system on the example of Ukraine. On the statistical data basis, the scientists propose to use the coefficient of territorial security of utilization capacity which enables the analysis of the waste disposal capacity in the territorial aspect. The authors also suggest the stages of solving the waste problem in Ukraine. N. Bulavinova et al. [10] have analyzed main trends in research of responsible investment in the context of sustainable development, which are directly connected to current problems of management of enterprise interaction with the environment.

The research of G. Qian et al. [11] is conducted from the hazard analysis standpoint. The research emphasizes the fact that sustainable management of waste and related hazards is a triune function of efforts from government, communities, and individuals. The paper analyzes the hazards from pollution according to different sources and defines the appropriate strategies of such hazards minimization.

Recognizing the importance of scientific and practical results obtained by these and other researchers, we should note that the complexity of the problems associated with ensuring effective interaction of the enterprise with the environment, the fragmentation of the relevant mechanism determine the relevance of this article.

3. Objective of the research
The purpose of the article is to provide further development of the conceptual foundations of the mechanism of management of enterprise interaction with environment. An appropriate mechanism of management of enterprise interaction with environment will not only increase the environmental orientation and social responsibility of the economic entity, but also will provide a positive impact on the formation of financial results by reducing unproductive expenses of environmental orientation. The defined objective involves solving the following tasks: identification of structural components of the relevant mechanism of interaction and their characteristics; practical approbation of individual components of the defined mechanism, in particular, in a part of its instruments; offering measures (instruments) for ME “Zhytomyrvodokanal” in order to reduce the negative anthropogenic impact of the enterprise on the environment.
4. Methodology
The basis of the research is a systematic approach, which involves considering the management of the enterprise interaction with environment as a complex polystructural process, integrated into the overall management system of the enterprise. For solving the tasks of the research, the following methods were used: monographic, logical, classification, methods of analysis and generalization – to identify the structure of the mechanism of management of enterprise interaction with environment, drawing conclusions; statistical method and method of constructing distribution series and time series – to form a database for research; method of correlation and regression analysis – to form a model of the impact of individual pollutants emissions on the overall rate of air pollution; methods of analysis and synthesis, the method of scientific deduction – to determine measures (instruments) for reducing the negative impact of ME “Zhytomyrvodokanal” on the environment; graphic and tabular methods – to illustrate the results of the research.

5. Results of the research
The problem of organizing the interaction of enterprises with the environment on the basis of integrity, sustainability, and holism today is one of the most urgent given the role of the environment in shaping the living conditions of people. The environment forms a direct impact on people’s health condition, and the climatic changes (which are the result of negative anthropogenic impact on the environment) have threatening consequences for the future of both individual countries and the planet as a whole. The growing concern of the world scientific community about the state of ecology and the environment is explained by extremely negative trends in this area. These negative trends, in turn, require intensified efforts to implement the concept of sustainable development both at the macro level (global and individual countries) and at the micro level (individual enterprise level).

Solving the problems of sustainable development ensuring also requires involvement of individuals. It is clear, that the main negative impact as well as the biggest environmental efforts are in the sphere of responsibility of enterprises and organizations, however, it is individuals who are able to influence the activity of enterprises and organizations [7]. J. F. Molina-Azorin et al. on the basis of a considerable research of scientific publications also define the role of “green” human resources management which is understood as the coordination of traditional human resources management practices with the goals and tools of environmental management [2]. According to the authors, for companies seeking to implement the concept of environmental management, it is important to focus employees on achieving environmental goals, considering the environmental aspects of individual positions, and the introduction of environmental criteria in the motivation system [2].

We believe, that one of the most expedient and effective ways of ensuring the sustainable development concept implementation in the activity of individual economic entities is the development and practical approbation of a relevant mechanism of management of enterprise interaction with environment (figure 1).

The mechanism of management of enterprise interaction with environment is a complex polystructural and, at the same time, integral system of elements, the mutual action of which is aimed at minimizing the negative impact of the business entity on natural factors and, if possible, at the implementation of environmental measures. We believe that the main components of such a mechanism should be defined as following: program and target, instrumental and methodical, support blocks.

According to figure 1 we will specify the peculiarities of the mechanism of enterprise interaction with environment. Environment is an external element relative to the mechanism. The environment, on one hand, defines the economic entity functioning conditions, on the other hand – is exposed to anthropogenic impact due to the activities of the enterprise.
Figure 1. The structure of the mechanism of enterprise interaction with environment.

The internal structure of the mechanism of enterprise interaction with environment consists of three key components.

The program and target block defines the general orientation and basis of functioning of the mechanism of enterprise interaction with environment. The main components of this block are the following:
- objects (key phenomena and processes of economic activity);
- subjects (managers of all levels who perform functions and duties according to their position within the organization, thus, those individuals who are able to influence the sustainable and ecological oriented behavior of economic entity [7]);
- goal (ensuring optimal interaction of the enterprise with environmental factors in order to reduce the negative impact of the business entity on the environment);
- tasks (the tasks are defined according to the overall goal of the mechanism functioning and may include the following: estimating the factors of environment; analysis of the impact of enterprise on the condition of environment; defining the instruments and ways of implementation of enterprise environmental measures; ensuring the minimization of negative anthropogenic impact).

The mentioned components in the complex form the vision of the economic entity in relation to its interaction with environment. In this context we propose to understand vision as the state
of interaction with environment and the image that the enterprise seeks to form as a positioning element.

Next block – the instrumental and methodical – includes principles, algorithms, methods, and instruments.

We consider it necessary to include the following key principles of the mechanism of management of enterprise interaction with environment:
- integrity and structuring;
- complexity and systematics;
- economy and substantiation;
- social responsibility and environmental friendliness;
- rationality and relevance.

These principles are not exhaustive and exclusive, at the same time, their observance in the process of organizing the interaction of the enterprise with the environment will increase the efficiency of the process.

Algorithms as a mechanism component include sets of actions which are appropriate to be undertaken in certain economic processes and / or operations. Such algorithms relative to enterprise interaction with environment should include:
- algorithm of estimating the state of environment factors;
- algorithm of estimating the enterprise impact on environmental factors;
- algorithm of substantiation of measures for ensuring the proactive interaction of the enterprise with environment;
- algorithm of estimating the measures efficiency.

We believe that the methods of ensuring the enterprise interaction with environment are expedient to be considered through the prism of classic management methods, namely economic, organization and administrative, social and psychological. Such approach is defined by the fact that management of enterprise interaction with environment is an integral component of the general management system of the enterprise, so it is based on the use of relevant methods.

The instruments of management of enterprise interaction with environment are the specific means of influencing the interaction processes. In our opinion it is advisable to identify the following three groups of instruments:

1) economic – are based on the use of market mechanisms, which are mediated by flows of financial resources. The key economic instruments in such context include: environmental payments; environmental taxes and fees; payments for resource use; penalties for environment pollution; environmental liability insurance, etc. It should be noted that environmental insurance is one of the most up-to-date and important instruments of environmental management which correlates with ISO 14001 standard [6];

2) ecological – involve the use of regulative and environmental mechanisms and include the emissions limits; means to reduce relevant emissions; waste management tools, etc.;

3) adaptive – are oriented on the ensuring the adaptation of the enterprise to the conditions of environment and may include a wide range of tools, the use of which is appropriate in certain economic operations (for example diversification, management “according to the weak signals”, reengineering, etc.). The specific choice of adaptive instruments is defined by a great number of factors, such as environment condition, the degree of anthropogenic impact of the enterprise on environment, corporate culture and social responsibility of the enterprise, resource (in particular, financial) capabilities of the economic entity. V. Pechancová et al. define that the availability of resources is one of the most important factors of influence on the choice of environmental management instruments. According to the analysis conducted by the researchers it was revealed that the representatives of small business face the challenges while implementing the environmental practices due to the resource scarcity and absence of strategic thinking [4].
The last component of the mechanism of management of enterprise interaction with environment is the support block, which includes the resource support of managerial processes as well as of processes of proactive interaction with environment (the measures aimed at reducing the negative impact). The specific set of resources will vary under the influence of a great number of factors (for example, size and type of activity of the enterprise, its management structure, the scale of negative impact of environment, etc.). The most common resource groups that can be involved to the relevant mechanism are: human, financial, technical, organizational, informational, natural, etc.

The structure of the interaction mechanism proposed by the authors provides an opportunity to organize all the components of the relevant mechanism, which, in turn, will increase the efficiency of the respective processes.

Theoretically developed basis of the mechanism require empirical testing. Considering the proposed structure, we believe it is expedient to substantiate the instruments of enterprise interaction with environment using the empirical data. For the specific recommendations substantiation, we propose to use the enterprises which are quite peculiar in their activity in the process of interaction with environment. In particular, in further research we will orient on the economic entities whose activities are related to the generation and management of waste and which, at the same time, provide environmental services. Such choice is defined by the fact that the mentioned subjects are characterized by the double impact on the environment: positive from the perspective of environmental services provision and negative from the perspective of environment pollution with emissions.

One of the most important stages of management of enterprise interaction with environment is the substantiation of specific instruments for reducing the negative anthropogenic impact of enterprise activity on environment. Moreover, in the process of determining specific instruments from the standpoint of an individual entity, it is necessary to consider not only the impact of the entity on the environment, but also the general state of the environment to achieve maximum efficiency. We believe that the appropriate substantiation should be based on a factor approach, which allows to identify the most important factors of negative impact for a particular region and / or business entity.

The economic entities activity forms a negative impact on all the environment components: land, water, air, biological diversity. For the need of substantiation of instruments for efficient interaction we will consider the example of air pollution by emissions. In order to determine the priority measures to ensure the reduction of negative impact on the environment, we consider it appropriate to find out which emissions are the most significant from the point of view of air pollution by economic entities of Ukraine. In order to build a factor model, we use the indicator of pollutant emissions into the atmosphere from stationary sources of pollution by regions (TAP – total atmosphere pollution) as the dependent variable. The data is collected for year 2020 using the information of the State Statistics Service of Ukraine [12]. To take into account the level of concentration of pollutants, the emission indicator per 1 km² was determined. The emissions of metals and their compounds, substances in the form of suspended solid particles, nitrogen oxide, nitrogen dioxide, ammonia, sulfur dioxide, carbon monoxide, methane, non-methane volatile organic compounds, polyaromatic hydrocarbons, carbon dioxide into the atmosphere from stationary sources of pollution in 2020 were selected as independent variables \(X_1, \ldots, X_{11}\). The dependent and independent variables are given in table 1.

According to the calculated TAP indicator, the highest indicator of air pollution belongs to stationary sources of Donetsk region and of the city of Kyiv, which came out on top in terms of air pollution. Donetsk region is characterized by a significant content in the air of emissions of metals and their compounds, sulfur dioxide and carbon monoxide. The atmospheric air of Kyiv is saturated with emissions of particles suspended matters, nitrogen dioxide, non-methane volatile organic compounds, methane, and carbon dioxide. However, Kyiv region has a neutral
Table 1. Analysis of pollutant emissions in the atmosphere from stationary sources of pollution by regions of Ukraine in 2020*.

| Regions       | TAP  | X1    | X2    | X3    | X4    | X5    | X6    | X7    | X8    | X9    | X10   | X11   |
|---------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Vinnytsya     | 2.949| 0.001 | 0.496 | 0.003 | 0.257 | 0.041 | 1.635 | 0.212 | 0.077 | 0.217 | 0.000 | 160.282|
| Volyn         | 0.252| 0.000 | 0.077 | 0.002 | 0.026 | 0.004 | 0.015 | 0.060 | 0.013 | 0.048 | 0.000 | 22.925 |
| Dnipropetrovsk| 16.753| 0.019  | 1.636 | 0.006 | 0.847 | 0.033 | 1.901 | 8.608 | 0.058 | 3.634 | 0.000 | 641.561|
| Donetsk       | 28.320| 0.097  | 2.201 | 0.012 | 1.397 | 0.006 | 8.047 | 11.455 | 0.021 | 5.042 | 0.000 | 839.398|
| Zhytomyr      | 0.396| 0.000 | 0.110 | 0.001 | 0.048 | 0.014 | 0.025 | 0.070 | 0.016 | 0.109 | 0.000 | 24.171 |
| Zakarpattya   | 0.259| 0.000 | 0.024 | 0.002 | 0.050 | 0.000 | 0.014 | 0.084 | 0.010 | 0.075 | 0.000 | 15.144 |
| Zaporizhzhya  | 5.720| 0.017  | 0.365 | 0.004 | 0.917 | 0.011 | 2.482 | 1.826 | 0.060 | 0.031 | 0.003 | 477.544|
| Ivano-Frankivsk| 10.103| 0.002  | 1.210 | 0.053 | 0.806 | 0.024 | 6.881 | 0.220 | 0.338 | 0.556 | 0.000 | 734.325|
| Kyiv          | 2.366| 0.001 | 0.601 | 0.004 | 0.231 | 0.028 | 0.960 | 0.095 | 0.056 | 0.372 | 0.001 | 130.780|
| Kyiv          | 0.435| 0.012 | 0.169 | 0.001 | 0.036 | 0.005 | 0.030 | 0.109 | 0.026 | 0.039 | 0.000 | 34.522 |
| Luhansk       | 1.332| 0.000 | 0.161 | 0.001 | 0.184 | 0.021 | 0.332 | 0.421 | 0.021 | 0.180 | 0.000 | 75.765 |
| Lviv          | 3.482| 0.001 | 0.295 | 0.005 | 0.253 | 0.010 | 1.005 | 0.179 | 0.092 | 1.635 | 0.000 | 135.961|
| Mykolajiv     | 0.455| 0.011 | 0.109 | 0.002 | 0.100 | 0.005 | 0.019 | 0.066 | 0.018 | 0.116 | 0.000 | 85.098 |
| Odesa         | 1.280| 0.002 | 0.107 | 0.001 | 0.043 | 0.037 | 0.033 | 0.104 | 0.023 | 0.299 | 0.000 | 47.432 |
| Poltava       | 1.594| 0.001 | 0.250 | 0.002 | 0.293 | 0.022 | 0.098 | 0.329 | 0.394 | 0.201 | 0.000 | 55.284 |
| Rivne         | 0.506| 0.000 | 0.102 | 0.061 | 0.207 | 0.012 | 0.018 | 0.066 | 0.017 | 0.021 | 0.000 | 103.341|
| Sunny         | 0.878| 0.002 | 0.105 | 0.001 | 0.092 | 0.015 | 0.135 | 0.265 | 0.061 | 0.194 | 0.000 | 54.345 |
| Ternopil      | 0.686| 0.000 | 0.099 | 0.001 | 0.064 | 0.066 | 0.025 | 0.118 | 0.022 | 0.289 | 0.000 | 35.260 |
| Kharkiv       | 2.997| 0.002 | 0.805 | 0.005 | 0.322 | 0.006 | 1.280 | 0.289 | 0.086 | 0.198 | 0.000 | 247.958 |
| Kherson       | 0.625| 0.000 | 0.033 | 0.000 | 0.012 | 0.005 | 0.020 | 0.027 | 0.011 | 0.516 | 0.000 | 11.566 |
| Khmelnytskyi  | 0.881| 0.001 | 0.109 | 0.004 | 0.250 | 0.031 | 0.075 | 0.256 | 0.050 | 0.100 | 0.000 | 111.190|
| Cherkasy      | 2.461| 0.001 | 0.358 | 0.002 | 0.414 | 0.209 | 0.222 | 0.119 | 0.028 | 1.033 | 0.000 | 114.621|
| Chernivtsi    | 0.217| 0.000 | 0.055 | 0.000 | 0.030 | 0.004 | 0.023 | 0.041 | 0.051 | 0.010 | 0.000 | 17.286 |
| Chernihiv     | 0.656| 0.000 | 0.093 | 0.001 | 0.072 | 0.072 | 0.062 | 0.063 | 0.043 | 0.249 | 0.000 | 42.867 |
| Kyiv city     | 30.000| 0.055 | 3.320 | 0.031 | 8.809 | 0.053 | 3.887 | 2.271 | 3.869 | 8.217 | 0.000 | 5462.486|

*X1 – emissions of metals of metals and their compounds, tons per 1 km; X2 – emissions of particles suspended matters, tons per 1 km²; X3 – emissions of nitrogen oxide, tons per 1 km²; X4 – emissions of nitrogen dioxide, tons per 1 km²; X5 – ammonia emissions, tons per 1 km²; X6 – emissions of sulfur dioxide, tons per 1 km²; X7 – emissions of carbon monoxide, tons per 1 km²; X8 – emissions of non-methane volatile organic compounds, tons per 1 km²; X9 – emissions of methane, tons per 1 km²; X10 – emissions of polyaromatic hydrocarbons, tons per 1 km²; X11 – emissions of carbon dioxide, tons per 1 km²

Source: State Statistics Service of Ukraine [12]

place among the other regions in terms of air pollution.

Among the leaders of the environmental rating on the minimum level of air pollution Zakarpattya and Kherson, Chernivtsi regions should be mentioned; Zhytomyr, Luhansk, Ternopil and Chernihiv regions can be referred to the second group of pollution in the ranking.

In terms of zonal stratification, the most polluted air is in the south-east of the country, and the cleanest is in the south and south-west, in some places in the north of the country.

One of the main prerequisites for determining the dependence of the effectiveness of the regional indicator of air pollution on various emissions of harmful substances when using the method of regression analysis is the linear independence of factors. To ensure this condition, the presence / absence of linear relationships between independent model variables was checked, i.e. factors multicollinearity was investigated. The most complete way to investigate multicollinearity is to construct a correlation matrix for all the identified factors, which were grouped above in table 1 (figure 2). The corresponding calculations were performed with the use of software GNU Regression, Econometrics and Time-series Library (Gretl).

After calculating a correlation matrix of harmful emissions into the atmosphere, we have found the presence of high collinearity between regressors X1, X2, X4, X9, which should be eliminated for further calculations.
Figure 2. The correlation matrix of independent variables (model 1).

Table 2. Regression indicators for the TAP Model.

|                | Coefficient | Standard error | t-statistics | P-value |
|----------------|-------------|----------------|--------------|---------|
| const          | 0.825282    | 0.423067       | 1.951        | 0.0639  |
| X7             | 2.18050     | 0.140679       | 15.50        | <0.0001 |
| X8             | 6.76226     | 0.534052       | 12.66        | <0.0001 |
| Mean dependent variable | 4.640061  | S. D. dependent variable | 8.303063 |
| Sum squared residuals | 79.88899 | S. E. of regression | 1.905602 |
| R-squared      | 0.951716    |                |              |         |
| F(5, 19)       | 216.8210    | P-value (F)     | 3.32e-15     |         |
| Log-likelihood | 49.99549    | Akaiki criterion | 105.9910   |
| Schwarz criterion | 109.6476   | Hannan-Quinn criterion | 107.0052 |

Subsequently, factors $X_3$, $X_5$, $X_6$, $X_{10}$ and $X_{11}$ were eliminated by iterative testing of the model. No linear relationship was found between emissions of carbon monoxide and non-methane volatile organic compounds in the atmosphere from stationary sources (correlation level less than 0.7). The results of the calculations of regression analysis are given in table 2.

According to the calculated data, 2 factors that reflect emissions into the atmosphere are linearly independent, as the value of the statistical indicator differs significantly from 0. The correlation matrix is normal. $R^2 = 95\%$.

According to the results of the $F-test$ (Fisher’s test), the constructed model is considered adequate for the sample data, because $F_{fact}(216.82) > F_{crit}(2.26)$ (with a probability of error of 0.1). The regression model (model 2) will look like this:

$$Y = 0.825 + 2.18X_7 + 6.762X_8$$

where $Y$ – the indicator of pollutant emissions into the atmosphere from stationary sources of pollution by regions ($TAP$ – total atmosphere pollution), tons per 1 km\(^2\); $X_7$ – emissions of carbon monoxide, tons per 1 km\(^2\); $X_8$ – emissions of non-methane volatile organic compounds, tons per 1 km\(^2\).

Thus, as a result of the constructed model 2, the most important factors influencing the overall rate of air pollution from stationary sources are carbon monoxide emissions and emissions of non-methane volatile organic compounds.

As already mentioned, to ensure the practical testing of the built model we will use the data of entities whose activities are related to the generation and management of waste and...
Table 3. Dynamics of emissions in the atmosphere of ME “Zhytomyrvodokanal”, tones.

| Pollutants                           | 2017   | 2018   | 2019   | 2020   | Deviation 2020 to 2017 |
|--------------------------------------|--------|--------|--------|--------|------------------------|
| Nitrogen dioxide                     | 7.106  | 6.483  | 6.148  | 6.143  | -0.963                 |
| Sulfur compounds                     | 0.754  | 0.702  | 0.533  | 0.535  | -0.219                 |
| Carbon monoxide                      | 29.240 | 28.925 | 28.806 | 29.018 | -0.222                 |
| Solid substances                     | 0.894  | 0.850  | 1.142  | 1.122  | 0.228                  |
| Chlorine                             | 0.003  | 0.012  | 0.012  | 0.012  | 0/009                  |
| Non-methane volatile organic compounds| 0.360  | 0.290  | 0.079  | 0.080  | -0.280                 |
| Total                                | 38.357 | 37.262 | 36.720 | 36.910 | -1.447                 |

Source: data of reports of ME “Zhytomyrvodokanal”

which, at the same time, provide environmental services. The specific list of such economic entities is determined by local environmental authorities in the territorial context. Further proposals will be considered on the example of Municipal Enterprise “Zhytomyrvodokanal” (ME “Zhytomyrvodokanal”), the subject of which activity are water collection, treatment, and supply, as well as sewerage. At the same time, the activity of this enterprise is also related to emissions into the atmosphere (table 3).

According to the data of table 3 we should note the overall reduction of emissions volumes into the atmosphere from the activity of ME “Zhytomyrvodokanal”. At the same time, the defined with the model 2 factors (emissions of carbon monoxide and of non-methane volatile organic compounds) are present in the emissions of the analyzed enterprise. So, we will propose the measures for the formation of instruments of ensuring the interaction of the enterprise with the environment considering these emissions.

One of the ways of reduction of negative anthropogenic impact on environment is the implementation of the appropriate management systems. The research of S. Roohy Gohar and M. Indulska emphasizes the role of green business-process management (BPM) in the securing the sustainable development of the economic entity. According to the scientists, the concept of green BPM is formed on the basis of understanding, analysis, and constant improvement of existing (current) business-processes with focusing on their environmental impact [3].

It is common in the world for eco-friendly companies to implement effective management systems with an environmental focus. In particular, we believe it is expedient to organize management with compliance to the ISO 14001:2015 standard [13]. The standard proposes to implement management systems using PDCA cycle with considering the ecological goals. The implementation of ISO 14001 standard in the management system of ME “Zhytomyrvodokanal” will contribute to increase of the overall level of environmental friendliness of the enterprise as well as it will have a positive impact on investment attractiveness from the standpoint of attracting foreign capital for financing the development projects. It should be noted that the cost of the certification procedure is relatively insignificant for the studied enterprise. Approximately the cost of certification procedure itself is about 50 ths. UAH. However, this amount does not include costs that must be incurred to bring the management system in line with the standard.

The implementation of “green innovations” is an important tool for reducing the negative anthropogenic impact on environment. According to P. T. Huong et al., green innovations include possible technology improvements, which enable energy-saving and waste recycling [5]. Moreover, green innovations can include solutions related with software use as well as with use of appropriate equipment, which enable to reduce waste and the use of hazardous materials by recycling or reusing them [5]. The implementation of green innovations not only forms a positive
impact on the image of the enterprise as of an eco-friendly subject, but also promotes increasing the efficiency of its functioning and competitiveness [2].

In particular, the source of carbon monoxide emissions in the activities of ME “Zhytomyrvodokanal” are combustion processes in small plants (boiler house activities at the enterprise). Thus, “green innovations” for reduction of carbon monoxide emissions from the activities of ME “Zhytomyrvodokanal” may include, for example, the installation of modern boilers, a sound approach to fuel selection, the use of filters that will reduce emissions. It is clear that such technological solutions are not new in absolute terms, but from a local point of view, for ME “Zhytomyrvodokanal” they will be innovative approaches to solving problems.

The source of emissions of non-methane volatile organic compounds at ME “Zhytomyrvodokanal” is a gas station located on the territory of the enterprise. Therefore, monitoring the technical condition and use of the gas station is important in the context of reducing this type of emissions. It is clear that the implementation of innovations requires the involvement of appropriate financial resources, which, given the financial condition of ME “Zhytomyrvodokanal” (uncovered loss of the enterprise as of 31.12.2020 amounted to 139003 ths. UAH), is a problem issue. At the same time, there are ways of solving this problem. In particular, we believe such solutions should include the following:

– the use of the mechanism of municipal and private partnership through involvement of investments from business subjects;
– interaction with business subjects to attract non-refundable financing within the concept of corporate social responsibility;
– attracting grant funding from international organizations.

The offered instruments of ensuring the interaction of ME “Zhytomyrvodokanal” with environment are defined in the context of pollution of just one environment component, namely the atmosphere (air). At the same time, it is important to conduct further research in the sphere of reducing the pollution of other environment components (namely, water and land) in order to increase the efficiency of respective interaction and provide the eco-friendly policy of the enterprise.

Considering the peculiarities of the ME “Zhytomyrvodokanal” activity subject (sewerage), it is extremely important to provide the efficient policy of waste management for this enterprise. This thesis is confirmed by the systematic discharge of wastewater in the Teteriv River and, consequently, its pollution.

According to G. Salvia et al. the problem of waste management is one of the most important in modern world, as the absence of the system approach to solving the problems in this area causes negative consequences for environment as well as for health of the local communities [8]. As for Ukraine, according to the research of I. Kolodiichuk and V. Kolodiichuk major part of Ukraine’s regions is characterized by the imbalance in the amounts of waste generated and capabilities for their disposal. In particular, only 3 regions of Ukraine are provided with their own capacities in sufficient quantities for waste disposal [9].

According to G. Qian et al. the main strategies of waste management can be presented as follows:

– minimization of waste sources and promotion of ideas regarding recycling / reuse of waste;
– elimination or reducing the hazards through the landfilling;
– control of hazardous waste sources with engineering means;
– administrative control and personal involvement;
– hazard management during natural disasters [11].

Therefore, the development of effective instruments in the relevant sphere is a promising and extremely important sphere of further research regarding ensuring the efficient interaction of ME “Zhytomyrvodokanal” with environment.
6. Conclusions
Ensuring the efficient interaction of the enterprise with environment is aimed at the solution of several tasks on macrolevel (promoting the achievement of SDGs) as well as on microlevel (reducing the negative impact of enterprise activity on environment, increasing its investment attractiveness, reducing the costs related to irrational resource use and penalties, etc.). The results of the research enabled the further development of the conceptual foundations of functioning of the mechanism of management of enterprise interaction with environment. The proposed by the authors structure of mechanism consists of program and target, instrumental and methodical, and support blocks and makes it possible to implement the complex approach to the solution of the problems of economic entities interaction with environment. The empirical approbation of the mechanism provisions was carried out through the prism of substantiation of interaction instruments. One of the components of the environment, namely air, was chosen for a more detailed analysis of the negative factors which can be managed by an individual entity. In particular, the impact of certain types of pollutant emissions on the overall level of air pollution was analyzed on the basis of data on individual regions of Ukraine. It was found with the use of regression analysis that the main types of emissions that have the most significant impact on the total atmosphere pollution indicator are the carbon monoxide and non-methane volatile organic compounds emissions. Empirical substantiation of the elements of the instrumental and methodical block in terms of specific measures for ensuring the interaction of the enterprise with the environment was carried out on the example of ME “Zhytomyrvodokanal”, whose activities are related to waste generation and management and which provides environmental services. The dynamics of emissions of pollutants into the air from the enterprise economic activity was analyzed. Based on the conducted regression analysis and relevant findings, as well as on the basis of the analysis of statistical data on emissions of ME “Zhytomyrvodokanal” the reserves to reduce the negative impact on the environment were identified. The instruments for reducing the corresponding emissions have been proposed for this enterprise. It was found that the prospects for further research are in the field of substantiation of specific instruments for the interaction of the enterprise with the environment in relation to other components of the environment.

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