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### **Bioinformatics&Biomathematics**

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#### Vybornova I.I., Sukhorukova Irina V., Vybornov A.N. Mathematical model of effects on living organisms in the biosphere negative anthropogenic stochastic factors

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Abstract: Development of theoretical and methodological foundations of long-term negative impact of anthropogenic ratemyserver effects on the chiral purity of the biosphere in order to ensure sustainable development of the territory represents a major socio-economic and national economic challenge. We studied the effect on the biosphere anthropogenic factors that have stochastic nature. It was assumed that recenserade stochastic effects can be entered into the model in the form of "white noise". From the biosphere were isolated bacteria and protozoa algae as the objects most susceptible to negative anthropogenic effects. Based on numerical studies of models identified for microorganisms important conclusions. Development of theoretical and methodological foundations of long-term negative impact of anthropogenic ratemyserver effects on the chiral purity of the biosphere in order to ensure sustainable development of the territory represents a major socio-economic and national economic challenge. We studied the effect on the biosphere anthropogenic factors that have stochastic nature. It was assumed that recenserade stochastic effects can be entered into the model in the form of "white negative impact of anthropogenic ratemyserver effects on the chiral purity of the biosphere in order to ensure sustainable development of the territory represents a major socio-economic and national economic challenge. We studied the effect on the biosphere anthropogenic factors that have stochastic nature. It was assumed that recenserade stochastic effects can be entered into the model in the form of "white

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**Keywords**: the mathematical model, the chiral purity of the biosphere, stochastic impacts, sustainable development of multiplicative noise

he implementation of the concept of sustainable development requires implementation of complex of measures to ensure good environmental quality and ecological safety of production. However, the impact of the global impact of anthropogenic factors on the environment, primarily on the chiral purity of the biosphere has to date not developed fully. This is especially true of the economic aspects of the problem.

This circumstance is underscored by the fact that the environmental situation in Russia is characterized by extreme heterogeneity.

It should be noted that along with the fact that 7-8 million sq km in our country remain virtually untouched by modern business activity, more than 2 million sq km are recognized as environmentally unfavorable. Of course, it is precisely those areas where a significant portion of the population, is the most dirty business, especially in actively operated farmland. Emissions of polluting substances in atmospheric air, discharges of polluted wastewater, fugitive landfill, irrational use of pesticides and mineral fertilizers cause ever increasing pollution of soils and food [1-2]. This circumstance is underscored by the fact that the environmental situation in Russia is characterized by extreme heterogeneity.

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significant portion of the population, is the most dirty business, especially in actively operated farmland. Emissions of polluting substances in atmospheric air, discharges of polluted wastewater, fugitive landfill, irrational use of pesticides and mineral fertilizers cause ever increasing pollution of soils and food [1-2].

Development of theoretical and methodological foundations of long-term negative impact of anthropogenic ratemyserver effects on the chiral purity of the biosphere in order to ensure sustainable development of the territory represents a major socio-economic and national economic task, which determines the relevance of this study.

The relevance of this work is largely defined by a lack of methodology and the organizational-economic mechanism of state management of the ecosystems of the major industrial centers of the Russian Federation. In this context priority ecological-economic research is the scientific study of transition to sustainable development of the territory, ensure balanced solution of socio-economic goals for the future and preservation of favorable environmental quality, which implies the strengthening of the environmental component in various fields, harmonizing environmental and economic interests of society in the process of managerial decision-making.

The implementation of these issues requires the implementation of complex of measures on the new methodological basis, which determines the practical value of this study.

In terms of impact economic losses can be divided into direct and indirect. In this case, direct damages are the costs and losses that are directly related to anthropogenic impact and localization of their consequences. Indirect damage is associated with more remote in time losses.

An axiom in the economy of nature is the thesis according to which the economic damage caused by nature is considered to be random, stochastic variable. This means that

indicators of environment-related losses cannot be estimated uniquely with a finite degree of accuracy, therefore, any assessment of damages should be described in terms of a greater or lesser degree of probability. Analysis of the definitions of «economic losses» allows to distinguish the following main forms of environmental harm: a) the loss of material goods or consumer properties created by the previous work; b) loss of (loss of) wealth or consumer properties when expenses incurred; C) the shortfall in the expected results when unrealized cost (loss of profit, unrealized potential); d) additional costs for compensation or prevent natural losses; d) inefficient use of available material and financial resources. In terms of impact economic losses can be divided into direct and indirect. In this case, direct damages are the costs and losses that are directly related to anthropogenic impact and localization of their consequences. Indirect damage is associated with more remote in time losses.

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The principle of minimizing impact on the environment during the sustainable development of production determines the balanced ecological-economic development of

both individual objects and the territory in General.

The decision of problems of rational nature management is carried out from the standpoint of economic approach based on cost estimation of natural resources and approach, based on the definition of regulations of economic use of natural resources.

The most reliable way of determining the economy is the ecological optimum environment is a simulation of the interaction of the system «economy – environment», i.e., presents them in the form of models that simulate the behavior under certain conditions and within a specified time.

In our understanding of economic–environmental model suggests the option of maintaining ecological balance by reducing the impact of or regulation of production, taking into account environmental requirements.

Chiral purity of the biosphere is a necessary condition of the biosphere's ability to replicate. Chiral (or mirror-antipode) are objects that do not possess a center or plane inversion. Mirror isomers (enantiomers), molecules usually called «left» (L) and «right» (D). Chiral purity is a property of the object (the environment) contain molecules of one type of chirality (either L or D). If the environment contains equally a mirror of opposites, it is racemic. Although inanimate nature «left» and «right» molecules are in equal amounts, the living organisms use only D isomers of sugars and L-isomers of amino acids.

The biosphere, as an open system located in a mirror-symmetric environment, should support their own chiral num-Toth, otherwise the system loses its ability to snowsprite Denia. There is experimental evidence of the link between loss of chiral purity of the metabolic networks of the organism and the occurrence of PA-tragicheskih States. So, it is established that the proteins of tooth enamel of people over 60 years rareminerals about 8% L-aspartic acid. When studying the process of racemization aspartic acid in the crystal structures of heavy molecular weight and insoluble proteins in the lens of the eyes

of people of all ages found to have a large degree of racemization of amino acids in a more stable and «old» proteins of the cortex of the lens. This same phenomenon is noted in advanced cases of «brown» (Mature) cataracts, compared to «yellow» (immature). Chiral purity of the biosphere is a necessary condition of the biosphere's ability to replicate. Chiral (or mirror-antipode) are objects that do not possess a center or plane inversion. Mirror isomers (enantiomers), molecules usually called «left» (L) and «right» (D). Chiral purity is a property of the object (the environment) contain molecules of one type of chirality (either L or D). If the environment contains equally a mirror of opposites, it is racemic. Although inanimate nature «left» and «right» molecules are in equal amounts, the living organisms use only D isomers of sugars and L-isomers of amino acids.

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The human body is influenced by a large number of optically active substances (pesticides, insecticides, pharmaceuticals, PI-xevie additives, perfumes). Thus the enantiomers of the same substance have different, sometimes opposite effect on the functioning of metabolically active systems. Therefore they must learn not only to reduce environmental pollution, but in the end, to prevent the influence on the human body of

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racemates with an unknown biological effect, the effect of which can be fatal.

The process of racemization bio-organic substances and their rate of occurrence is significantly dependent on external conditions [3].

Analysis of the influence of negative anthropogenic impacts on the chiral purity of the biosphere was carried out in [4].

The biosphere is presented in the form of two interacting subsystems R and A, one of which (R) enables the production of a chiral substance by coming into it from the outside achiral substance and energy. The second (A) consists of objects used for selfreproduction of chiral substance subsystem R. the Consumption of L — enantiomers leads to the reproduction and consumption of  $\alpha$ , D — to the loss of the object of this ability, his death  $\alpha \rightarrow \alpha'$  and transition  $\alpha'$  to a subsystem of P in the form of a racemate. $\theta$  — the total number of chiral substrate,  $\theta = L + D$ , and the -chiral order parameter of the subsystem P,  $\eta = (L - D)/(L + D)$ . The racemic condition of the correspond  $\eta =$ 0; chiralmotion the state  $|\eta|=1$ .

In the presented model of the biosphere, there are three steady States:

 $\alpha > 0$ ,  $\eta > 0$  — in the biosphere there are living objects.

II.  $\alpha = 0$ ,  $\eta > 0$ , — the entire biosphere is represented by the subsystem P, which is in Giraldo polarized state.

III.  $\alpha = 0$ ,  $\alpha' = 0$ ,  $\eta = 0$ , -subsystem (A) is destroyed, a subsystem (P) fully racemized.

We studied the effect on the biosphere anthropogenic factors that have stochastic nature. It was assumed that recenserade stochastic effects can be entered into the model in the form of «white noise». From the biosphere were isolated bacteria and protozoa algae as the objects most susceptible to negative anthropogenic effects. Based on numerical studies of models identified for microorganisms important conclusions.

Further development of models of loss of chiral purity leads to the need of numerical analysis of the model identified for the processes occurring in microorganisms, in that case, if racemize stochastic factors represent the «color noise».

The object of the study are bacteria and protozoa algae, as the most exposed to anthropogenic factors. The importance of the functioning of bacteria and algae to the biosphere cannot be overestimated. None of the nutrient cycle is not without bacteria, so their livelihoods is a precondition for existence of life on the planet.

According to current estimates, the share of the ocean accounts for at least half of global primary production, expressed in the amount of fixed carbon. This primary production form algae, the only plants that inhabit the ocean. Algae are very important primary producers at the start of most food chains, including almost all marine and many freshwater circuit. These chain via zooplankton, crustaceans, etc. reach the fish. A microscopic algae — single celled, and they are major component of phytoplankton.

Fixation of carbon is only one of the consequences of photosynthesis. In addition, through photosynthesis, maintained the level of oxygen in the atmosphere, while at least half of all the algae emit oxygen, and their contribution to this process much more than the contribution of terrestrial forests.

However, phytoplankton biomass is low, often less than the biomass feed for his animals. This is possible thanks to an intensive metabolism, and photosynthesis of unicellular algae, providing a high growth rate of phytoplankton. Therefore, negative anthropogenic impact, preventing the growth of algae will affect many living organisms.

According to current data the total biomass of all plant organisms of the ocean is

0.3 billion tons of dry matter, biomass of animals of the ocean — 6 billion tons

The total biomass of bacteria and other microorganisms is expressed in significant quantities in the biocenoses sushi is superior to animal biomass (biomass of soil animals is approximately equal to 0.5 billion tons of dry matter, total biomass all other animal sushi 1-2 orders of magnitude less).

Bacteria involved in cycles of all the biologically important elements and ensure the circulation of substances in nature. About 2 billion years ago, bacteria formed a biosphere, similar to modern. A key reaction of the nutrient cycle (e.g., nitrification, denitrification, nitrogen fixation, oxidation and reduction of sulphur compounds) are carried out only in bacteria. One g of soil contains hundreds of thousands or millions of bacteria in one ml of water — tens or hundreds of cells. In the upper layers of cultivated soil in 1 ha there is a few tons of bacterial cells. Mineralize plant and animal residues, microorganisms involved in the cycle of all the chemical elements composing the living cells. Thus, the source of carbon for higher plants and chemoautotrophic bacteria use the carbon dioxide of the atmosphere is fixed during the photo or chemosynthesis. The biomass of plants and animals are decomposed by microorganisms able to utilize cellulose, peptides, starch, lignin, pectin, ultimately to carbon dioxide and water.

As the role of bacteria in the nitrogen cycle. The atmosphere contains 79% nitrogen. It's a pretty inert element, so that it is relatively rare in the bound state. Nitrogen is a necessary component of amino acids and proteins. No other element so does not limit the resources of nutrients in ecosystems, as nitrogen. It can become available to living organisms only in a bound form, i.e. as a result of nitrogen fixation.

Animals eating plants to synthesize proteins and other nitrogen-containing products in your body due to the protein plant. When mineralization of animal and vegetable protein putrefactive bacteria to form ammonia which is oxidized by nitrifying bacteria into nitrites

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and then into nitrates. As ammonium salts and nitrates serve as a source of nitrogen nutrition for higher plants, thus synthesizing proteins in your body.

The mineralizing ability of the bacteria provides to the cycle, and other biogenic elements (e.g. phosphorus and sulfur).

Bacteria differ changeable exchange, highly dropping with a lack of food. Under the influence of external factors (Ultraviolet rays, ionizing radiation, ailenin and other chemical substances), bacteria can lose their mobility, ability to form pigments, to give the debates, to increase or decrease the ability to synthesize various organic compounds, etc.

Meanwhile, a number of biochemical processes (glycolysis, electron transport, synthesis of aminoacids, proteins, nucleic acids, etc.) occurs in bacteria almost the same as in the cells of plants and animals. Synthesis of amino acids, proteins, nucleic acids represents an autocatalytic process.

The growth of bacteria depends primarily on the temperature, pH, availability of nutrients and ion concentrations [3,4].

Pollution of the biosphere with chemicals has a negative impact on microorganisms. For example, SO2 and H2S, passing the plasma membrane and penetrating into the cytoplasm, produce structural damage of the organelle membranes, in addition, inhibit and decompose the enzymes. All this leads to a reduction in the rate of autocatalytic processes.

This conclusion serves as a basis for further development and analysis of models of loss of chiral purity of the biosphere. It implies the need for quantitative research model identified for the processes that occur in microorganisms, with the aim of ascertaining the level of negative anthropogenic impacts that can lead the biosphere to environmental disaster.

The study of influence of negative anthropogenic factors on bacteria algae and

protozoa (with the feasibility of the introduction of anthropogenic effects in the reaction of racemization and autocatalysis, going bacteria and algae) were obtained the following result [4]: while the long-term impact of negative anthropogenic factors on biosphere the most damaging effect of exposed single-celled organisms such as bacteria and algae, whose livelihoods is a necessary condition for the existence of life. Anthropogenic factors will influence the processes occurring in microorganisms, primarily on the autocatalytic reaction and the reaction of racemization.

This conclusion complements the quantitative research model that identified for processes in microorganisms. Accidental anthropogenic fluctuations were simulated there, using «white noise» [4].

We introduce in the system a multiplicative noise  $k_r(t) = k_r + f(t)$ .  $k_r$  — given the rate constant of racemization substance subsystem P. Here f(t) is white noise with zero mean and amplitude H.

The numerical study shows that the state II the system is resistant to such fluctuations. For a long time even when the value of the amplitude H close to the critical one kr, the system is not out of status II.

In contrast, the system in state (I) significantly reacts to random changes of speed of racemization. Near the first critical speed values of racemization (bifurcation point), the system goes from state (I) in condition (II), i.e. from the biosphere disappear living objects and the order parameter remains positive.

The amplitude of the random fluctuations in this case may be less than the critical value of 5-6 orders of magnitude, i.e., stochastic effect even of very small amplitude can cause the disappearance of subsystem (A) living organisms.

In the transition system from (I), (II) the order parameter tends to a stationary

solution of the form (II) corresponding to this value of speed of racemization.

This means that the transition from (I) to (II) occurs with fluctuations of the speed values of racemization and not due to the transition through the first critical value .

Entering into the system multiplicative noise  $\kappa(t) = \kappa + g(t)$ , K- the resource firething raw materials, g(t) — «white noise» with zero mean and amplitude H, obtain similar results. Condition (II) of the system will be resilient to such fluctuations, and the condition (I) near the first critical value will go into a state (II), and as in the previous case, the amplitude of the random fluctuations may be less than the critical value of 5-6 orders of magnitude.

Effect on the biosphere with an exponentially-correlated random forces.

In this section we study the question of the impact on the dynamics of the chiral purity of the biosphere «colored noise», as more appropriate to real processes.

Considering the destruction of the chiral purity of the biosphere, as a model, in which the living objects  $\alpha$  come from microorganisms, for the system of equations will take the following parameters:

 $\varepsilon = 0.717$ ; T = 300;  $k' = 10^{-4}$ ;  $k_0 = 1.3 \cdot 10^{-4}$ ;  $\delta = 0.0034 \div 0.34$ ;  $\kappa = 200$ .

Below investigates the impact on the state of the biosphere accidental anthropogenic factors expressed exponentially-correlated random forces.

We introduce in the system a multiplicative noise  $k_r(t) = k_r + f(t)$ . Here f(t) -is exponentially correlated goussinsky noise» with «colored zero mean  $\langle f(t)f(s) \rangle = H\lambda \exp(-\lambda |t-s|)$ , where H — is the amplitude;  $\lambda^{-1}$  — the correlation time of  $\eta$  takes equation random force. Then the for the form  $\frac{1}{k'}\frac{d\eta}{d\tau} = \left(\delta\theta - k_0\frac{\alpha'}{\theta} - k_r(\tau)\right)\eta - \delta\theta\eta^3 + \frac{1}{k'}\left(1 - \eta^2\right)\varepsilon\alpha$ 

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The numerical study shows that the condition (II) system, as in the case of white noise, is resistant to such fluctuations («color noise»). For a long time, even with fluctuations of the amplitude of the H close to the critical value kr, do not take the system from state (II).

However, the condition of (I) the system reacts visibly to random changes of speed of racemization . Near the first critical speed values of racemization  $k_r = 3.304 \cdot 10^{-3} \div 40.039$ (kr 3.304\*10-3 to 40.039 if  $\delta$  changes accordingly from 3.4\*10—5 to 0.34) (bifurcation point) there is a transition of the system from state (I) in condition (II), which means the disappearance from the biosphere of living things  $\alpha$ , the order parameter  $\eta$  remains positive.

At the transition of the system from state (I), (II) the order parameter tends to a stationary solution of the system of equations of the form (II) corresponding to the selected value of speed of racemization. This means that the transition from state (I) to (II) occurs with fluctuations of the speed values of racemization and not due to the transition through the first critical value .

The bifurcation value kr equal 3.304\*10-3 corresponds to the speed of racemization at which time pluralization still 0.2\*10-3 year, the value 40.039 corresponds to the time of pluralization equal  $17 \cdot 10^{-3}$  year. The condition when a resource achiral material is K equal to 200 means that the response time of the autocatalysis still  $10^2 \div 10^3$  c. If the response time of the autocatalysis changes  $10^{-2} \div 10^{-3}$  c, then K will change within  $10^9 \div 10^{10}$ .

The decrease in the reaction rate of autocatalysis (which K = 200) possible, since it is known that increased razemicescuu cell environment leads to the decrease rate of synthesis of polynucleotides and protein.

Entering into the system multiplicative noise  $\kappa(t) = \kappa + g(t)$ , where g(t) –

exponentially correlated goussinsky «colored noise» with mean zero;

 $\langle g(t)g(s) \rangle = H\lambda \exp(-\lambda |t-s|)$ , H – amplitude,  $\lambda^{-1}$  — the correlation time of random force; get the same results. The equation<sup> $\theta$ </sup> will look as follows:

$$\frac{1}{k'}\frac{d\theta}{d\tau} = \kappa(\tau)\theta - \theta^2 + \delta\theta^2\eta^2 - \frac{1}{k'}(1 - \varepsilon\eta)\theta\alpha + k_0\alpha'$$

Condition (II) of the system will be resilient to such fluctuations, and the condition (I) near the first critical value K will go into a state (II).

Note that anthropogenic factors, introduced as a Delta-correlated random forces affect the chiral purity of the biosphere is much stronger than the negative impact, expressed as an exponentially-correlated random forces. For example, under the same parameter values, but when  $\lambda = 0.1$ , that is, if the correlation time  $t_c = 2 \cdot 10^{-3}$  of the year., the time of the transition of the system from state (I) in condition (II) increases several times.

To simulate the impact on the biosphere «colored noise» system of equations it is

$$\frac{d\beta}{d\tau} = -\lambda\beta + \lambda\xi$$

convenient to Supplement the equation  $d\tau$ 

where  $\xi(t)$  is white noise with zero mean,  $\langle \xi(t)\xi(s) \rangle = 2H \times \delta(t-s)$ . The equation  $\eta$  for takes the form

$$\frac{1}{k'}\frac{d\eta}{d\tau} = \left(\delta\theta - k_0\frac{\alpha'}{\theta} - k_r(\tau)\right)\eta - \delta\theta\eta^3 + \frac{1}{k'}\left(1 - \eta^2\right)\varepsilon\alpha$$
$$k_r(t) = k_r + \beta(t).$$

Similarly, when  $\kappa(t) = \kappa + \beta(t)$  the equation  $\theta$  will look as follows:

$$\frac{1}{k'}\frac{d\theta}{d\tau} = \kappa(\tau)\theta - \theta^2 + \delta\theta^2\eta^2 - \frac{1}{k'}(1 - \varepsilon\eta)\theta\alpha + k_0\alpha'$$

White noise was generated using the algorithm of Box-Muller using uniformly distributed random variables .

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Conclusion. Summarizing the research it should be emphasized that the impact on living organisms in the biosphere a negative anthro-poganyj stochastic factors entered with as «white» and «colored» noise is extremely high. In a long-term impact of negative anthropogenic racemosus stochastic factors on the organisms an ecological disaster and the extinction of life on Earth can occur at speeds of racemization below (and for achiral resource material above) the critical (bifurcation) values. However, near the critical values under the influence of random deviations from the value of the speed of racemization (achiral resource), which is an exponentially-correlated random force with a fairly large correlation time, disastrous results in the microcosm will come much later than when the effects of time correlation which is close to zero.

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### **Environmental Risk Assessment**

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#### Dudnik D.V., Sher M.L., Opryshko E.L., Mironov L.V. Environmental and ecological risks, review and management in modern conditions

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**Abstract**: People try to manage the environmental risks about hundreds of years. The first legislative act aimed at reducing environmental risk, can be considered the decree of the English king Edward I signed more than seven hundred years ago, in 1285, This decree was forbidden to burn in the ovens, served for firing and drying bricks, the so-called "soft" coal, which produce many pollutants. A review of environmental risks becomes very important in time of "Greenifying economics", around the world.

Keywords: Environmental risks, modern management, economics conditions, environmental management, ecology, ecological development

Environmental risks the majority of researchers defined as the probability of occurrence in the natural environment of such violations (effects) with anthropogenic intervention, which can be unfavorable for the continued functioning and existence of ecological systems (6). Another definition of environmental risks is given in work of P.A. Vaganov(4), where he describes how the environmental risk should be to understand under

the totality of risks to the health, life risks and threats as habitat. The ecological risk assessment is usually considered in terms of biomedical concepts about the threat. The ecological risk assessment are usually considered in terms of biomedical concepts about the threat to human health and ecosystems. These estimates are usually obtained from a consideration of the chemical and biological data pertaining to a particular region.

A review of the scientific publications shows that increasingly, this approach to determining the risk of adverse events, which takes into account not only the probability of this event, but also all its possible consequences. The probability of the event or the process here is one of the risk components and measure the consequences (damage) to others. This two-dimensional definition of risk is used in quantitative risk assessment.

But there is another approach to the definition of risk is multidimensional. It is based on many factors responsible for the perception of risk involved in making riskrelated decisions. These factors identified by psychologists, are qualitative in nature. To compare the expression of these factors, they are credited with notional units (for example, on a five-point system: if this factor is considered to be very strong, his weight taken for 5, and if very weak, then for 1). After that, all weights are summed up, this is the essence of the so-called psychometric approach to risk, using its multidimensional definition. A multi-dimensional definition is of a qualitative nature, it is useful in identifying people's priorities as they relate to the totality of dangerous events or processes.

The term «risk» is generally used only when there is a possibility of negative consequences. In some situations, the risk due to the possibility of deviation from the expected outcome or event. The outcome of an event can be one or more consequences. The consequences can range from positive to negative. However, with regard to the security aspects of the consequences are always negative. Consequences can be expressed qualitatively or quantitatively.

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In modern scientific literature discusses several types of risk, each of which has its own characteristics. According to RAO Kolluru, there are five such species:

- safety risks;

— health risks;

- environmental risks;

- public welfare/goodwill risks;

— financial risks(7)

Environmental risk is the likelihood of negative changes in the environment. These changes can be caused by anthropogenic impacts or other impacts on the environment. Under the concept of «environmental risk» is often understood as likely causing harm to the environment, which is expressed in the form of potential losses over time.

Environmental risk, as one type of risk can be classified based on the basic risk classification, scale of manifestation, the degree of validity, prediction, possible, prevent, possible insurance.

Based on the causes, one can imagine this classification of environmental risks (Picture 1).

Natural-environmental risks — due to changes in the natural environment.

Techno-environmental risks — related to the emergence and development of the technosphere:

The risk of persistent anthropogenic impacts — associated with environmental changes due to normal economic activities;

The risk of catastrophic effects — associated with changes in the environment as a result of technogenic catastrophes, accidents and incidents.

Social-environmental risks — caused by the defensive reaction of the state and society to the worsening of the environmental situation:

Environmental-regulatory risk — arising from the enactment of environmental laws and regulations or their constant tightening;

Ecological-political risk — risk caused by environmental protests.

Environmental-economic risks — related to the financial and economic activities.



Picture 1. Ecological Risks

Based on the classification of environmental risks, you can select the entities whose activity is a source of danger to the environment, and to take measures for prevention of risks, protection of the facility from exposure to environmental risk factors.

Environmental risk assessment can be carried out at all levels — from point to global. Under the environmental risk assessment always means qualitative and/or quantitative assessment of the actual or potential impacts of contaminants to the environment.

Environmental risk assessment is the identification and evaluation of probability of

events having adverse consequences for environmental health activities of the enterprise and caused environmental pollution, violation of environmental requirements, emergency situations of natural and technogenic character.

Environmental risk assessment helps:

to identify potential environmental risks, eliminate or minimize them;

predict the onset of adverse effects, to prevent or minimize the likelihood of their occurrence;

to obtain quantitative and qualitative indicators of adverse effects;

to prevent accidents, harm to health, components of environment, damage the reputation of the entity that implements the project;

And therefore risk assessment has become a tool of decision-making. Environmental risk assessment includes the following stages:

determining the emergency situations connected with pollution of the environment can occur as a result of the project;

estimate cost for complete elimination of environmental impacts caused by the emergency of each type;

determination of the probability of emergency situations of every kind.

Processes for managing environmental risks are important results of the study of perception. The identified priorities of public concern the state of the environment should be taken into account in the preparation of the necessary environmental measures. Risk prevention or reduction should take into account not only quantitative but also qualitative characteristics of the risk which is caused by different factors and mechanisms of risk perception.

To prevent or reduce the risk are developed are many and varied documents, the scope of which may be limited to any one company, and can spread to the whole country.

These documents include legislation and regulations aimed at protecting health, improving working conditions, reducing pollution of the environment, ensuring road safety, the standardization of quality of goods, etc. All the famous inscription on cigarette packs «Ministry of health warns: Smoking is dangerous to your health» is an example of the simplest measures to reduce risk.

In recent years there has been a clear tendency to regulate environmental risk through legislation, and at the highest levels. Risk management — the broad concept of the theory of risk. It solves complex tasks related to the regulation of the effects on the environment and humans. Risk management uses information about hazard identification and risk assessment together with information about technical resources, social, economic and political variables, to implement control of choice or decision-making on measures to reduce or remove the risk.

The implementation of the design and implementation of policies and strategies in the areas directly related to the health of the population. To assess the effectiveness of managerial decisions has often used valuation techniques — the «risk — benefit», «cost — benefit», «cost — effectiveness», etc.

Risk management is the coordinated actions to direct and control an organization with regard to risk. Risk management typically includes risk assessment, risk treatment, risk acceptance and risk communication. System risk management is a set of elements of the management system of the organization towards risk management.(2)

The risk management process is based on the results of quantitative risk evaluation, which allows you to:

compare alternative projects of potentially hazardous facilities and technologies;

identify the most dangerous risk factors acting on the given object;

create database and knowledge base for expert systems support decision-making

and development of regulatory documents;

to identify priority areas for investments aimed at reducing risk and risk reduction.

First is a comparison of the results of the risk assessment for a given situation and the corresponding criteria. After this comparison are the options for reducing risk, each of which is estimated to account implementation costs. Evaluation of options is an iterative operation is repeated until then, until the optimal solution.

A significant stage of the search process options for risk reduction is the forecasting of the current situation and simulation of the behavior of the object. Under the scientific Outlook to understand the statement in the form of probabilistic statements about dependent on uncertain or unknown factors the behavior of some system in the future made on the basis of studying and generalization of experience of the past, using intuitive ideas about the development of this system in the future. Scientific predictions are made by experts and specialists in this area.

Expert assessment are issued in the form of qualitative characteristics and quantitative values of the probabilities of the considered events, or processes related to a certain length of time.

Currently there are several dozen methods of expert estimations, the most famous of them is the collective discussion and agreement according to Delphi method. The Delphi method was applied, in particular, when analyzing possible violations of the integrity of containers in radioactive waste repository in the nuclear center Hanford of the United States. This method is widely used in making risk-related decisions. Among its advantages are convenience and visibility of the graphical representation, as well as a significant simplification of the calculations on computers.

Picture 2 shows the iterative process of the overall assessment, analysis and risk reduction.

Picture 3 shows the basic scheme of assessment in the field of risk management, allowing you to spread out on the main stages of the whole system of risk management.



Picture 2. An iterative process of General evaluation and risk reduction.(3)

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Picture 3. The basic scheme of assessment in the field of risk management.(3)

Picture 4 presents the process of ecological risk assessment. The sign «?» denotes the MPR at this stage.

The basic scheme of risk assessment in environmental management should describe the basic elements of the process for scientific assessment of the negative impact of this factor on the ecosystem or ecosystem components.

The basic scheme draws Parallels between the natural environmental effect and impact assessment by combining the two assessment processes in the analytical phase between the phases of problem formulation and risk characterization. Professional science applies the Creative Commons Attribution (CC BY 4.0) license to the materials publishedhttps://creativecommons.org/licenses/by/4.0/deed.rul



Picture 4. The process of ecological risk assessment(2)

In the formulation of the problem, the expert sets goals, breadth and focus of the

evaluation. The organization responsible for the assessment, determines the final point of assessment (WHO) in the form of exact expressions valid values of environmental indicators (environmental resources or values) that need to be protected. Endpoint measurements (LPS) is a measurable environmental characteristic that is associated with the assessed characteristic, selected as a WHO. In fact, LPS is a representative characteristic (property) of an object, which, in fact, measured on the basis of which conclusions are made about the characteristics of WHO.

For example, the results of measurements of pollutant concentrations in water compared with the concentrations of which from documentary sources it is known that they can lead to death of sensitive aquatic organisms. On this basis we can conclude about the risks for the structure of aquatic (water) community. As a consequence, the LPS includes and measurable effect, and measurable impact.

For adequate risk assessment, use of relative damage, which can be used to compare the Ecotoxicity values for the screening level values specific effects. Ecotoxicity values at this level should be equivalent to the documented values or the least restrictive estimate, USNA. Thus, for each type of pollution or environmental damage relative can be expressed as a ratio of potential impact to the level of USNA:

$$RR = \frac{Doze}{USNA} \text{ or } RR = \frac{LCCI}{USNA}$$

Legend:

RR — the relative risk;

Doze — the value of absorbed contamination on the site in milligrams of pollutant per kilogram of weight per day;

LCCI — the level of concentration of contaminants identified at the site in

milligrams of contaminants per liter of water (per kg of soil / per kg of food);

USNA — the highest level of exposure at which the adverse effect does not appear. Is measured in units corresponding to the Doze or LCCI.

If RR is less than 1, it means that a particular pollutant will not cause adverse environmental impacts. If multiple pollutants are able to cause environmental damage identified in the control plot, it is necessary to determine their joint effect on the organisms (receptors) that can be subjected to simultaneous impact, and lead to Toxicological contamination. The amount of R is called the hazard index (AI). If RR is less than 1, it means that the group of contaminants will not cause adverse environmental impacts. However, even if RR, and IO less than 1, this does not mean complete absence of environmental risk.

If there is a potential of causing environmental harm, these calculations can be used to exclude from further consideration those contaminants and how they impact the risk which is insignificant.

IO = LCCI 1/USNA 1 + LCCI 2/USNA 2 + LCCI 3/USNA 3,

Legend:

LCCI 1 — the concentration of the i-th pollutant in the environment at the site;

USNA 1 — the greatest level of lack of adverse effects of the i-th pollutant in units appropriate Doze.

If in the assessment of risk at a screening level to determine what adverse effects may occur at concentrations below the specified value, the group by risk rating and the risk Manager needs to set a limit on discovery or to continue the evaluation in stages 3-7, where the acting concentration will be determined using other information.

Environmental risk management is provided through the development and application of normative legal acts which establish the environmental and legal responsibility.

In Russia (more precisely, in the former USSR) the concept of environmental legal responsibility was first formulated in the Law of RSFSR «On enterprises and entrepreneurial activities», which provided damages from pollution and irrational use of the natural environment. Then this provision was developed in a special Law of the RSFSR «On environmental protection», where, in particular, has established three types of damage to compensate:

damage caused to the natural environment are a source of danger;

damages caused to health of citizens the adverse impact on the environment;

damage caused to the property of citizens.

Since 1997 in the Russian Federation, the laws and regulatory legal acts concerning questions of licensing of hazardous production facilities, mandatory environmental insurance, the calculation of fines and revocation of licenses, etc.

Currently the latest edition of the Federal law of 10 January 2002 № 7-FL «On environmental protection» (as amended on December 28, 2016) (version effective from 1 March 2017).

In articles 32, 33 it is stated that «assessment of environmental impact is carried out in relation to the planned economic and other activities which may have direct or indirect impact on the environment, regardless of their organizational-legal forms of ownership of legal entities and individual entrepreneurs», «ecological examination is carried out in order to establish the compliance of documents and (or) documentation substantiating planned economic and other activity requirements in the field of environmental protection. The procedure for conducting ecological expertise is established by the Federal law on ecological expertise».(1)

In our opinion, and according to many scientists engaged in this problem, the main

task of the analysis and risk assessment is to identify ways and means to control them, rather, to reduce them to an acceptable level. Of particular importance are problems of analysis and risk assessment, due to the possibility of environmental disasters occurring in recent years in the world in large quantity. Now very often used in inextricably linking the two terms risk and safety. Safety is the state of the object at which the risk for him or from him does not exceed some acceptable level.(5)

When determining environmental safety of man and society, the natural environment must consider the environmental hazards and threats to environmental security in the complex, taking into account their interconnections. Thus, the concept of «environmental security» is seen as a condition of protection of the natural environment and people from human impact and emergency situations of natural character, their consequences.

The main purpose of management decisions in land use should be reasonably effective environmental management, or environmental and economic effectiveness of the exploitation of the regional resources and the natural environment, which could be in the form of a summary of the quality characteristics of the natural-anthropogenic formations, including the ratio of economic cost and environmental effectiveness of the system. The effectiveness of the balanced development of land use should be based on the ratio of the following parameters:

— performance capital investments in environmental management system, which represent the ratio between the economic costs of reproduction of fixed assets and conducted through the economic evaluation of the degree of preservation of ecological potential as a factor in the sustenance of the natural–anthropogenic systems;

— consumption performance in environmental management system, which is confined to the utilization of useful properties of natural resources involved in the process

of exploitation of natural-anthropogenic systems;

— performance indicators for environmental solutions in the system of environmental management appropriate to the rate of change of efficiency of functioning of the analyzed system.

The risk to society is defined as the amount of risk natural disaster multiplied by the probability of its occurrence. This risk is sometimes expressed quantitatively as the change in the number of people killed in a particular incident, per unit time (e.g. within a year).(8)

In connection with human activity has mainly come from two of the most common trends in risk management: risk can be reduced through the introduction of protection systems, but not reduced to zero; risk increases as the continuation of the activities so that over time the value of losses is greater than the magnitude of the benefits from the exploitation of a particular object.

Research of the observed phenomena contribute to the development of solutions that reduce adverse impacts of natural disasters. Assessment of environmental risk is reduced to a number of stages: 1) identification of sources and types of negative impacts; 2) release of potential anthropogenic and natural risk factors (excess toxicants, lack biopiling substances, etc.), contributing to the emergence of stress for ecosystems; 3) definition of environmental objects (targets) that can influence risk factors; 4) consideration of possible exposure routes; 5) development of a conceptual model for the development of stressful situations.

Reducing environmental risk and danger must serve the basic principles of ecodevelopment, i.e. the concept of socio — economic development aimed at the preservation and restoration of the ecosystem as a whole.(9)

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#### Kaurova Z. G., Spiridonova N. S. Hydro-chemical and sanitarymicrobiological study of small lakes in Novgorod region

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**Abstract**: For small lakes, close to which often are located settlements and agricultural land, is more typical of anthropogenic impact from the agricultural sector. To prevent environmental emergencies is necessary to conduct regular monitoring

Keywords: water, lake, hydrochemical analysis, microbiological analysis, research

The Novgorod region is rich in rivers and lakes. First of all, this is due to the relief, the depth of groundwater and the climate. From the annual amount of precipitation evaporates 325-375 mm. The rest of the moisture feeds rivers, lakes and marshes.

Lakes of the Novgorod region are poorly studied, some do not even have names. They, like rivers, are distributed unevenly across the territory of the region. Lakes in the eastern part of the region are larger than in the western part. This feature of the location of lakes is associated with the origin of the lake basins. In the eastern, elevated part of many small and medium-sized lakes of glacial origin, having an oval or lobate shape. The largest glacial lakes of the region are Velikoye, Meglino, Velye, Borovno, Zaozerye. The largest lakes, the Ilmen and the Valdai, occupy depressions that were formed in preglacial times and then processed by a glacier. In the east of the region there are karst lakes. These include Lake Gorodno, Yamnoe, Sukhoi in Borovichi and Khvoyninsky districts. In years with dry summers, the basins of some karst lakes may dry up (Lake Gorodno and others). But in addition to them, there are more than 1,500 small lakes in the Novgorod region, which, at times, are not even registered in the cadastre of water bodies and have no official name. Often such lakes are within the boundaries of rural settlements and other settlements. This group includes the Borovenkovsky and Beloye lakes.

Lake Beloe is located one and a half kilometers from the village of Borovenko and has been used for many decades by the local population for bathing and fishing. The lake is stretched from west to east. Its length is 1.75 km, average width — 201 m. The surrounding area is hilly, covered with coniferous forest, the hillsides are steep, the peaks are flat, flattened. The bottom is sandy.

Lake Borovenkovskoe is located on the territory of the village of Borovenka and is one of the main recreational facilities of this settlement, as well as a place for watering animals in the summer. The lake is stretched from west to east. Its length is 715 m, the average width is 80 m. The banks are covered with grass, in some places coniferous trees; Bottom — sand and silt. In the east the lake gives rise to the Borovenka River, which in turn flows into the Horinku River.

On the territory of a rural settlement there are 3 timber processing enterprises. Some of the local residents are engaged in farming in their household plots.

The administration of the settlement monitors the state of the coastal zone of the lakes. For this purpose, subbotniks are organized, in which the local population, in particular schoolchildren, participates. Also near the beaches are garbage bags, which are regularly exported.

The aim of the work was to assess the water quality of the Beloye and Borovenkovsky lakes in terms of hydrochemical and sanitary-microbiological indicators. For this purpose the following tasks were set:

- conduct a chemical analysis of water;

— to conduct a sanitary and microbiological analysis of water;

— determine the trophic status of water bodies.

Laboratory studies were carried out with the participation of the research laboratory of the enterprise LLC «Corporation Seven Ruches» in Okulovka.

Sampling for sanitary-microbiological and hydrochemical studies was carried out using the generally accepted methods of GOST 31861-2012 «Water. General requirements for sampling «, GOST 31942-2012» Water. Sampling for microbiological analysis «.

In the hydrochemical analysis of the waters of the Beloe and Borovenkovsky lakes, the following results were obtained (in fractions of the MPC): turbidity 0.6-0.8; Chromaticity 0.46-, 62; PH 0.9; Chlorides 0.008-0.01; Iron 0,4; Sulfates 0.002-0.004; Permanganate oxidation 0.7-0.8; Hydrogen carbonates 0.33-0.61; Alkalinity 0.33-0.6; Nitrites 0.01-0.1; Nitrates 0,006-0,008.

Trophic status is a characteristic of a reservoir in terms of its biological productivity, which is estimated by the value of primary production. There are 4 main types of water bodies: oligotrophic, mesotrophic, eutrophic, dystrophic. For the assessment of the trophic status of natural waters, indicators such as primary production, chlorophyll a concentration, phytoplankton biomass, etc. are traditionally used. All of them require special studies and are rarely determined in the usual practice of ecological monitoring of water bodies. In connection with this, the importance of other, indirect indicators of the trophic state of the ecosystem (especially its temporal variability) increases, for which there is a sufficient number of observations. In particular, an increase in the trophicity of the ecosystem can also be indicated by an increase in the background of the amount of organic substances (including those easily oxidized, estimated by the permanganate

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oxidation capacity), an increase or a violation of their vertical distribution and seasonal course. Permanganate oxidability is a widely used hydrochemical index, the determination of which, as a rule, is carried out with many hydroecological observations. An analysis of the permanganate oxidizability in the water bodies examined showed that the water's oxidizability is comparatively small.

Discharge of organic, bacterial and chemical pollutants into reservoirs can result from exceeding the ecologically permissible load on the reservoir, which in turn will lead to a violation of sustainability and the destruction of the ecosystem. A large role here is played by the capacity of the medium, thanks to which the ecosystem of the reservoir remains stable when pollutants enter. The capacity of the reservoir for self-cleaning has boundaries. In small and non-permanent water bodies, self-cleaning capacity is extremely low. If we consider together with this the use of a reservoir for domestic, drinking or cultural and household purposes, then, ultimately, this can lead to negative consequences for human health.

The number of saprophytic bacteria is closely related to the amount of organic matter that can be easily assimilated by them from water, and is an indicator of the trophicity of the reservoir. The total number of bacteria at the time of the studies in both lakes did not exceed 1.5 million. L / ml. In the lake. Borovenkovsky average number of bacterioplankton averaged 0.97 mln.kl / ml, and in White — 0.86 mln.kl / ml. In connection with this, it is possible to classify these lakes as mesotrophic. Also, based on these values, the saprobity coefficient can be calculated. For Lake Borovenkovskogo, it was 0.07, for the White — 0.05, which indicates the purity of the water of these lakes.

The number of coliform bacteria is an indicator of fecal contamination of the reservoir. When studying the Borovenkovsky and White lakes, coliforme and thermotolerant bacteria were not detected. According to this indicator, the water of this

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reservoir refers to uncontaminated waters.

Summarizing the obtained data, it can be noted that for all indicators, water bodies are suitable for recreational purposes, as well as for domestic and fishery activities. According to hydrochemical and sanitary-microbiological indicators, water bodies correspond to pure waters — grade I of purity.

Based on the work done, it can be recommended to continue monitoring water reservoirs.

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# Mishurova U., Krivoguz D. Risk analysis of the influence of the population of mugil cephalus population of phalacrocorax carbo with the monte carlo method

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Abstract: This research is devoted to the study of the impact of anthropogenic activity on the stability of the population and its properties. Since factors, such as a decrease in the feed base, based on fish catching and birds shooting, have a significant impact on the existence of the population. The relevance of the work is that at this moment intensive fisheries are being carried out and as a result of excessive catch, the ecosystem is declining. Often, this negatively affects on the food chain [5], mainly birds, being their main food base. Thus, one of the solutions in assessing this impact and predicting dvnamics analysis population can be the population viability [1. 41. The aim of the study is to simulate the viability of a population and assess the impact of the abundance of one species on the viability of the other, taking into account the negative factors. The practical approach of this research is that with the help of the developed scenario we can monitor the viability of the population and the probability of its extinction [2]. This can be useful when decisions are needed to restore the population, to compare proposed ecosystem management options and assess the current situation.

The main results of this work are scenarios, that was modeled, in which two negative factors impacts on the population of birds: Phalacrocorax carbo shooting and fish catching. As a result of the forecast of the existence of the Phalacrocorax carbo, it can be seen that the stable functioning of the population is possible only if two important environmental requirements are met, which are presented to users operating in the Azov-Black Sea coast. These requirements include both regulation of the fence hunting and hunting by the hunters of the investigated object

Keywords: Population viability analysis, Kerch Strait, Monte-Carlo method, biostatistics

#### Introduction

Phalacrocorax carbo are widespread on the Azov-Black Sea coast. They eat fish,

mostly commercial, and in significant quantities. For a day each bird eats up to 2 kg of fish. However, the Phalacrocorax carbo is useful as an ambulance, since he is a biological impasse for all helminth diseases of fish. They catch primarily diseased fish, which is much easier to catch, and digest it along with its parasites.

In the last 10-15 years in the Azov-Black Sea region there has been a rapid increase in the number of large Phalacrocorax carbo that began locally in individual colonies of the Azovo-Black Sea region from 1975-1980, and from 1985-1989 and acquired the character of an «explosion».

In the Northern Azov Sea, 13 species of fish from 4 families are registered in the diet of large Phalacrocorax carbo, mainly (90%) are Neogobius melanostomus (Pallas, 1811), N. Ratan (Nordmann, 1840), N. Fluviatilis (Pallas, 1811), N. Syrman (Nordmann, 1840), Gobius ophiocephalus (Pallas, 1811), Proterorhinus marmoratus (Pallas, 1811), Mesogobius batrachocephalus (Pallas, 1811), Mugil cephalus, Clupeonella cultriventis (Nordmann, 1840), Mugil soiuy (Basilewsky, 1830), Atherina boyeri pontica (Eichwald, 1831); Carassicus carassius (Linnaeus, 1758), Platichthys flesus luscus (Pallas, 1811) and Perca fluviatilis (Linnaeus, 1758).

Important is the impact of birds on ecosystems through excrement, with which nutrients and energy return to water bodies and land. Eating a day about 350-500 grams of fish, the Phalacrocorax carbo releases 56.4-60.9 grams of excrement with a moisture content of 7.5%. On land Phalacrocorax carbo leave 10-25% excrement. Dry feces of fisheating birds contain 17% of mineral salts, of which phosphates — 7%, sulfates — 3.2%, ammonium derivatives — 1.8%, chlorides in combination with potassium, sodium, magnesium catholytes — 0.35% [7]. The soluble fraction consists of organic substances (83%), which contain phosphorus — 5% and nitrogen — 15.5%, as well as nucleic acids, amino acids, peptides, creatine, carbohydrates, vitamin B12, etc.

Phalacrocorax carbo are numerous only in areas with the highest biological productivity of water bodies. Their impact on commercial fish is largely offset by the consumption of weedy and low-value fish, which are active competitors of commercial species [6]. Ultimately, the role of these numerous large birds, tied throughout the life cycle to water bodies, is reduced to participation in the circulation of organic matter in them, without removing this substance, i.e. without reducing the potential for fish productivity of water bodies [3]. They do not significantly affect the abundance, reproduction and size of catches of commercial fish. Unreasoned destruction of biological chains by excluding fish-eating birds from them, without taking into account their importance in the biological balance, can lead to very undesirable results for the fishery. Phalacrocorax carbo can cause local damage to the fishing industry, destroying fish in small areas of water bodies or fish breeding ponds, only in a limited period of fish life (for example, in the period of the fall of the young). At this time there is a need to regulate their numbers or take other measures to protect valuable fish species from piscivorous birds.

#### Materials and methods

The simulation was carried out using the Monte Carlo method and the PVA Vortex software. The program is an interactive simulation model [8]. It allows determining the probability that the population will exist a certain number of generations.

The PVA Vortex software uses population data, where the program monitors the population on an annual basis. The model time used in assessing the viability of the population varies from 10 to 500 years.

In this paper, an analysis was made for two populations — Mugil cephalus and Phalacrocorax carbo for the next 20 years.

For carrying out PVA, the parameters characterizing the analyzed species can be

seen in Table 1.

Table 1

#### Analyzed parameters for simulation of population viability analysis for Mugil cephalus

#### and Phalacrocorax carbo

Parameter	Mugil cephalus	Phalacrocorax carbo		
First year for female breeding	2	3		
First year for male breeding	3	2		
Last year for reproduction	9	12		
Sex ratio (%)	female – 60, male — 40	female – 55, male — 45		
Maximum number of broods born within 1 year	5000	4		
Number of females born each year (%)	65	60		
Number of females that reproduce (%)	78	89		
The mortality rate of females at each age (%)	0-1: 15 1-2: 5 2-3: 7 3-5: 16 5 and more: 25	0-1: 11 1-2: 7 2-3: 4 3-5: 12 5 and more: 27		
The mortality rate of males at each age (%)	0-1: 18 1-2: 7 2-3: 10 3-5: 16 5 and more: 21	0-1: 17 1-2: 14 2-3: 15 3-5: 21 5 and more: 28		
Probability of catastrophe	0,5	0,5		
Adult males that successfully reproduce (%)	84	88		
Population size for the first year of modeling	50000	50000		
Maximum life expectancy	9	12		
Reproductive indicators (monogamy, polygamy, hermaphroditism)	polygamy	monogamy		

Results and discussion

Figure 1 shows the dynamics of the number of populations without catastrophes. The initial population is 50 thousand individuals. Curves Population 1 — the number of fish, Population 2 — the number of birds. Without external influences on the analyzed populations (i.e, the frequency of the disaster is 0%), their numbers remain predominantly stable for 20 model years. Stability of the population varies slightly depending on natural factors and reproductive functions of populations. The graph shows the dependence of populations on each other — with a decrease in the population of fish, the density of the bird population decreases.



Figure 1. Scenario 1. The frequency of the accident is 0%, the deviation in the population is  $\sim 5\%$  (seasonal fluctuations) — 20 years.

Next, two catastrophes are considered — catching fish by humans and shooting Phalacrocorax carbo s by hunters. The error in the calculations is 15%. We analyze how

population sizes behave under the current situation (Fig. 1). Curves Population 1 — the number of fish, Population 2 — the number of birds.



Figure 2. Scenario 2. The frequency of the disaster is 30%, the deviation in the change in population is  $\sim 15\% - 20$  years.

The graph above (Fig.2) shows two curves that characterize the density of the population for 20 years, taking into account existing disasters, the frequency of which is 33%. Population numbers were initially taken of 50 thousand individuals. Due to the catch of the forearm by humans, the fish population often decreases. In particular, the factor of direct reduction of the Phalacrocorax carbo population is considered — their shooting by hunters. This causes a lack of feed base and, as a consequence, a decrease in the bird population. As a result, population density is steadily declining during the model time, which can lead to negative consequences for populations.

Next, consider the dynamics of the number of populations with a disaster rate of

50% (Figure 3).



Figure 3. Scenario 3. The frequency of the accident is 50%, the deviation in the number change is  $\sim 15\% - 20$  years.

Thus, in this scenario, taking into account existing catastrophes, the fish population decreases and, accordingly, the Phalacrocorax carbo one gradually decreases over the course of 20 years and the negative changes leading to the disappearance of the population are clearly traced.

Thus, the application of the method of analysis of the viability of the population is a necessary tool for assessing the influence of the number of one species of a population on the viability of another species, showing the vector of its further development.

So, in the first scenario, the dynamics of populations remains on the same level for the next 20 years, while scenarios 2 and 3 clearly show negative changes that could lead to the disappearance of the population.

Therefore, we can conclude that the implementation of environmental measures to maintain the Phalacrocorax carbo by regulating the food supply is vital to preserve the existing population.

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### **Econometrics**

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# Zubarev I.S. Influence of profitability of the enterprise on analytical indicators of an inconsistency (bankruptcy)

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**Abstract**: The profitability of capital is the most important indicator of the effectiveness and activity of any business object, be it enterprises engaged in industry, be they organizations related to the financial and credit system. In the financial and credit system of the Russian Federation, the level of this indicator is quite large. This is due to the favorable situation for banks in the financial market. The indicator of the bank's profitability reflects the efficiency of the use of bank funds. The indicator allows to give a description of how high the efficiency of attracting and placing resources available to the bank. Low profitability indicators indicate that the customer base is not large enough. Even if the market situation in the market is not very favorable, banks are able to remain profitable and retain customers due to wide diversification, by offering customers a variety of banking services and products

Keywords: stability, solvency, payment of debts, capital, finance

Introduction.

Until recently, there was no analysis of banking activities in the Russian Federation, as there was no need for this. At present, when commercial banks become more independent, such analysis is necessary, and this analysis should be carried out by each bank independently. This analysis allows management to think through the most beneficial credit policy and take a number of other decisions to ensure the profitability of the bank.

It should be noted that in countries with developed market relations, information is usually published annually by the Chamber of Commerce, industry associations or the government, which discloses the normative values of profitability indicators. Comparison of its indicators with their permissible values allows us to conclude on the state of the financial situation of the enterprise. In Russia, this practice is not yet available, so the only basis for comparison is information on the magnitude of indicators in previous years. [1]

Materials and methods.

For a more detailed and more descriptive analysis, let's look at the activities of Sberbank of Russia, which holds leading positions in the ratings of Russian banks for almost all indicators, however, according to the profitability of capital, the result of OJSC Sberbank of Russia is slightly behind other banks and is only on the 145th place To March 2016) [2].

Now we will make a rating of the well-known commercial banks of Russia on profitability of the capital [2]. Imagine it in the form of table 1.

Table 1

The place in the rating	Name of the bank	Profitability, %		
1	CB «Transnational Bank»	58,98		
2	OJSC AKB «VANGUARD»	33,38		
3	OJSC ALFA-BANK	27,5		
4	OJSC AKB Rosbank	24,17		
5	OJSC AKB «Bashkosnabank»	22,77		
6	ZAO Citibank	21,93		
7	OJSC «Sberbank of Russia»	20,24		
8	UniCredit Bank CJSC	17,92		
9	ZAO Finam Bank	15,43		
10	OJSC InvestCapitalbank	12,09		
11	OOO Vneshprombank	10,12		
12	JSCB «Investtorgbank»	9,08		

Rating of commercial banks in Russia by return on equity

The place in the rating	Name of the bank	Profitability, %		
13	OJSC «Transcapitalbank»	7,51		
14	OJSC VTB	6,48		
15	PJSC «VTB 24»	3,63		
16	OAO Gazprombank	1,89		
17	Rosselkhozbank OJSC	1,56		
18	Promsvyazbank OJSC	0,93		
19	OJSC Uralsib	0,51		
20	OJSC AKB Bank of Moscow	0,26		

Thus, the leading position is occupied by CB «Transnational Bank» LLC with a return on capital of 58.98%, according to the rating agency AK & M, this financial institution belongs to a class of borrowers with a high degree of creditworthiness. The risk of late fulfillment of obligations is low, the probability of debt restructuring or its part is minimal. During the validity period, the assigned rating level is likely to remain. And the factors that support the rating assessment of the bank are:

- growth of capital and assets;
- high profitability of activities,
- high value of liquidity standards.

Not always a decline in the profitability of capital heralds failure. The indicator of profitability of capital should be considered in the dynamics with the indicators of past years, as well as with the level of the profitability index of capital of other organizations in the related industry [3].

Having examined the data of Table 1, it can be noted that Sberbank is the seventh in terms of indicators. If you take countries such as the United States and Britain, the average return on capital is about 10-12%. For the Russian inflation economy, this

indicator should be higher, therefore, the return on equity of Sberbank of Russia, equal to 20.24%, is quite acceptable. The reasons why the bank's return on capital may be reduced is a decrease in the volume of services, an increase in costs and an increase in assets. Reduction in the volume of services can be caused by a decline in demand for services and even poor management performance. To provide the bank with a sufficiently high return on capital, one must strive to maximize profits.

For a more complete and detailed analysis, consider the rating of the most reliable banks, presented in Table 2.

Table 2

Bank	Rating	Assets		Capital					Share of
		место	млрд. руб	место	млрд. руб	Return on equity,%	Capital adequacy as at 01.01.2016,%	Major credit risks,%	physical persons' deposits to assets,%
1.Sitibank	BBB+(Fitch)	10	365	14	55	22.2	17.4	22.5	19.3
2.Nordei Bank	BBB+(Fitch)	20	274	25	27,5	11.8	14	43.2	3.4
3. HSBC Bank	BBB+(Fitch)	80	59	70	10	37.2	20.6	44.4	0
4.Credit Agricole Kib	BBB+(Fitch)	96	49	101	6	7	39	25.8	0
5.Sberuyank	BBB(Fitch)	1	16298	1	1926	35.9	13	н/д	44.9
6. The VTB Bank	BBB(S&P)	2	5246	2	754	6,6	12,4	43,3	0,3
7. Bank VTB24	Baa2(Moody's )	4	2023	6	138	16,6	11	6,7	62,9
8. UniCredit Bank	BBB(S&P)	9	901	5	127	20,3	14,5	15,7	7,9
9. ING Bank (Eurasia)	Baa2(Moody's )	29	231	23	30	5,7	22,8	25,7	0,7
10.MMS Bank	BBB(S&P)	40	127	30	22	2,3	22,9	60,2	0
11.BNP Paribas	BBB(S&P)	62	97	63	7,9	13,4	16,6	39	0,5

Rating of the most reliable banks for 2016

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Bank	Rating	Assets		Capital					Share of
		место	млрд. руб	место	млрд. руб	Return on equity,%	Capital adequacy as at 01.01.2016,%	Major credit risks,%	physical persons' deposits to assets,%
12.Gazprombank	BBB-(S&P)	3	3555	3	291	17,2	11,4	47,5	10,1
13. The Russian Agricultural Bank	BBB-(Fitch)	5	1812	4	202	3,8	15,3	9,5	12,6
14.Rosbank	Baa3(Moody's )	12	684	9	103	10,8	13,3	10,5	20,9
15.Reiffeisen Bank	Baa3(Moody's )	11	689	10	97	34,9	13,5	16,4	35,716
16. Deltacredit	Baa3(Moody's )	61	99	52	13	24	13,8	н/д	1,7

According to Table 2, it can be noted that the leader in this rating is ZAO Citibank, much attention is paid to servicing individuals in the field of lending. [4]

However, Sberbank notes that the tense situation in Ukraine and the imposition of economic sanctions could further adversely affect macroeconomic indicators in the banking sector of the Russian Federation.

The largest state-owned banks of the Russian Federation and organizations, including OJSC Sberbank of Russia, were out of the West's capital markets, which were blocked by EU and US sanctions imposed on the Russian Federation for their policy towards Ukraine. The value of money in the domestic market increased following the increase in the Central Bank's rates amid financial instability and inflationary risks.

In all markets, except for the CIS markets, margin decrease is more than one percentage point.

The report of the Savings Bank of the Russian Federation for the current year says

that, on the main market for the bank, a decrease in the margin will also be accompanied by a significant decrease in asset growth rates, which will lead to an intensification of competition and an increase in the influence on the current indicators of the banking system of the accumulated assets that were previously accumulated.

But not all organizations are striving to improve the profitability of capital. There are strategies in which organizations or other financial institutions seek to reduce this figure, but at the same time to double their assets. This happens in cases when the world economy ceases to be stable, the behavior of clients changes, which leads to a slow growth of the banking sector.

An example of this is the new development strategy for 2014-2018, which was presented by Sberbank of Russia. By 2019, the bank intends to double, the resulting profit and assets. Sberbank intends to sell more products to customers and increase the share of operations that can be remotely performed. For five years, the number of products sold to one customer should grow by about 1.5 times. [4]

**Results and Discussion** 

Banks are a very important component of the economy and money economy of any country, their activities are inextricably linked with the needs of reproduction. Banks are the founders of the market mechanism, thanks to which the country's economy functions. Commercial banks regulate the movement of all cash flows, including credit, contribute to ensuring the most beneficial use of the financial resources of society and the flow of capital into those sectors of the economy of the country where the return on investment will be maximum.

Unfortunately, banking activities are subject to risks that need to be identified, assessed and eliminated at the time, if possible. Underestimation of risks can cause bankruptcy of the bank, which, in turn, will cause damage to its customers and shareholders. In our time, banks are trying to seriously approach this issue.

Thus, we can conclude that the profitability ratio shows the profitability of the bank's operations. The high value of the indicator indicates the effective use of the bank's assets, but at the same time may reflect the high riskiness of operations. If the return on equity grows, then profit grows, borrowed capital, and if it falls, then the turnover of assets falls.

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### **Human-Computer Interaction**

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# Korolev G.T., Golovin P.R. Computer-mediated communication in information and communication technologies

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**Abstract**: As technologies change, computer-mediated communication forms evolve. Sometimes, for example, new audiovisual capabilities contrast with purely textual ones, while in other aspects convergence is observed, as when many forms merge in one Web browser environment. computer-mediated communication is considered and compared with other communication media through a number of aspects that are considered universal for all forms of communication, including but not limited to synchronism, perseverance or environmental friendliness and anonymity. The relationship of these aspects with various forms of communication varies widely

Keywords: Computer-mediated communication, human-computer interaction, types of communication, electronic text

Introduction.

Technological revolution, which led to the rapid development of ICT in general and computer networks in particular, caused the emergence of an electronic communication environment. Due to the ability to transmit textual information, hypertext became the most important communicative unit, as a special kind of written communication, a form of organization of written text, conditioned by its functioning in the computer environment and characterized by non-linearity of writing and reading processes.

The development of electronic communication is becoming so comprehensive that it becomes necessary to comprehend this phenomenon theoretically. Functional and technological capabilities of electronic text in comparison with printed text are significantly expanding. Among the advantages of electronic text the following opportunities can be identified: ensuring compact storage of large volumes of textual information; realization of almost instant replication and at a high speed of circulation; division of text into smaller segments or merging of several texts into one, creating versions of the text or making changes to it; simultaneous work of a great number of independent users with the text; integration of text with other semiotic systems.

Materials and methods.

In the process of studying computer-mediated communication, the most interesting are theories, approaches and models in which communication is seen as the primary process that coordinates the logical practical actions of a person. A characteristic feature of these transactions between communicants is that they are implemented in a computer environment, through a computer communication channel. At the same time, communication is a mutual reflexive process in which technical means influence the practice of communication, and practice, in its turn, reconstructs the means of communication. This mutual influence of hardware and software tools and practices of computer-mediated communication can be traced to the dynamics of changes in network technologies [1].

At the moment, there are several classification bases for a structured description of different types of computer-mediated communication, but the most common classification is based on the number of communicants participating in communication, communication language, reality or virtuality, synchrony or asynchrony of its course and some other factors.

In the analysis of models and forms of communicative interactions on the Internet, carried out within the framework of the social structure, the researchers often pay attention

to the nature of the communication links, which can be strong or weak, which are described through the frequency of contact, the saturation of content, the length of the communication process and network relationships over time, etc. [2]. In academic communication the terms virtual community and professional network community have already firmly established [3].

At the same time, the social space of the Internet, acting as a communicative medium, dictates the emergence of a new paradigm of the relationships of its participants, taking into account not only the variety of technical solutions available to users, but also the multiplicity of contexts of interaction. One of the main functions of communicative interaction in the network is the achievement of the social unity of communicants, while preserving the individuality of each of them. The means of communication between users at the beginning of the development of the Internet were not an end in itself, but were intended exclusively for utilitarian purposes. The increasing role of communication leads to the fact that the person on the web is reduced to a set of verbal messages. It should be noted that the Internet forms a special communicative environment, i.e. the space of realization of the language, which had no analogues in the past. It can be argued that verbal communication, expressed by means of written speech in the form of electronic texts, is a system-forming sign of the entire Internet as a social reality [4, 5].

According to I.N. Rosina, computer-mediated communication is different from human-computer interaction. The latter is characterized by its accuracy, logical foundations and numerous limitations. If a person uses a language other than a computer program, the machine simply does not understand human commands. Even small errors such as extra space or incorrect syntax will lead to the failure of the command by the computer. A computer-mediated communication is, first of all, communication between people while maintaining significant elements of electronic interaction. The Russian term

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«computer-mediated communication» retains the most approximate version of the English term, as it reflects all three important components — computer, environment and communication. In addition, the skill of computer-mediated communication requires certain training.

I.N. Rosina believes that the basics of electronic communication are formed either on their own experience, or on the example of more experienced users. Communication between users depends on the technical means they have chosen for communication. But at the same time the needs of communication form technological changes in the computer environment [6].

Gradually, the Internet becomes a kind of speech space, serving as a testing ground for creating and testing a wide variety of speech strategies and communication techniques. In this space there is a constant complication of some and simplification of other speech tools associated with the plan of expression, content and plan of pragmatic intentions realized through the Internet. In this communicative space new digital genres appear or old ones are modified all the time. Gradually the Internet turns into a kind of genregenerating environment, where the appearance of each new genre usually becomes one of the signals informing about the emergence of yet another new speech community with a new communicative practice [7].

Considering the process of communication through Internet technologies, it is possible to note the combination of at least two opposite applied communication trends, which are traditionally highlighted in practice: face-to-face communication, human communication, as, for example, interpersonal, organizational communication, communication in small groups, public speaking, etc.; and implying the use of such telecommunications technologies as television, radio, printed press, related to the mass media [8]. And not all means of telecommunications uniquely belong to one category or another, for example, telephone and some Internet technologies support interaction between people, but do not require direct contact. The approach distinguishing these two directions is presented in two learner-centered communication [9] models for the traditional and computer information and communication learning environment.

In constructing the model of the information and communication environment, five features were taken into account: integrative continuity; multiculturalism and multidimensionality; positive redundancy; openness and linguistic orientation. The global Internet is referred to as macromedium, having in view its dimensions, or metamedium, implying the integration of older means of communication with it, providing high reliability, speed and distribution of information and communication between people [10]. Despite the active development of information and communication technologies in the sphere of multimedia, the convergence of various environments, the basis for interaction in the information and communication environment is text. The model of the educational information and communication environment can be considered as object-oriented, in which the objects are: users, interaction rules, events and information objects.

Studying the features of electronic communication, many researchers state that a virtual linguistic personality is extremely creative in the choice and use of linguistic means of communication. This is facilitated by the absence of visual contact, which creates a situation of complete anonymity for its participants.

Sapid language features occur with the functioning of the language on the Internet and from the point of view of psycholinguistics of text, namely, the novelty of its generation and perception. Electronic text is created using the keyboard, and the analogue that appears on the screen is already perceived as a teletext with its gradual unfolding. This leads to a lack of visual and semantic coverage of the entire page, which cannot but be reflected in the processes of perceiving the meaning of the text [11].

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The possibilities of hypertext technologies provided by the Web, which caused the transition from the linear form of the letter to the hypertext, also affect the processes of generation and perception of texts on the Internet. Hypertext technologies influence communication in the network, making the recipient a subject in the construction of coherent text, increasing the importance of associative connections, reducing the sharpness of the boundaries of the utterance, which leads to the multivariate nature of the entire communicative process flowing through the network [4]. The graphic and audiovisual factors also take on enormous importance in the web: the possibility of attaching sound or visual information to a textual array using all the design features of modern web technologies leads to rethinking of both the text concept in its linear version and methods of its analysis. Many researchers of the network language also emphasize that the computer text becomes extremely creolized, because for the effectiveness of its perception from the screen, along with textual information, design tools and audiovisual applications are used that are practically available only on the network, and this process affects virtually all the language sectors of the Internet [12].

Results and Discussion.

Computer-mediated communication is polyphonic and combines a large number of different types of discourse and speech practices. Essential factors that affect communication on the network are its anonymity and remoteness. These factors, along with the physical unrepresentation of the participants in communication, the lack of coercive tools, on the one hand, contribute to the strengthening of deviant communicative behavior, since responsibility for acts is reduced to a minimum, and on the other hand, they stimulate violation of the language norm in order to establish and maintain virtual contacts [13]. With computer-mediated communication, there is the problem of constantly creating, maintaining and retaining contact, which requires the maximum mobilization of

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the language tools intended for this. And this is not only a violation of the language norm. According to the observations of many linguists and according to the data of different languages serving the Internet, performative utterances here acquire an exceptional significance. Many web resources provide their users with additional opportunities to build performative statements. The situation of establishing and maintaining contact leads to communicative innovation [14].

Thus, at present it is necessary to study the influence of the computer environment on the state of modern discourse, since computer-mediated communication is part of the verbal reality, but it is carried out in special conditions and in a special environment. Electronic discourse has a number of significant functional and pragmatic features. Knowledge of the skills of computer-mediated communication is in demand by society in the socio-economic and socio-psychological terms. In the modern professional world focused on ICT, including network technologies, knowledge of the principles and rules of computer-mediated communication is one of the key among the professional qualities.

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#### Nefyodov O.V. Basic requirements of computer linguodidactics for construction of multimedia coursebooks

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**Abstract**: This article examines the features of new direction in the methodology of teaching foreign languages – computer linguodidactics. The author of the article analyzes the characteristics of hypertext structure of multimedia coursebooks and some of the tested programs for constructing multimedia applications

Keywords: computer linguodidactics, multimedia coursebook, foreign language teaching, hypertext structure

Introduction

In modern methodology of teaching foreign languages a new scientific trend has arisen – computer linguodidactics, which studies the problems of using Internet resources and constructing electronic coursebooks for foreign language teaching.

The circle of domestic specialists working in the field of computer linguodidactics, including the construction of electronic coursebooks is expanding.

Currently used in the practice of teaching English at non-linguistic educational institutions coursebooks go out of date very quickly. They do not reflect indicators of rationality, providing appropriate strategies and techniques for teaching foreign-language communicative competence. For example, in the analyzed coursebooks there is no focus on achieving objective self-control and reflection of learners, which, in our opinion, is extremely important in teaching foreign languages in non-linguistic universities. Self-

control and reflection influence students' awareness of the goals of their learning process and their cognitive actions towards the desired result. It is obvious that they also determine a sufficient degree of cognitive activity in mastering foreign language communicative competence. We also emphasize the insufficient productivity of the proposed tasks, which requires teachers' additional efforts, for example, when searching for or preparing additional material. This concerns various aspects of productivity: lack of independence, reflection, creativity, reproduction of «ready» knowledge, the indicated characteristics of the coursebooks that we found during the analysis cannot become conditions that transform teaching non-linguistic students communicative competence into an expedient, effective process.

Materials and methods

The methodological basis for construction of electronic coursebooks is being developed. In preparing our two-level coursebook, we were guided by the general requirements of methodology of teaching foreign languages, guidelines of the textbook theory set forth in the works of modern scholars.

To create a modern coursebook, active integration of knowledge in the field of teaching foreign languages, involving ideas from an ever wider range of related sciences are essential: cultural anthropology and regional studies, sociology and social pedagogy, economics and political science, cognitive science and philosophy of education [1]. In a foreign language coursebook for non-linguistic students, both paper and electronic, all the components of the content of learning should be reflected: language material (organized with due account for its functions in foreign-language communication and rules of operating with it); verbal material (from speech sample to text); spheres of communication, reflecting practical use of a language, including professionally-oriented one; topics, subtopics and communicative situations; system of exercises and assignments

to them, as well as tests for self-control; sociocultural information. The content-related plan is one of the main factors that can increase the internal motivation of students.

An electronic coursebook, like a paper coursebook, is defined as a kind of script for the educational process, and if availability of the coursebook allows the learners to dispense with a teacher, then we can consider such a coursebook to be full [2]. The possibility of functioning of the coursebook without a teacher's assistance is ensured by including in its contents all the necessary reference material, system of exercises with accessible and clearly formulated tasks, a systematic presentation and revision of language material and means for monitoring the performance of assignments. The main tasks that a teacher should solve, according to A.P. Minyar-Belorucheva are confined to the following:

- statement of all that is to be said to learners;

- description of all the actions of a teacher and a student;

- availability of the essential language material, as well as the rules for its use;

- availability of the grammatical satellite with revision of the selected grammatical material and corresponding exercises;

- availability of lexical references;

- availability of general scientific and special scientific limited syntagmatic sequences (Ibid.).

The authors define the distinguishing features of electronic coursebooks and indicate their advantages. Among the most significant are the following distinctive features:

- possibility of including several levels of difficulty in electronic coursebooks;

- availability of variative tasks and control of educational achievements in interactive mode;

- open system of the coursebook, allowing to supplement, correct, modify the educational material in the course of its operation;

- greater visibility (animations, accompanying sound, hyperlinks, picture shots, etc.);

- expanding usage based on rapid and non-expensive increase in circulation or distribution through the network.

V.A. Vul relates to the advantages of the electronic coursebook the following:

- adaptation and optimization of the user interface for individual requirements;

- use of additional, in comparison with print, means of influence on the student;

- methods of constructing a fast and convenient navigation mechanism.

In print textbooks, these characteristics are provided by means of a table of contents, running titles and glossaries, for which one needs to flip through pages. In electronic coursebooks, hyperlinks, frames, or image maps are used to quickly jump to the desired section or fragment and, if necessary, go back. When using network structures, it is possible to discuss the material with other students without leaving the workplace, to provide interactive teamwork between students and coursebook elements [3]. According to O.V. Zimina, electronic coursebooks maximally facilitate understanding and memorization of the most essential information, using computer explanations, involving in the active learning process other than the usual coursebook, the capabilities of the human brain, in particular, auditory and emotional memory [4].

As for the structure of the electronic coursebook, first of all, it should be said about its hypertext structure. Hypertext systems have become widespread in many areas of science, technology, education, and economics. The term «hypertext» was introduced by Ted Nelson in 1965 [5]. By «hypertext» the author understands a nonsequential write. Typically, the process of writing is performed sequentially for the following two reasons: firstly, because it is derived from speech, which cannot be nonsequential, and, secondly, because books are inconvenient to read otherwise than sequentially. However, thoughts form structures that are not sequential – they are connected by many possible transitions (Ibid.). A.A. Vorozhbitova defines hypertext as a special form of storing and presenting textual information that converts numerous final texts into a single whole and is characterized by the infinity of possible interpretations [6].

Hypertext system uses electronic and software tools to overcome the limitations of the linear nature of text printed on paper, i.e. represents a non-linear organization of information units that can be represented by text, audio and video information, which opens up unique opportunities for authors of electronic coursebooks. Hypertext information model is recognized as a framework for effective presentation and transfer of knowledge as well as, according to P.A Carlson, it is based on the hypothesis that processing and generation of ideas by the human brain occurs associatively [7].

It is known that the idea of expanding the traditional notion of text lies in the basis of hypertextual representation of information, by introducing a non-linear text in which cross-links between the selected text fragments (information articles) and rules for the transition from one piece of text information to another are created. If printed books can only present a two-dimensional information flow: linear and hierarchical, hypertext systems contain a network of cross-points (fragments, modules, frames) and the associative links given on them generate a three-dimensional information stretch, which creates an information environment adequate to the deep structure of ideas processed by the human brain [8].

Hypertext is considered a universal technology, the use of which does not depend on the specificity of the educational area, since it contains practically all the disparate methods of storing and presenting information. Yu. Hartung and E. Breydo identify the most important properties of hypertext: principal possibility of existence only in computer form; nonlinearity; multiplicity of virtual structures; incompleteness; virtualization of information [9].

Based on the research of hypertext systems, V.L. Epstein came to the conclusion that hypertext systems are systems of anthropocentric type, since the presentation of information and methods of navigation are oriented not to the computer, but to the brain of a person who solves a problem, in this case information is presented in the most effective form, considering not only its nature, but also the individual physiological characteristics of the user [8].

Hypertext system applied at practical lessons offers students a dynamic system in which there are opportunities to rationally combine students' classroom and independent work, to provide students with the necessary resource for improving the quality of linguistic competence (phonological, lexical, grammatical), and also to form other components of foreign language communicative competence.

The process of constructing an electronic coursebook is greatly simplified with the advent of specialized programs such as: ToolBook Instructor, MatchWare Mediator, AutoPlay Media Studio and many more. Let's consider some advantages of the listed programs. ToolBook Instructor is a professional tool for developing and designing elearning courses, electronic learning materials, simulators, etc., and assessment in on-line mode. ToolBook Instructor has a full-featured scripting language for creating interactive tutorials, built-in tools for recording and editing simulations that provide step-by-step performance of tasks, input of necessary data, filling in blanks, etc. In addition, the program allows one to track user results in accordance with international standards – SCORM (Sharable Content Object Reference Model), AICC (Aviation Industry Computer-Based Training Committee) etc.

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For multimedia presentations, educational applications based on computer technology and Web-based presentation MatchWare Mediator can be used. The program is focused on creation of Flash-, HTML- and interactive CD-presentations. It is based on the classical scheme of creating presentations, both in the form of one's own projects, and based on a variety of templates organized as visual effects, which allows to create unique presentations that resemble an interactive video. The presentation can combine text, images, video, sound, animation, interactive elements, variables and input objects that affect the course of demonstration.

Study and analysis of these and other programs made it possible to determine that teachers who do not have a special education in programming should use AutoPlay Media Studio to construct electronic coursebooks, CD DVD business cards, presentations, simple games, electronic photo albums, collections of video files with easy viewing etc. The program allows integrating various types of media, such as images, sounds, (flash-) video and text into a single interlinked presentation of information.

It should be noted that learning programs developed on the basis of AutoPlay Media Studio have a number of advantages, such as:

- more than 865 operations (actions with objects);
- 12 operational actions;
- custom dialog boxes;
- parallel audio channels;
- macro plug-ins support;
- pluggable objects support;
- 21 embedded object;
- customizable application window and object positioning support;
- 2500 pages in one project;

- language identification for multilingual applications;

- timer push button, save functionality function when individual elements fail (Flash), start button, sorting objects by time and size;

- application version identification (dependencies);

- built-in CD/DVD/Blu-Ray recorder.

The use of Autoplay Media Studio does not require special instruction, since it is quite easy-to-use.

As for the evaluation of the electronic coursebooks, the following criteria are highlighted:

- compliance of the content of a coursebooks with the approved curriculum;

- compliance of the volume of material with the set norms;
- compliance of the content of the coursebooks with its form;
- completeness (composition) of a coursebooks;

- up-to-date educational material;

- accepted way of self-testing learners [10];

- to be interactive and easy to navigate;

- to provide the potential of changing the trajectory of learning;

- to have hypertext structure of learning material (links to definitions, sequence of steps, interconnection of segments);

- to contain illustrative material;

- to contain various practical and control activities to consolidate knowledge, means of self-control, as well as monitoring and evaluating the knowledge gained (tests, exercises, creative assignments);

- to have a system of links (hyperlinks) to various electronic resources posted on the Internet [11].

Results and discussion

The compliance of the electronic coursebook with the above mentioned characteristics and requirements fills it with linguodidactic potential for presentation, automation and application of educational material in the classroom. At the same time, we draw attention to the fact that for an electronic coursebook aimed at teaching foreign language communicative competence, it is not enough to meet only the specified requirements for electronic coursebooks in general. The effectiveness of the educational process in this case is in direct dependency on fundamental methodological categories and awareness of rationality and expediency of methods of activating the mechanisms of foreign language speech activity. The implementation of the provisions of rational methodology in the development of an electronic two-level coursebook becomes a factor in achieving the effectiveness of learning and its rationalization. For example, an electronic coursebook provides objective self-control and reflection, choice of the appropriate individual educational trajectory of study and self-study, regulation of the degree of cognitive activity in mastering foreign language communicative competence, achievement of the necessary degree of productivity of self-study by using an electronic coursebook, efficiency of educational activities, determining the optimal sequence of teaching activities. These characteristics of the use of an electronic coursebook for teaching foreign language communicative competence are correlated with the indicators of rationality, which confirms the expediency of choosing an electronic coursebook as a means of implementing the rational methodology.

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# Ryabkov A.V. The principles for increasing the usability of educational content

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**Abstract**: In the article typical errors of educational content placement on the site of the educational institution are considered and principles of increasing the usability of the educational content that forms the basis of modern e-learning are formulated.

Keywords: usability, educational content, electronic training

The term usability is estimated from the point of view of its user-friendliness.

Educational content on the site of the educational institution forms the basis of elearning, which has many advantages over traditional, classroom instruction [1]. The usability of educational content is characterized by the convenience of searching and understanding the educational material on the site.

Consider the most typical errors in the placement of educational content on the site of an educational institution [2].

The trainee does not have a direct entrance to the site section, in which he would see only the study materials intended for him. Instead, the student ends up in a «common heap», where he has to go through multiple referral links to find the necessary teaching materials.

Slurred navigation, understandable except that the developers of the site, from the lack of a first-level menu and ending with the absence of a personal office menu. At the same time, there is no single page containing links to all training materials, which are

often randomly scattered around the site. To get to the necessary educational material, the listener needs to repeatedly click through the links every time, and he often is deprived of the opportunity to quickly return to the original page.

Lack of internal search for educational materials. On the site there is no internal search either, or it is not optimized for the needs of the student and gives out a lot of useless links.

The lecture material is presented in one file or scattered into hundreds of files by structural units in the absence of a table of contents, from which it would be possible to click on the links to the desired section of the text (chapter, paragraph, point).

All text materials have different fonts — from too small to too large, with the compilers of the texts overdoing with bright colors, using the entire palette. From this variety, it is dazzled in the eyes.

Video materials, illustrative, graphic materials are either missing or presented in formats that require the installation of additional software.

Based on the identified problems in the interface of the educational organization, we formulate the basic principles of increasing the usability of educational content.

A visitor to a training site who has received the status of a course participant should have a direct entry into the section of the site, the interface of which is no less than half of the menu, links, training materials intended only for him. The top-menu of the site, various other information, advertising and all that is not for the learning process, should not be in the center of attention of the trainee, that is, they should not be located in the center of the screen. It is very important that the personal cabinet contains its own menu, which would include links to:

- the main page of the personal cabinet,

- curriculum-program,

— a list of test questions,

— instructions for training, including templates of documents necessary for filling out,

— page for sending documents for examination by the curator and completion of training.

From the successful experience, we will highlight the site of the Academy of Training of Chief Specialists (https://specialitet.ru), where the main page of the personal cabinet has a direct entrance and contains:

— the most important instructions-hints that allow a person, who first appeared in his personal office, to clearly understand their further actions,

- start and end dates of training,

— links to the page with training materials and a test page.

At the same time, the page with educational materials contains links to all materials that are strictly sorted and presented in the form of an understandable table:

— in the lines — module number (curriculum section),

— in columns — types of educational materials: lectures, normative acts, reference documents, video, audio lectures, tasks for independent work.

Navigation of the educational site should be implemented in an extremely simple way, especially in the personal cabinet — there should be nothing superfluous in it. It is important to avoid a variety of colors and use, as a rule: white background, black font, blue links, purple viewed links. In rare cases, use a fifth color, for example, red, to attract the attention of the listener to some important details.

The organization of an effective internal search is based on the following principles:

— the form of internal search should be on all pages of the site, as an option, be located between the top menu and the main menu of the personal cabinet,

— the length of this form must be at least 25 characters,

— search in your account should only be based on educational materials.

Lecture material is not properly placed in one file — it's very inconvenient for reading purposes because each time the reader has to spend a lot of time scrolling an electronic document in search of the right page. Optimal splitting of lecture material, given the experience of e-learning contract managers [3], in paragraphs. In doing so, try to ensure that the total number of paragraphs does not exceed 50 pieces — this number corresponds, for example, to 5 paragraphs in 10 modules.

All text materials must have a single main font of at least 12 pt. Thus headings can have a font on 2-4 pt more basic, and tables and figures — on 2-4 pt it is less than the basic.

A full-fledged e-learning system should include video materials, as well as a variety of illustrative, graphical materials presented in the most widely available formats that do not require the installation of additional software.

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### Ziangirova L. Cloud computing in teaching students on direction «Applied informatics»

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**Abstract**: The article presents a study of the course "Cloud computing" in the training of students in the direction of preparation "Applied Informatics". There are considered basic model of cloud computing services (Infrastructure as a Service, Platform as a Service, Software as a Service), cloud platform Microsoft Azure, cloud platform Amazon Web Services, the advantages and disadvantages of cloud computing model, cloud computing technology risks, the basics of cloud services, and a choice of cloud services

**Keywords**: Cloud computing model Infrastructure as a Service, Model Platform as a Service, Model Software as a Service, virtual network, virtual hardware, information infrastructure, cloud storage services

Introduction

One of the main trends in the development of information technologies at the moment is the implementation of cloud computing. The course «Cloud computing» is aimed at teaching students enrolled in the direction «Applied Informatics», used in the practice of teaching modern cloud computing technologies.

Materials and methods

In the section «Theoretical Foundations of cloud computing» provides a definition of cloud computing technologies, and a classification of these technologies with explanations and examples are discussed modern trends in the field of computing.

The service-oriented architecture (SOA) has formed a basis of modern cloud computing service. The approach to development of the software based on services using

with the standardized interfaces is understood as the service-oriented architecture [4].

«Cloud computing» is an alternative to the classical model of education. Computer infrastructure and information services are provided as a service «cloud» provider. The documents, programs, e-mails and other data involved in the educational process are stored on remote servers' provider. At the same time there is no need for the institution include its own expensive IT-infrastructure and pay for computing resources, which in most cases are not used to full capacity.

Significant contribution to the study of cloud computing have D. Avresky, S. Ahson, B. Sosinsky, K. Hwang, G. Fox, V.P. Potapov, V.V. Gubarev. There are a variety of service models of cloud computing: model IaaS – Infrastructure as a Service, model PaaS – Platform as a Service and a model SaaS – Software as a Service.

Infrastructure as a Service. At this level, the user constructs his own ITinfrastructure into the cloud and operate it. For example, create virtual networks, adds virtual hardware (servers, storage, database), sets required to operate the application software and operating systems, ie. It uses a cloud as if it were a real IT-infrastructure of educational institution. IaaS-known solutions are: Google Compute Engine, Microsoft Azure, Amazon Cloud Formation.

Platform as a Service. If the basis of class IaaS cloud applications are virtualization technologies, the solutions of a class «Platform as a service» require additional tools to develop network applications with greater efficiency and lower cost, in addition to virtualization. Ways to improve the efficiency and reduce the cost of application development can be a lot, and the technology underlying the decisions PaaS, as are diverse [1]. At this level, a provider of cloud services gives the user access to operating systems, data base management, development tools and testing. Thus, the consumer is able to cloud-based services and tools for self-build, test and operates the software. The entire

information infrastructure (computer networks, servers and storage) managed by the provider. The most famous PaaS-services: Google App Engine (for software development languages Java, Python), Microsoft Azure (for ASP.NET, PHP), Cloud Foundry (programming languages Java, Ruby).

Software as a Service. At this level, provider allows users clouds software. All data is stored in the cloud, and to access them the user need only to have a web browser. This type of cloud computing does not require additional costs for installing and configuring the software. In most cases, payment for use of the software under SaaS is calculated based on the number of users and does not involve the so-called Enterprise-licenses allowing the use of a certain service for any number of users without any restrictions. Samples of free SaaS-solutions for educational institutions: Google Apps for Education and Microsoft Office 365 for education. It contains the functions of office package (work with documents, tablesheets, and presentations), means effective submission of information (in the form of presentations, videos) and communication (e-mail, instant messaging).

In recent years, attracted the most attention hybrid «clouds», Hybrid «clouds» are the introduction of a cloud computing, in which part of the system is placed in the public «cloud», ie, based on the data centers of cloud providers, and some – in a private «cloud», ie on servers owned by the company itself. In fact, hybrid «cloud» is not an independent type of cloud deployments, but only points to the close integration of public and private cloud systems [1].

In recent years, major cloud companies are actively rebuild its strategy with the «hybridization» of cloud computing. For example, Amazon Web Services is planning to develop not only by building their own services, but also by creating a community partners and vendors, the services that will be integrated with the cloud-based platform from

Amazon [1]. Microsoft is moving toward a hybrid model more consistent, which cloud strategy involves the possibility of placing computing power of choice: in your own site, in a public «cloud» or a service provider. Therefore, Microsoft allows you to combine elements of public and private «clouds» in those ratios, which are most convenient for the company. Under this strategy, Microsoft has recently added the ability to own premises generated virtual machine in the «cloud» Microsoft Azure [1].

In the «Basics of cloud services» provides an overview of the most popular cloud services technologies, are examples of popular cloud storage services.

Today on the Internet there are many free services cloud storage. Each of others are offering the possibility for storage of any type, from office documents and ending with multimedia information. Nearly all of the providers of these services offer the following services for free: the amount of free storage; automatic synchronization of data stored across all the devices that are connected to cloud services; security of storage in the «cloud»; the possibility of public access through the Internet to files stored in the cloud, to any person; data reliability.

In the «Choice of cloud services and the associated risks» provides guidance on the use of cloud services. Also explains the advantages and disadvantages of this approach, highlights issues of organizational and legal changes that may occur as a result of the implementation of cloud technologies in the educational process.

The use of cloud computing in the field of education has the following advantages: cost-effectiveness, scalability, availability, meeting the needs of users, reducing the impact on the environment («green» technology).

Recommendations regarding the selection of the service provider share the following areas: functionality, platform, technical features, convenience and accessibility for users, contract costs.

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Students also learn the basics of MOODLE in the cloud and create a teacher-led training courses and place them in a special cloud. For example, in the cloud material is presented on the following topics of the course «Computer systems, networks and «Overview of networks telecommunications», computer systems, and telecommunications. Classification of computer systems», «Physical fundamentals of computing processes», «Fundamentals of construction and operation of computers», «Functional and structural organization of the computer», «Features of the functioning and organization of computers of different classes», «Classification and architecture of computer networks», «The structure and characteristics of telecommunication systems», «Telecommunication systems», «Design of Computer Networks», «IP-telephony over computer networks», «Firewall», «The effectiveness of the networks and their development prospects». The educational complex theoretical information is represented on the design of computer networks and laboratory work. Also the analysis of the organizational and legal consequences of the use of cloud services is carried. Under the guidance of a teacher, students make a list of organizational and legal changes that would need to do in the work of educational institutions [2; 3; 5].

**Results and Discussion** 

Cloud computing – software and hardware, is available to users via the Internet or LAN as a service. Cloud computing can reduce the complexity of IT systems, through the use of a wide range of effective technologies, managed independently and available ondemand within a virtual infrastructure.

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### **Economic-mathematical modeling**

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## Nechaeva M.L.The main aspects of a research of perception in the factorial analysis

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**Abstract**: The factorial analysis is one of the main directions in the analysis of production activity of the organization, namely an assessment of perception of indicators of quality of the made food products. As have shown researches, the existing techniques have serious shortcomings, such as lack of researches in the field of perception of quality of production. We offer a technique of determination of parameters of perception of quality the cornerstone of which the procedure of the factorial analysis is. On the basis of selection of the key parameters included in the questionnaire for drawing up the questionnaire. Further an object of a research is estimated, the most significant parameters of the analysis come to light. One of the main advantages of the factorial analysis complexity and recurrence belongs, that is stages consistently replace each other and allow to obtain detailed information on the studied object. As a result of statistical processing of primary information we receive factors, by results of a correlation matrix and taking into account dispersion indicators

Keywords: factorial analysis, quality perception, parameters

Intoduction.

In a basis the analysis of activity of the enterprises of the food industry, often, methods of synthesis and comparison are applied. However for these methods there is a number of serious shortcomings, such as a significant amount of the indicators estimating efficiency from the economic point of view, and also a lack of communications of cause and effect character between the studied characteristics of activity of the organization. Therefore we will apply the factorial analysis to a complex assessment of activity of the enterprises of the food industry. Further we will present definition of the factorial analysis — a technique of studying of influence of various factors in activity of the organization on a productive indicator, taking into account the principle of complexity and systemacity. Proceeding from this definition, we will present a research technique which will allow to allocate the major factors exerting impact on level of quality of products.

The procedure of the factorial analysis as bases of the majority of researches contains three obligatory elements in the basis: 1. The researcher who acts as the subject. 2. An object, in our example is activity of the organization as system social and economic. 3. The received factors on the basis of which the researcher can define the directions of development of the organization. Therefore one of the main advantages of the factorial analysis complexity and recurrence belongs, that is stages consistently replace each other and allow to obtain detailed information on the studied object.

Materials and methods.

The study of the pacing factors defining perceptions of factors of quality of food products was carried out on the following stages:

The list of the main components of perception of quality for customers is defined. The task force is created of 50 people. On the basis of researches 16 component perceptions of quality of food products for customers were revealed. (X1-X16).

Results of a research of food products component perception of quality for customers is exposed to factor analysis of methods of the principal components in the Minitab 16 program for the purpose of separation of the most important components quality perception which require special attention from the enterprises vendors for formation of positive perception of meat production.

For determination of quantity of factors we will use: the percent of the explained dispersion of a factor shall be more, than 100% / quantity of variables = 100% / 16 = 6,25%, i.e. only those factors which share more than 6,25% are taken into account. Also

the index – own value which value for switching on in calculation shall be more than 1,0 can be used. On the basis of the diagram it is recommended to select 2, 3 factors (a figure 1), value of «own value» confirm such choice (6,79; 1,55; 1,36). Thus, we make the decision on switching on in model of 3 factors.



Figure 1. the Diagram of «a stony talus»

From data of correlation matrix (table 1) it is visible that the highest value of correlation is watched between the variables X1 and X2, X1 and X10, X1 and X11, X1 and X12, X2 and X8, X2 and X10, X2 and X13 X2 and X14, X3 and X4, X3 and X10, X3 and X15, X4 and X10, X4 and X15, X5 and X6, X8 and X9, X10 and X13, X10 and X14, X10 and X15, X12 and X16, X13 and X15.

Table 1

				•												
	Correlation analysis															
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16
X1	1,0															
X2	,526	1,0														
X3	,402	,565	1,0													
X4	,478	,315	,764	1,0												
X5	,417	,278	,429	,471	1,0											
X6	,265	,161	,406	,381	,666	1,0										
X7	,342	,309	,375	,398	,501	,696	1,0									
X8	,436	,610	,396	,330	,309	,288	,503	1,0								
X9	,388	,366	,409	,300	,385	,370	,357	,544	1,0							
X10	,540	,503	,511	,582	,328	,313	,344	,446	,336	1,0						
X11	,505	,164	,318	,383	,482	,416	,389	,153	,312	,372	1,0					
X12	.586	.294	.328	.268	.355	.190	.258	.299	.393	.273	.419	1.0				
X13	.443	.540	.409	.401	.372	.390	.438	.353	.373	.636	.390	.203	1.0			
X14	.492	.519	,330	,	,220	,362	.242	.417	.273	.572	.285	,248	.458	1.0		
X15	.416	,362	,520	,554	.452	.514	,354	.275	.379	,587	.417	,215	.508	.432	1.0	
X16	,110	,302	,320	,229	,132	,231	389	103	,577	,326	,117 453	,213	,200	,152	349	1.0
Prelim	,202	,150 estimat	es of c	,22) ommu	nities:	$\frac{251}{0}$	alues of	,105 f a mat	rix of c	orrelat	ion: su	m = 16	,240	,230	,547	1,0
	X1	x2	x3	X/	X5	X6	X7	vs	vo	X10	X11	$\mathbf{x}_{12}$	, X13	<b>X</b> 14	X15	X16
Con		Λ2	Λ3	Лт	Λ.	Λ0	Λ/	Ло	Λ)	A10		Λ12	Λ15	Λ1 <del>1</del>	Λ15	ЛЮ
nea	6,79	1,55	1,36	1,14	1,00	0,77	0,61	0,58	0,48	0,41	0,36	0,32	0,19	0,17	0,12	0,08
Share	42,4	9,7	8,5	7,2	6,3	4,8	3,8	3,6	3,1	2,6	2,3	2,0	1,2	1,1	0,8	0,5

### Factor analysis of results of an assessment of the main components

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Mode	l of factors										
	Factor 1	Factor 2	Factor 3			Factor	Factor 1		r 2	Factor 3	
X1	-0,727	-0,108	0,347		X9	-0,600		-0,123		-0,140	
X2	-0,648	-0,567	0,069		X10	-0,751	-0,751		7	0,091	
X3	-0,720	-0,135	-0,203		X11	-0,613	3	0,454		0,233	
X4	-0,697	0,052	-0,189		X12	-0,542	0,542			0,577	
X5	-0,660	0,356	-0,311		X13	-0,700	)	-0,167		-0,047	
X6	-0,641	0,424	-0,436		X14	-0,610		-0,321	l	0,190	
X7	-0,660	0,301	-0,254		X15	-0,716	-0,716 (			-0,117	
X8	-0,623	-0,406	-0,099		X16	-0,446	5	0,419		0,575	
	The dispersion explained with each factor										
	Factor 1		Factor 2		Factor 3						
	6,78		1,55		1,36						
	0,424		0,09				0,08				
	Rated coefficients of value of factors										
	Factor 1	Factor 2	Factor 3		Facto	Factor 1		Factor 2		Factor 3	
X1	-0,107	-0,070	0,255	X9	-0,088	8	-0,079	)	-0,102		
X2	-0,095	-0,366	0,051	X10	-0,11	1	-0,160	)	0,067		
X3	-0,106	-0,087	-0,149	X11	-0,090	)	0,293		0,171		
X4	-0,103	0,034	-0,139	X12	-0,080	)	0,126		0,424		
X5	-0,097	0,230	-0,229	X13	-0,10	3	-0,108		-0,034		
X6	-0,094	0,274	-0,320	X14	-0,090	)	-0,207 0,139				
X7	-0,097	0,194	-0,186	X15	-0,10	5	0,051		-0,086		
X8	-0,092	-0,262	-0,073	X16	-0,06	6	0,271 0,423				

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On the basis of the analysis of model of factors it is possible to draw a conclusion that rather high value of correlation for a factor 1 is watched between the X1 variables (appearance of a product) X3 (consistence), X4 (color) of X10 (storage life) of X13 (rating), X15 (range). These variables characterize appearance food izdeliy can be visually evaluated by a customer directly during acquisition in trade retail network, and also estimate these markings. Therefore these variables allow to estimate quality food изделийс the points of view of appearance and from the point of view of requirements to storage conditions and composition which are regulated in the normative document, this factor can be called «a visual assessment of quality of meat products». The second factor most of all correlates with the X2 variables (tastes), the highest value of correlation therefore this factor can be called as «flavoring advantages of meat products» is watched.

The third factor correlates with the X12 variables (popularity of manufacturer) X16 (advertizing activities and actions). From data retrieveds it is possible to draw the following conclusion that the factor 3 is responsible for different programs for formation of positive perception of the meat-processing enterprise and carrying out competent marketing policy on advance and advertizing of meat goods. It allows to build such system of marketing communications which would help them to fix necessary style, a brand, a logo in consciousness of customers, to show the social directivity. The third factor can be called as «efficiency of marketing communications».

**Results and Discussion** 

The technique of the factorial analysis is developed for determination of level of perception of quality of food products with a possibility of receiving factors of perception. In the course of approbation of a technique the most significant parameters of perception of quality in the market of food have been determined that allows to form on the basis of this analysis the production development strategy to domestic manufacturers in the conditions of ensuring food security. It is necessary to consider the factors revealed during the researches on the basis of which development of strategic plans of the enterprises is possible. It her quality will allow to ensure safety of products and improvement. Quality and safety of food for the state have to become the national idea, the priority project. Mechanisms of impact of socially responsible business are directed to increase in efficiency of economy and improvement of life of the population. Electronic scientific editions

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