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UDK 621.313.333

Identification of the Mathematical Model of the Transmission of a Car with a Traction Valve Electric Motor

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Key words and phrases: mathematical model; optimal control; traction electric drive; valve motor.

Abstract. The paper presents research to develop more refined approaches to modeling a traction electric drive of a car based on a valve engine. The aim of the study was to study existing approaches to modeling a traction electric drive of a car based on a valve motor to obtain an estimate and conditions for optimal control of the current vector. To achieve this goal, structural diagrams of dynamic and static models of traction electric drive and a model of a car transmission were developed. The paper uses methods of comparative analysis of models based on the time dependencies of the main variables.

Introduction

In recent years, a fairly large number of works by domestic and foreign researchers devoted to the identification of mathematical models of traction electric drive of various vehicles and the synthesis of optimal control of automotive power plants have appeared. This indicates the relevance of the problem under consideration. In particular, [1–5] investigate the issues of mathematical modeling of the valve motor, as well as optimization of the control of the stator current vector.

Currently, a valve motor (**VM**) is often used as a traction electric drive. The VM is a system of an adjustable electric drive, which consists of an alternating current electric motor, structurally similar to a synchronous machine, a valve converter and a control device that provides switching of the circuits of the stator windings depending on the angular position of the rotor. The use of VM has a number of design and technical and operational advantages: the relative simplicity of the serviced engine components; high overload capacity and high energy performance due to the absence of excitation losses.

Analysis of the traction electric drive control system based on a valve motor

When designing new automotive power plants, a complex problem arises of scientific

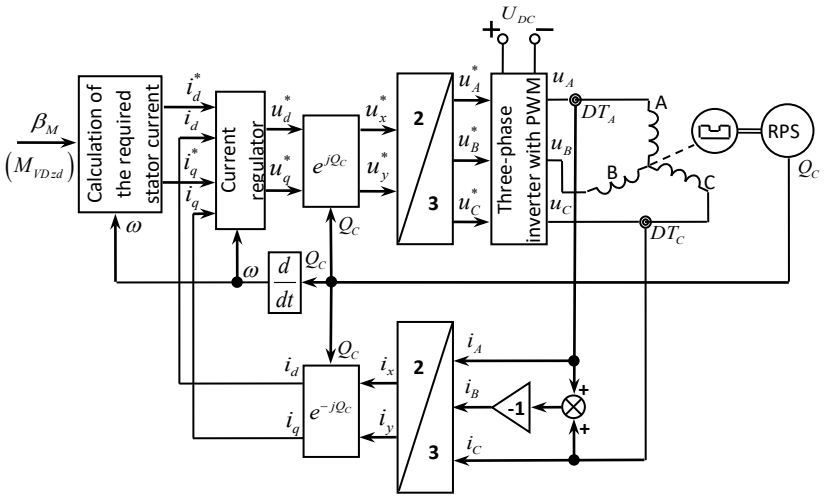

Fig. 1. Functional diagram of the traction electric drive control system based on VM

substantiation of their basic parameters and characteristics. To solve this problem, methods based on computational experiments with appropriate mathematical models are used. However, a comparative analysis of various design solutions is not possible without optimizing the control algorithms of both the power plant as a whole and its individual components. This paper is devoted to the development of a model of the VM control system as part of an automotive power plant, in order to ensure a minimum current consumption at specified traction and speed characteristics. Consider the coordinate system (*d*, *q*) associated with the rotor of the VM and stationery relative to it. We assume that the axis *d* is aligned with the axis of the magnetic flux of the rotor. In this coordinate system, the equations for electromagnetic processes in scalar form can be written as:

$$\begin{cases} u_d = R_1 \cdot i_d + L_{1d} \cdot \dfrac{d\, i_d}{dt} - p_p \cdot \omega \cdot L_{1q} \cdot i_q, \\ u_q = R_1 \cdot i_q + L_{1d} \cdot \dfrac{d\, i_d}{dt} + p_p \cdot \omega \cdot L_{1q} \cdot i_q + p_p \cdot \omega \cdot \psi_{mag}, \\ M_{VD} = \dfrac{3}{2} \cdot p_p \cdot \left(\psi_{mag} + i_d \cdot \left(L_{1d} - L_{1q}\right)\right) \cdot i_q, \end{cases}$$

where u_d, u_q, i_d, i_q are projections of the stator voltage and current vectors on the axis of the rotating coordinate system; L_{1d} and L_{1q} are total inductance of the stator windings along the longitudinal and transverse axes; R_1 is active resistance of phase windings; ψ_{mag} is the vector of flow coupling of the stator relative to the magnetic flux of the rotor; p_p is the number of motor pair poles; ω is the angular rotation speed of the rotor; M_{VD} is electromagnetic torque of VM.

Based on the above equations, the control of the electromagnetic torque of the VM can be carried out by regulating the longitudinal and transverse components of the stator current, taking into account the limitations of the range of permissible modes. The functional diagram of the traction electric drive control system based on the VM can have the form shown in Fig. 1, where RPS is rotor position sensor.

The values of the components of the VM and stator current required to ensure a given traction-speed mode are determined taking into account the selected control quality criterion.

If the quality criterion is the minimum of the total current consumption of the VM in static mode, the optimal dependence $\left[i_d^*, i_d^*\right] = f\left(\beta_M, \omega\right)$ can be obtained from the condition:

$$\begin{cases} i_d^* = \arg \min\limits_{i_d \in [-I_{\max}, 0]} \left(I_m\left(i_d, M_{VD\,zd}\right)\right) \\ i_q^* = \sqrt{\left(\min\limits_{i_d \in [-I_{\max}, 0]} \left(I_m\left(i_d, M_{VD\,zd}\right)\right)\right)^2 - i_d^2} \end{cases}, \quad M_{VD\,zd} = \text{const},$$

where $I_m = \sqrt{i_d^2 + \left(\frac{2 \cdot M_{VD\,zd}}{3 \cdot p_p}\right)^2 \cdot \frac{1}{\left(\psi_{mag} + i_d \cdot \left(L_{1d} - L_{1q}\right)\right)^2}}$ is the stator current vector module (total current consumption of the VM); $M_{VD\,zd}$ is the specified electromagnetic torque required to maintain the required traction and speed mode of the car; $\beta_M \in [-1; 1]$ is the electromagnetic torque control signal VM: $\beta_M = M_{VD\,zd} / M_{VD\max}$; $M_{VD\max}$ is the maximum torque of the VM. It is obvious that the optimal, according to the selected criterion, the ratio of the longitudinal and transverse components of the current can be provided only in those areas of the permissible operating modes of the VM, where the field attenuation mode is not used. The block diagram of the model of a traction electric drive with a VM can be represented as a link for determining the optimal control current, a link of a current regulator, a link of an inverter with PWM and a link of a VM.

The transmission elements of the car, which act as the load of this electric drive, have a sufficiently large reduced moment of inertia. The time constants of the process of controlling the speed of rotation of the VM rotor as part of the power plant of the car turn out to be significantly greater than the time constants of the VM, current regulator and inverter with PWM. This makes it possible to neglect the dynamic properties of the traction electric drive itself when studying various traction-speed modes of an automotive power plant.

The model of the transmission of a car with a traction motor

When studying the characteristics of a traction electric drive, a car transmission model can be used, the block diagram of which is shown in Fig. 2.

The parameters of the valve electric motor and transmission models of a traction electric vehicle are given below: J_{em} = 0.0059 kg·m^2 is the moment of inertia of the rotor of the valve motor; $U_{\max}$ = 190 B is maximum permissible voltage; u_M = 7.605 is gear ratio of the transmission from the VM rotor to the driving wheels; m_A = 1,100 kg is vehicle weight; r_{kol} = 0.26 m is rolling radius of the drive wheel; k_{vm} = 1.02 is the coefficient of accounting for rotating masses; c_W = 0.5 is aerodynamic drag coefficient; S_A = 2.0 m^2 is the area of the largest cross-section of the car; k_{pk} = 0.013 is rolling resistance coefficient; η_{TR} = 0.92 is transmission efficiency; T_u = 0.0625 ms is PWM inverter Time Constant.

The reaction of the transmission model of a car with a traction electric drive based on the VM to a stepwise control action when driving with a constant transmission ratio on the road without a longitudinal slope (Θ = 0) is shown in Fig. 4. In this case, a static model of a traction electric drive was used. The rotation speed of the VM rotor is expressed in revolutions per minute: $n = 30 \cdot \omega/\pi$. M_C is the moment of resistance brought to the shaft of the VM. Fig. 3 shows the change in the power consumed by the VM from the traction network during acceleration of the

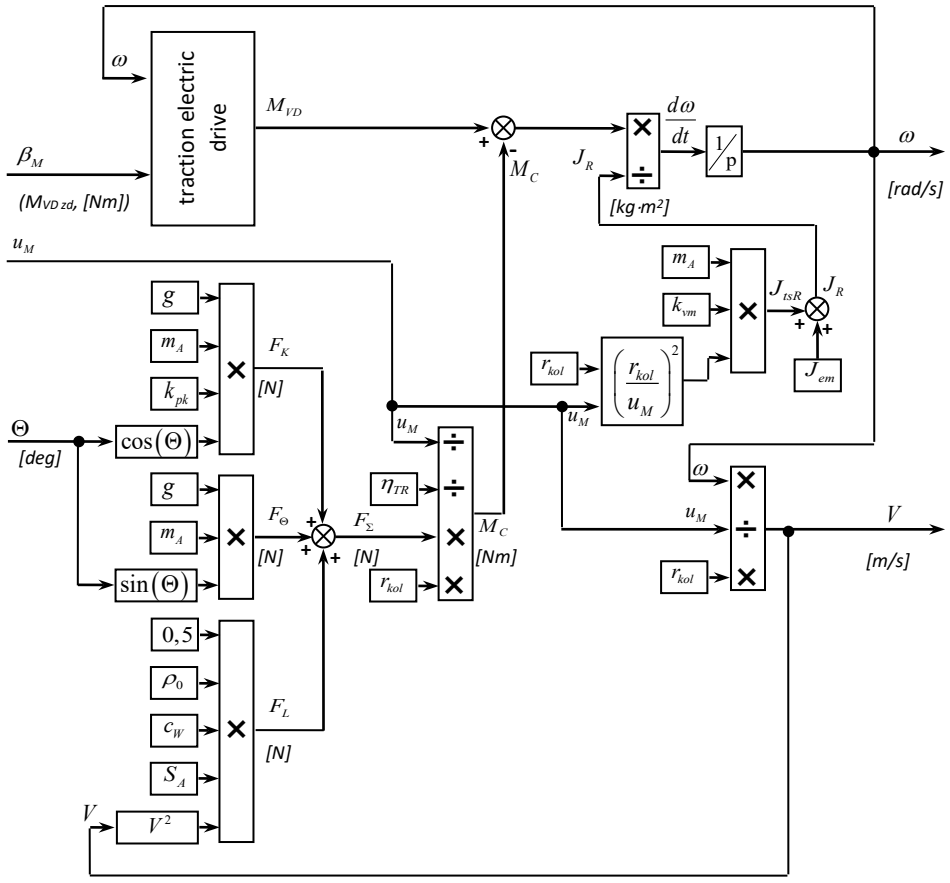

Fig. 2. Block diagram of the car transmission model

car or given to the network as a result of the recovery of kinetic braking energy.

In those areas of the permissible operating modes of the VM, where it is impossible to maintain an optimal ratio of the longitudinal and transverse components of the currents, their redistribution was carried out in such a way that the total current consumption did not exceed I_{max}, and the electromagnetic torque was as close as possible to the set one.

The power consumed by the VM can be defined as the sum of the instantaneous powers of the stator phases: $P_{ptr} = u_A \cdot i_A + u_B \cdot i_B + u_C \cdot i_C = \frac{3}{2}\left(u_d \cdot i_d + u_q \cdot i_q\right)$.

In the case of using a dynamic model of a traction electric drive with the model parameters described above, the corresponding characteristics are indistinguishable visually from the characteristics of the static model shown in Fig. 3–4.

Conclusion

A comparative analysis of the results of modeling the transmission of a car with a traction electric drive using static and dynamic models of the high-speed drive with stepwise control action and optimal control of the current vector showed that the standard deviations of the components of current and voltage, electromagnetic torque and rotor speed of the high-speed drive are: σ_{Iq} = 0.90478 A; σ_{Id} = 0.57824 A; σ_{Uq} = 0.35869 V; σ_{Ud} = 0.56286 V; σ_{MVM} = 0.37262 N·m; σ_{MVM} = 1.6344 min^{-1}. Thus, the error values of the main modeling variables caused by neglecting the dynamic properties of the VM turn out to be quite small, compared with the range of changes

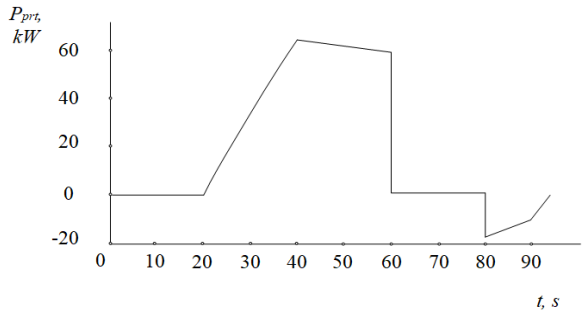

Fig. 3. The power consumed or given to the traction on-board network by the electric drive of the car

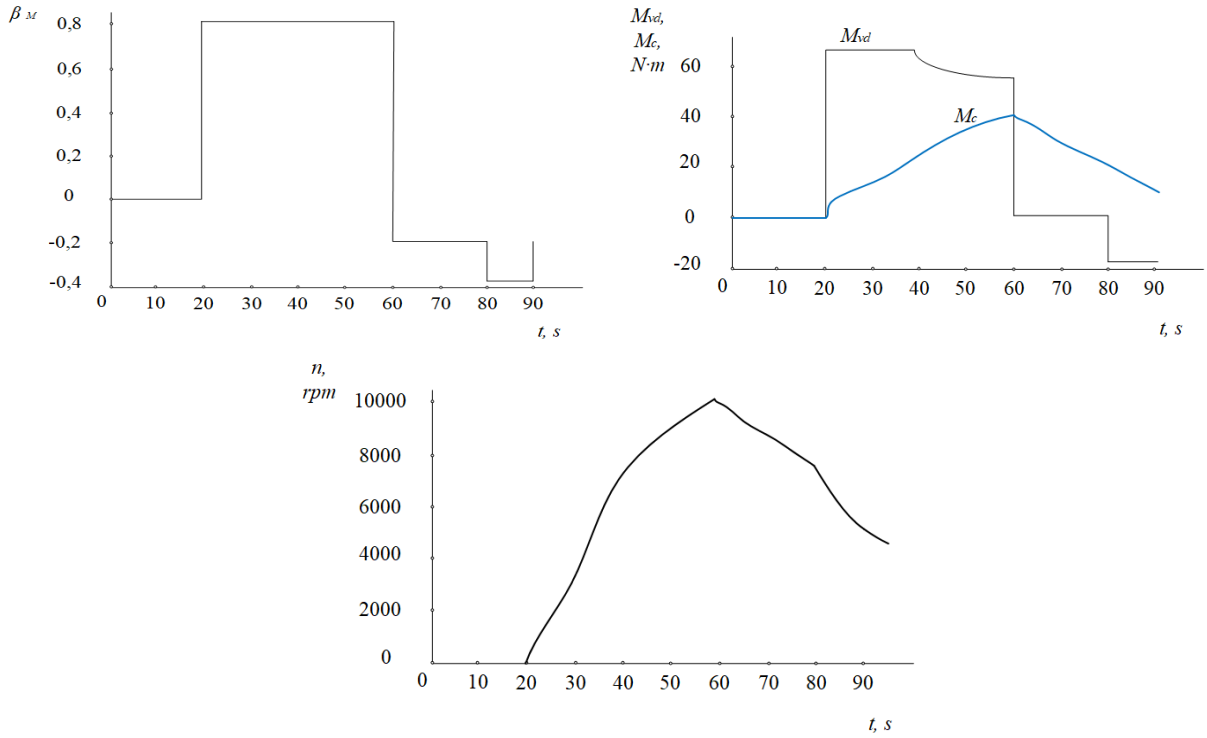

Fig. 4. Reaction of the traction electric drive of the car to the stepwise control action

in the corresponding variables. This confirms the expediency of using a static VM model in the synthesis of optimal control of the power plant of a car with a traction electric drive, as well as the selection and justification of its basic parameters and characteristics.

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Идентификация математической модели трансмиссии автомобиля с тяговым вентильным электродвигателем

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Ключевые слова и фразы: вентильный двигатель; математическая модель; оптимальное управление; тяговый электропривод.

Аннотация. В работе приведены исследования по разработке более уточненных подходов к моделированию тягового электропривода автомобиля на основе вентильного двигателя. Целью работы являлось исследование существующих подходов к моделированию тягового электропривода автомобиля на основе вентильного двигателя для получения оценки и условий оптимального управления вектором тока. Для достижения поставленной цели были разработаны структурные схемы динамической и статической моделей тягового электропривода и модель трансмиссии автомобиля. В работе использованы методы сравнительного анализа моделей по временным зависимостям основных переменных.

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Universal Model for Representing the Problem of Situational Calculation of the Working Fluid State

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Key words and phrases: image; recognition; hydraulic system; aircraft; working fluid.

Abstract. The purpose of this paper is to develop a model for presenting the problem of assessing and evaluating the state of the working fluid of hydraulic systems of the aircraft. The tasks are to study the possibilities of using pattern recognition, within the framework of an exact formalism based on measurements of its forming technical characteristics, measured when assessing its condition in a specific situation. In the course of the research, special attention was paid to the theoretical aspects of images of the state of the working fluid at the stage of its operation, measurements of its evolutionarily changing parameters (estimates). As the results of the study, the proposed description of the states of the general predicates of situational calculus of this language has the functionality to solve a complex problem related to determining the state of the working fluid of hydraulic systems of the aircraft.

The working fluid (**WF**) is incompressible for most practical purposes, and this fact makes it possible to transfer movement through pipelines over long distances without loss of time or movement. However, the WF will expand or contract (mechanical effects) as a result of temperature changes. When moving the WF, it is also necessary to take into account its dynamic characteristics. The friction existing between the liquid molecules, as well as between the liquid and the pipeline through which it flows, increases with increasing viscosity or flow velocity. Friction leads to the fact that part of the pump power is converted into heat, and the pressure in the pipelines decreases. Any change in the pipeline design increases or decreases the speed of the WF and creates turbulence, which leads to a decrease in the pressure along the flow when the cross section changes.

Evaluation of the state of the WF in a given situation, as an ordered set of compatible states of its technical characteristics, from a general standpoint, when X^1, …, X^n ($n \geq 1$) is the essence of the description of the states [1].

The development of special mathematical methods for assessing the state of the WF, models and algorithms used in maintenance systems to obtain estimates and evaluation – making decisions about the possibility of using it (WF) for its intended purpose is an urgent research

Table 1. Scope of application of NGZH-5U oil technical characteristics [2]

The name of the indicator	The norm according to GOST (TU)
Appearance	Transparent liquid
Colour	From purple to blue
Kinematic viscosity, mm^2/s:	
at 50 °C, no less	8.5
at –60 °C, no more	4200
Temperature, °C:	
flashes in an open crucible, not lower	155
solidification, no higher	–65
Acid number, mg KOH/g, no more	0.08
Density at 20 °C, kg/m^3	1060–1080
The content of mechanical impurities, water-soluble acids	absence
and alkalis	
Water content, %, max	0.1
Liquid purity according to GOST 172216	No rougher than Grade 10
Specific electrical conductivity, mcm/m, no less	40
Thermo-oxidative stability after oxidation at temperature	200 °C for 30 h:
a) kinematic viscosity, mm^2/s, no more, at a temperature of:	
50 °C	10.5
–60 °C	5000
b) acid number, mg KOH/g, no more	0.15
c) corrosion of metal surfaces, g/m2, no more	±1.0

problem, the solution of which provides the necessary theoretical level underlying the use of accurate models, methods for solving problems of assessing the state in this situation. In order for the formulation of the problem to be meaningful, it must include an adequate representation of the problem in some language, which requires a description of the sets associated with it, which must be adequately described in this language.

The development of models for describing methods of theory and algorithms for solving problems of assessing the state of the WF is a decision-making task underlying their classification for its admission to operation. The procedure for the classification of WF, as a rule, is based within the framework of modern approaches on the allocation of a set of technical characteristics determined by their measurements, which consist of a limited number of their representatives (Table 1). The apparent triviality of solving the problems of assessing the state of the WF, in the presence of a well-developed on-board maintenance system and measurement hardware, does not give grounds to abandon the relevant activities of qualified system analysts who make decisions based on the data of the system and the measurements performed, on the basis of which an image of its states and image evaluations by maintenance specialists at all stages of aircraft maintenance is built.

The existing formulation of decision-making problems, in which a set of options X (finite) is

given, leads to the choice of any of the options, which is associated with some outcome $y_i \in Y$, where Y is the set of possible outcomes, which in this problem are reduced to only two (0 or 1), which does not correspond to the tasks of aircraft maintenance, the alternatives for which are equal to three. The solution of this problem requires new logical assessments of the state of the WF. Within the framework of formal logic, the state of the WF can be described as a set of decisive rules, which are represented by expressions of the form:

IF ⟨conditions⟩, THEN ⟨solution⟩.

The central task of TO is the classification of objects according to their state, which, from the standpoint of artificial intelligence, belongs to one of its areas of pattern recognition, closely related to the issues of solving problems of assessing the state of objects maintenance. The paper will use the concept of an image as a set of objects from a given class [3; 4]. Thus, if a class of images from a formal standpoint is a set of generators constructed from them and configurations of images, as the results of observation corresponding to a certain set of regular configurations, the set of the latter is an obfuscated concept of “image” consisting of subimages constructed in a given set of generators that underlie the description of images. From the set of images, in turn, an image of the states of the object is constructed, in particular the WF.

In this paper, the class of images is limited and represents a set of images, within which a set of subsets of states are allocated, forming a class of subsets of this set, which is the area of reasoning in which the WF is the object under consideration. For each specific element of this domain, there are general statements – predicates of the form $P(x) = p$, where P is some property, p is its value, and x is a variable. Clarifying the structure of the field of reasoning, which together with logical connectives makes up the descriptive language of the image of the working fluid as an object of research is the image of the working fluid.

To solve the problem of image synthesis of the state of the working fluid, the theory of image synthesis within the framework of exact formalism is used [5]. The problem is considered from formal positions as follows.

Let U be a metric set that includes all elements with certain properties, for example, the set of all parameters of the WF. To describe the properties of all the elements of the set, a base of variables X_1, X_2, …, X_n, is introduced, characterizing the parameters of the corresponding properties C, elements from U and their values from the sets $A_i = a_1, a_2, \ldots, a_n$, $i = 1, 2, \ldots, n$, with these designations, an element from U represents the forming a, set which we denote by A, and for a separate primary element we will use a, $a \in A$.

The object in this section (working fluid) is an image that is defined by a set of values of input properties P.

The study of the formal aspects of this task revealed the need to create a universal model of descriptive languages, which would fit various descriptive languages related to specific indicators of the working fluid. This would make it possible to replace one language with another, which is necessary for the formulation and solution of the main task – to determine the purity of the working fluid and the state of its components.

The creation of a universal WF model follows from the need to solve the problem of assessing its state in this situation based on the states of individual components of the WF. To solve these problems, a systematic approach is applied in the work, implemented within the framework of a universal model that allows an adequate description of the task and its subtasks. The set-theoretic interpretation of the field of reasoning proposed above in the paper, additional restrictions are introduced on the fields of reasoning concerning its structure. At the same time,

we assume that for each specific element of this area there are some general statements, in accordance with symbolic logic, called predicates. Thus, if an element is obtained from the region, then its belonging to the image describing the state of the WF must satisfy the entered conditions for describing the state in a given situation. Therefore, we will assume that the descriptive language of images of the state of the WF, containing initial predicates and logical connectives “or”, “and”, “not”, “implication” and others, can describe any element from the class of images of fluid states under consideration. At the same time, in the work of many states of the WF, its image is determined.

In this paper, the language of assessing the state of the WF in a specific situation is constructed to solve applied problems within the framework of the calculus of predicates of the first order and represents a formal axiomatic system of situational calculus of the state of the WF in a real situation.

To solve the problem of describing the states of situational calculus, we introduce the following general predicates of this language.

1. “Situation X is a conjunction of joint indicators of state s X^i (denotes $X = X^1 \cdot X^2 \cdot \ldots \cdot X^n$). The predicate represents descriptions of the state of the WF in a specific situation and is a conjunction of the measured parameters of indicators determined by measurements.

2. The exponent X^i is a part of X of the WF (notation $X^i < X$). The intuitive meaning of the predicate is essentially related to the verbal formulation.

3. “Indicators of X^i of the WF are compatible with indicators of Y^i of the WF”. The expression $X^i \sim Y^i$ fixes a way to determine the identity of the indicators of the states of X^i of the WF in a particular situation and the corresponding indicators of the Y^i of the WF range.

4. “The indicators the Y^i of the WF standard predetermines the indicators of X^i in a specific situation”. The predicate fixes the causal relationships “the object being evaluated X^i Y^i standard”.

5. “Indicators X^i of the WF is X in state s” this predicate captures the state of X in the current situation.

We introduce axioms for the predicates of the universal model of the representation language of the Russian language presented above.

We will divide all axioms into basic and special ones. The basic axioms of the proposed universal model will be associated with the predicates $X^i < X$, $X^i \cdot X^n$, $X^i \sim Y^i$, whose matting is performed in terms of indicators as part of the whole X (integrity):

$$\text{I. } X^i X^j \sim (u)(uX^i \sim uX^j).$$

This means that if X^i and X^j are in the same situation (i.e. $X^i \cdot X^j$), then every third part u is either in the same situation (then uX^i and uX^j), or not in this (then $\overline{uX}^i$ and $\overline{uX}^j$). This logical construction is reduced to the following scheme from the above premise (axioms), it is necessary to make a “logically correct” conclusion (conclusion, consequence []), since the premises and conclusions are presented in the language of making statements that adequately reflect the subject area of assessing the state of the WF, using a knowledge system, are necessary for the automatic synthesis of solutions for assessing the state of the WF in this situation.

The language of assessing the state of the WF includes the alphabet in symbolic form (X^1, …, X^n) a set of indicators that characterize the state of the WF in a given situation (at a given time t):

$$\text{II. } X^i < X^j \sim (u)(u < X^i \supset u < X^j).$$

We are talking about complex statements consisting of parts that generate some integrity or equivalence of the third and subsequent parts by a long conjunction (predicates) about the components of the WF, which fully characterize its state, constructed from the indicators X:

$$\text{III. } X \equiv Y \sim (u).$$

This equivalence means that if $X \equiv Y$, i.e. we are talking twice about the same integrity (u), in our case about the WF, then its parts X^i and Y^i correspond to each other, in the sense of identity. But this fact (because the identity is transitory []) can be written so that each integrity is either simultaneously identical to the parts X^i and Y^i:

$$\text{IV. } X^i \equiv Y^j \wedge X^i\, Y^i \supset [A(X) \sim A(Y)].$$

This scheme works for arbitrary predicates of A. throughout the work, it is assumed that the predicates $A(X)$ can have other free variables besides X^i that are different from the variables of this axiom. These free variables can be meaningfully interpreted as parameters in the axiom scheme that reflect these changes, for example, indicators of WF:

$$\text{V. } X \equiv Y \wedge XY \sim (u)(u < X \sim u < Y).$$

Axiom V means that if their parts coincide in two wholenesses, then this is equivalent to the fact that we are talking about the same wholeness – the WF in the same situation. To solve the problems of situational calculus, we define the predicates that are important for this purpose:

1. We define the triple predicate $P(x, y, s)$ "s as a state variable acting on the subject variables x and y", characterizing the states of the WF for each indicator. A state variable that can take the values (states) $s_1, s_2, \ldots, s_n$, these states map state to state.

2. We define double predicate "x and y have identical parts", in particular, is selected indicators of the WF (symbol $\wedge (x, y)$:

$$\wedge (x, y) \sim (u)(v)(u < x \wedge v < y \supset (\overline{u \equiv v}).$$

3. We define single predicate "x is the situation" (notation $S(x)$):

$$S(x) \sim (y)(xy) \supset y < x.$$

Conclusion

The paper summarizes the idea of representing the physical components of the WF on the basis of a formal predicate language as a calculation with the help of the WF, which the authors specify the area of reasoning to determine the state of a single object, i.e. the representation of the RS as a single object and a formalized language is constructed to describe its state.

This work was carried out within the framework of the topic "syntactic methods for recognizing images of complex physical objects". The authors plan to publish articles related to this topic.

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Универсальная модель представления задачи ситуационного исчисления состояния рабочей жидкости

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Ключевые слова и фразы: гидравлическая система; образ; рабочая жидкость; распознавание; самолет.

Аннотация. Целью данной работы является разработка модели представления задачи оценке и оцениванию состояния рабочей жидкости гидравлических систем самолета. Задачи: исследование возможностей использования распознавания образов в рамках точного формализма на основе измерений ее образующих технических характеристик, измеряемых при оценке ее состояния в конкретной ситуации. В процессе исследования особое внимание уделено теоретическим аспектам образов состояния рабочей жидкости на этапе ее эксплуатации, измерениям ее изменяющихся параметров (оценок). Как показали результаты исследования, предложенное описание состояний общих предикатов ситуационного исчисления этого языка характеризуется функциональностью для решения сложной задачи, связанной с определением состояния рабочей жидкости гидравлических систем самолета.

UDK 332.1

The Demand for High-Skilled Professionals in the Arctic Zone of Russia

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Key words and phrases: labor market; demanded specialties in the conditions of the Far North; highly qualified personnel; employment of graduates of higher educational institutions; employment in the specialty of training.

Abstract. The article is devoted to the analysis of the labor market in the Arctic zone in order to identify the necessity of personnel in the conditions of the far north. The purpose of the article is to identify the need for highly qualified personnel and find a way to meet it. To this end, the employment rates of graduates of higher education organizations in the most in-demand specialties are considered. The requirement and volume of graduates' and their employment were compared. The hypothesis of the study is that the requirement for professional personnel is not satisfied by the graduates of universities entering the labor market. The main methods of research in the article are the analysis of scientific literature and statistical data. As a result of the study, the authors highlight the need to develop a mechanism to organize information flows between the labor market represented by employers and applicants – young professionals on the need for a highly qualified workforce.

The effectiveness of the staffing of the economy is determined by the orientation of the population to obtaining in-demand professions, a conscious professional choice. The availability of qualified personnel is one of the determining factors for the successful development of the country, including the effective development and development of the Arctic zone of Russia. The need to address issues of national security, economic and other strategic objectives imposes increased demands on the quantitative and qualitative composition of the labor resources of the Arctic.

The specifics of the regions of the Arctic zone of Russia, the harsh natural and climatic conditions for human life and professional activity require the identification of in-demand professions that reflect the priorities of the strategic development of the Arctic zone.

The priority directions of the economy of the Arctic zone of Russia are shown in the Fig. 1.

The list of professions in which the economy of the Arctic zone of the Russian Federation is in need can be assessed by studying the labor market. Thus, according to the data of the employment service authorities (source: Federal Service for Labor and Employment, 2019,

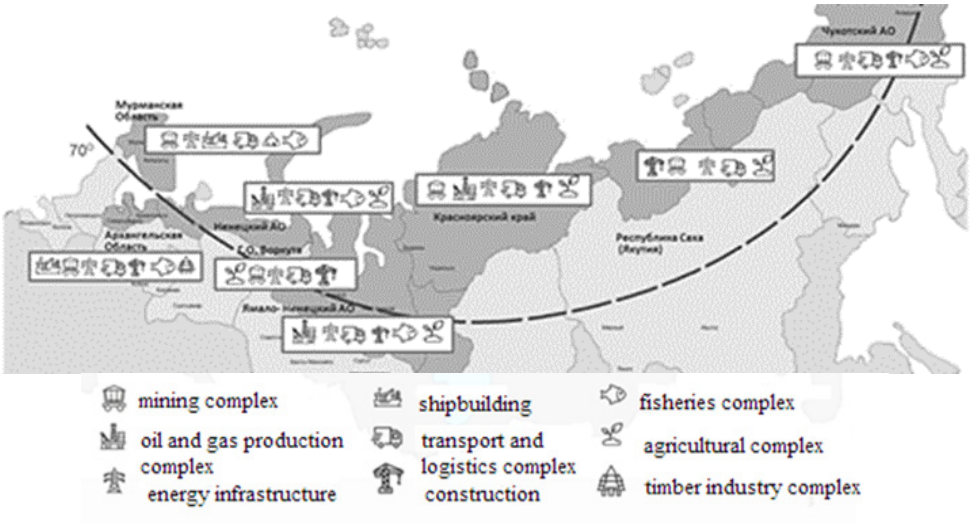

Fig. 1. Priority directions of development of the AZ of the Russian Federation

Sector of the economy	Examples of the most in-demand professions in the AZ RF
Industrial manufacturing	design engineer
Construction	cost estimate engineer, design engineer
Transport and logistics complex	transport engineer, dispatcher, captain
Mining and oil and gas production complex	geologist, geophysicist, oil and gas field development engineer, mining engineer, drilling engineer, mineral concentrator
Social sphere (education, health care, housing and utilities, etc.)	doctor (various specializations), additional education teacher, social work specialist, teacher (various specializations), pharmacist, ecologist
Services, trade	administrator, consultant, waiter, sales manager, customer service manager, commodity expert
Fishery and agriculture	veterinarian, hydrobiologist, agronomist, specialist in aquatic bioresources and aquaculture, animal breeder
Energy infrastructure	power engineer, engineer for control and measuring devices and automation in the electric power industry
Information technology, telecommunications	Database administrator, computer graphics designer, software engineer, electronics engineer, automated process control systems engineer, web and multimedia application developer, network and system administrator, information protection specialist
Cross-industry professions	Manager, accountant, economist, lawyer, HR specialist, translator

Fig. 2. Examples of the most in-demand professions in the AZ RF by sector of the economy

source: HeadHunter, 2018), the largest number of vacancies were posted by companies and organizations engaged in economic activities in the regions of the Russian Arctic in the following sectors of the economy (Fig. 2).

It should be noted that the basis for the successful development of the Arctic is highly qualified personnel. This requirement is determined both by natural and climatic conditions in the region, and by the consequent science-intensive nature of almost the entire spectrum

Table 1. Job compliance of employed graduates of 2018–2020 years to the specialty obtained in an educational organization of higher education (Thousand people)

	Total	including the connection of the job with the profession (specialty) obtained		Percentage	
		job-related	not related	job-related	not related
Total	1691.6	1244.6	447.0	74	26
Earth Sciences	18.6	9.9	8.7	53	47
Architecture	18.8	12.8	6.0	68	32
Building Engineering and Technology	44.1	29.3	14.8	66	34
Electronics, Radio Engineering, and Communication Systems	18.7	14.1	4.6	75	25
Power and heat engineering	40.2	31.8	8.5	79	21
Nuclear Power Engineering and Technology	3.4	2.9	0.5	86	14
Mechanical Engineering	53.5	37.2	16.3	69	31
Applied geology, mining, oil and gas engineering and geodesy	38.8	27.3	11.5	70	30
Land Transport Engineering and Technology	29.6	21.9	7.7	74	26
Shipbuilding and Water Transport Engineering and Technology	7.7	5.8	1.8	76	24
Other	1418.2	1051.6	366.6		

of economic activity. Today the Arctic needs competent managers and leaders, who must have scientific, technical and economic-psychological potential, engineering and economic knowledge, the qualities of a traditional manager and research scientist. There is a shortage of such very rare professions as oceanologists, specialists in permafrost and cryologists, whose absence makes it impossible to solve the urgent problems of the Arctic territories. These include deformation of buildings in permafrost conditions, disturbance of structural stability, and the consequences of climate change.

In ensuring the development of the Arctic regions, the focus is primarily on young people as the most mobile, creative, ambitious social group, ready to overcome difficulties, master new things and focused on promising career growth.

In connection with the above, let us consider the need for personnel with higher professional education in the economy of the AZ RF. As of December 2020, the Arctic employers necessity is 182.4 thousand new jobs until 2035. This is the need identified by more than 3,400 Arctic organizations that participated in the study. At the same time, over the period 2018–2020, 1,691,600 people were graduated from institutions of higher professional education, among which only about 15 % in the specialties demanded by the AZ RF. As can be noted (Table 1), on average, more than 70 % of graduates have found their place in the labor market in the specialty obtained in an educational organization of higher education.

At the same time, if we consider the unemployment rate among graduates over the past 2 years, we should note a significant increase from 5 % to 11 % of the total number of graduates

Table 2. Unemployment rate of 2018–2020 graduates of higher and secondary vocational education organizations (%)

	Graduates 2018	Graduates 2019	Graduates 2020
Total	6.1	8.4	12.7
have the level of education:			
higher	5.1	6.6	11.2
secondary vocational:			
on the program for training of specialists of the middle level	7.0	10.0	14.1
under the program for preparation of qualified workers (employees)[1)]	8.9	11.7	15.5
Urban	4.7	7.5	11.9
have a level of education:			
higher	4.5	5.8	10.9
secondary vocational:			
under the program for training of specialists of secondary level	4.6	9.4	13.4
under the program for training of qualified workers (employees)[1)]	6.3	10.8	13.8
Rural	10.5	10.9	14.8
have a level of education:			
higher	7.6	9.4	12.8
secondary vocational:			
on the program for training of specialists of the middle level	12.4	11.4	15.5
under the program for training qualified workers (employees)[1)]	13.9	13.4	18.5

[1)] Including initial vocational education

(Table 2).

Thus, there is an imbalance of information flows between the labor market represented by employer and employed young professionals on the need for a highly skilled workforce. Modern Internet platforms can be used to improve the awareness of employers and graduates. The object of such work is to stimulate interest in Arctic professions, to establish employer-employee relations, and to create up-to-date information products devoted to Arctic exploration.

The Internet resources can be considered as one of the publicly available products containing a description of the professional skills, requirements for important job qualities in the Arctic, indicators of demand, average wages, social guarantees and obligations of the state for social protection and ensuring.

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Потребность экономики российской Арктической зоны в кадрах с высшим профессиональным образованием

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Ключевые слова и фразы: востребованные специальности в условиях Крайнего Севера; высококвалифицированные кадры; занятость выпускников высших учебных заведений; рынок труда; трудоустройство по специальности подготовки.

Аннотация. Статья посвящена анализу рынка труда в Арктической зоне с целью выявления потребности в кадрах в условиях Крайнего Севера. Целью статьи является выявление потребности в высококвалифицированных кадрах и поиск пути ее удовлетворения. С этой целью рассмотрены показатели занятости выпускников высших учебных заведений по наиболее востребованным специальностям. Проведено сопоставление потребности, объема выпуска и трудоустройства выпускников. Гипотеза исследования заключается в предположении, что потребность в профессиональных кадрах не удовлетворяется поступающими на рынок труда выпускниками вузов. Основные методы исследования в статье – анализ научной литературы и статистических данных. В качестве результата проведенного исследования авторами выделяется необходимость разработки механизма организации информационных потоков между рынком труда в лице работодателей и соискателей – молодых специалистов по поводу потребности в рабочей силе высокой квалификации.

UDK 336.025

Monetary Policy of the Russian Federation in Conditions of Instability and Global Sanctions: How to Maintain Balance and Prevent a Large-Scale Crisis?

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Key words and phrases: monetary policy; global sanctions; instability; equilibrium; Central Bank of the Russian Federation; large-scale crisis; key rate; GDP; inflation; unemployment.

Abstract. Recently, the topic of sanctions has become relevant for the whole world, and especially for the Russian Federation. Sanctions now concern not only state bodies abstracting citizens from problems, but also each of us. The purpose of this work is to study the monetary policy of the Central Bank of the Russian Federation. In this regard, the following tasks are highlighted: the study of the main indicators of monetary policy, their changes over the 10 analyzed years, the analysis of the main forecast options provided by the Central Bank of the Russian Federation for various scenarios in the world market. Statistical methods, analysis of theoretical and practical aspects of the topic under study, and the method of comparison are used as analysis tools. As a result of the conducted research, the measures proposed by state bodies at the moment were studied, and additional measures were individually identified to improve the situation in the country's economy.

Currently, the domestic economy is facing unprecedented conditions and challenges of the global economic community, which cannot but affect its sustainability. That is why it is necessary to make every effort and opportunity to stabilize this situation and, in particular, to mitigate the way out of it, that is, to create a kind of "financial cushion". It is also worth noting the fact that the domestic economy has been on the verge for about eight years and exists very unpredictably. Since 2014, foreign countries have started so-called "restrictive political and economic measures", which have not had the best effect on the economy. Thus, monetary policy in the economic literature is most often defined as the policy of the central bank affecting the amount of money in circulation. According to the comments to the federal law "On the Central Bank of the Russian Federation (Bank of Russia)", monetary policy is defined as an integral part of the unified state economic policy, manifested in the impact on the amount of money in circulation in order to achieve price stability, ensure the maximum possible employment of

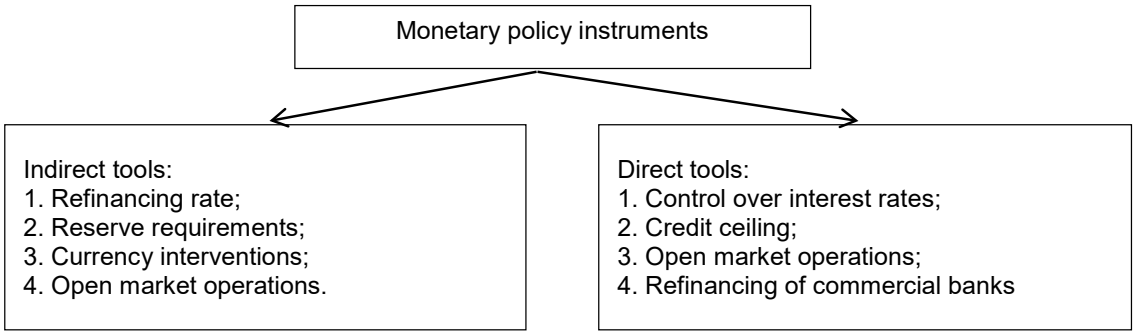

Fig. 1. Monetary policy instruments

Table 1. Problems in the Russian economy in 2022

Problems faced by the Russian economy	
Trade restrictions	Financial restrictions
Disruption of logistics routes for the supply of goods and services	Sanctions against Russian banks (Sberbank, VTB, Alfa, Gazprombank)
Restriction of import supplies from Russia to other countries (the metallurgical industry, gold mining companies, diamond mining suffered the most)	Prohibition and sharp restriction of the possibility of using VISA and Mastercard payment systems by citizens and legal entities of the Russian Federation
Parallel ban on the export of many important goods and products from the EU and the USA (most of them are aviation industry goods, high-tech goods)	Restriction of the SWIFT system translation. SWIFT is an international money transfer system that allows you to transfer money between banks in different countries
The departure of a large number of foreign companies providing a decent level of employment from the market (as a rule, clothing stores, and even corporations serving government orders)	Blocking of foreign shares held in foreign depositories of the National Settlement Depository (**NSD**)

the population, as well as the growth of real production [1, p. 5]. Monetary policy is a very important and necessary tool that is developed, developed, improved and used by any state in the world. Of course, the more developed and stable a country's economy is, the more effective and significant influence this economic category has. It is worth highlighting the goals pursued by monetary policy. The objectives of monetary policy are:

– control over prices in the country, here, this goal is rather manifested in the fact that the Central Bank, implementing monetary policy, is trying to use special tools to stabilize the growth of prices for goods and services, or to make them grow at an insignificant and imperceptible pace for the population;

– national production should grow, and this is a fact, but there are crisis and difficult periods, as, for example, now, when without support and regulation, no growth should be expected;

– from the previous goal we considered, we can easily and clearly distinguish another, namely, that human capital is the basis on which the national economy of any country should be built and maintained.

In addition to goals and objectives, monetary policy has its own specific tools, thanks to which the process of implementing the former is realized.

As a result of the material presented, the question automatically arises: do the goals, tasks and tools that were outlined above somehow change under the influence of external factors?

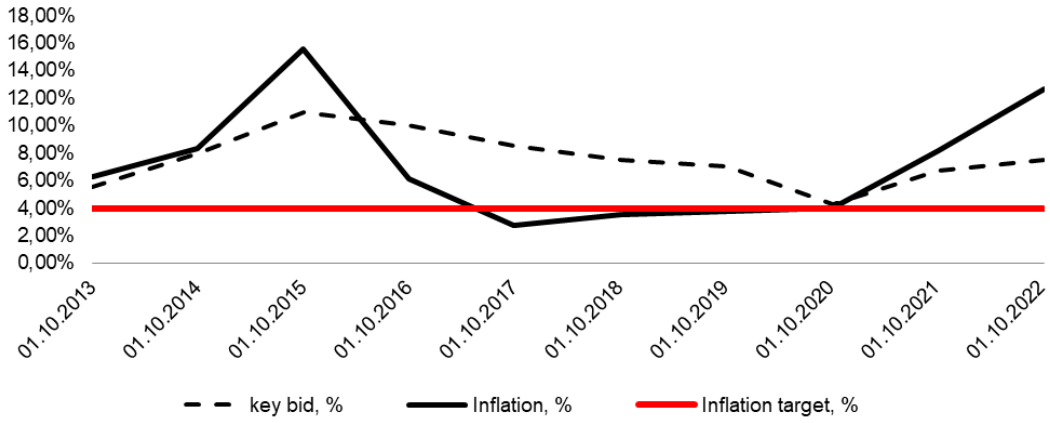

Fig. 2. Dynamics of key rate indicators, inflation and inflation targets from 2013–2022, %

Obviously, the answer will be positive. The introduction of anti-Russian sanctions undoubtedly had a significant impact on the policy of the Central Bank of the Russian Federation and the stability of the national banking system. The imposed sanctions have become a kind of indicator that showed that there are a number of internal problems within the banking system that have worsened under unfavorable conditions of the surrounding financial and credit environment [2]. The problems faced by the domestic economy can be summarized in Table 1 below.

As mentioned above, monetary policy is a set of measures carried out by the Central Bank of Russia. And, of course, any set of actions is aimed at any specific indicators that are important for regulation. So, in this area, the following are distinguished: money supply; volume of loans; the level of inflation in the country; the key rate of the Bank of Russia. The Central Bank of the Russian Federation pays special attention to the percentage of inflation, since this indicator is the key one in determining other indicators of the positive state of the economy. Of course, it remains clear that the main indicators of monetary policy are the key rate and the inflation rate. This is understandable, because these two factors are interrelated, that is, one of them is always directly dependent on the other. The Bank of Russia maintains inflation near the target level of 4 %. This policy is called inflation targeting. The main instrument of monetary policy is the key rate. The key rate is the percentage at which the central bank issues loans to commercial banks and accepts money from them for deposits. A change in the key rate affects demand through rates in the economy and ultimately inflation [3].

To regulate monetary policy, the Central Bank of the Russian Federation periodically issues methodological guidelines in which it provides an analysis of the main policy indicators, as well as suggests a number of measures that could be aimed at stabilizing the economy. In 2022, a document entitled “The main directions of the unified state monetary policy for 2023 and the period 2024 and 2025” was issued. In the material presented, two scenario variants of the macroeconomic forecast of the Bank of Russia were put forward: basic and alternative.

In the baseline scenario, the global economy continues to develop within the framework of previously formed trends. Supply shocks caused by COVID-19 will continue to gradually weaken. The baseline scenario does not imply a significant change in the current configuration of geopolitical conditions until the end of the forecast horizon (Table 2).

Let us move directly to alternative scenarios that are necessary for the force majeure development of the situation in the international arena. We start with the “accelerated adaptation” scenario. This scenario, despite the fact that it is an alternative, assumes that the economy will

Table 2. The main components of the “basic forecast” of monetary policy

Baseline scenario forecasts	Description of the forecast
Balance of payments forecast	By the analyzed 2025, the surplus inherent in the current account at the moment will be reduced by 94 %. At the same time, the balance of goods and services will decrease by 80 % compared to 2022
Forecast of the main macroeconomic indicators	1. According to the results of 2022, the final consumption of households will be reduced by 5.5 %. In 2024, the growth rate of household spending on final consumption will accelerate to 2–3 % and in 2025 will continue to grow at a similar pace. 2. Gross fixed capital accumulation will decrease: – in 2022 by 3.5–7.5 %; – in 2024 by 4.5–0.5 %; – in 2024–2025, the growth rate of the VNOK will grow at a rate of 1.5–3.5 %. 3. Export: – in 2022 it will fall by 13–17 %; – in 2024, the basic forecast assumes near-zero dynamics; – in 2025, a small increase is possible, up to 2 %. 4. Import: – it is planned that in 2022 imports will decrease by 29.5–31.5 %; – for 2023, there will be a slow rate of decline, even a positive option is possible, in which imports can increase, accelerate the growth rate by 2.5–4.5 %; – and already in 2025, import growth will return to the pace corresponding to the potential growth of the Russian economy
Forecast of monetary indicators	1. The growth rate of the banking system's requirements to the population will be in the range of 5–10 %. 2. Mortgage lending, according to the forecast, will increase by an average of 18–20 %. This will happen under the influence of the possibility of preferential lending. 3. In 2023–2024, the lending rates will increase and amount to: – for legal entities – 8–13 %; – for the population – 9–14 %

develop in a more optimistic way, thereby giving positive results for our country. This scenario is based on a more sustainable development of demand within the country, as well as on the fact that the domestic economy will have partners who will be able to support it in instability and crisis. A separate role is assigned to parallel import, which will avoid shock situations.

There is another alternative scenario, which is called the “global crisis”. This is the most pessimistic scenario. In this situation, the picture will be as follows: the world economy will increasingly move to regional sales markets, ties between countries will become weaker and weaker. The global economy will slow down sharply, which will have a disinflationary effect on the overall rate of price growth. Prices on world commodity markets will decrease under the influence of lower demand. The growth rate of lending to the economy in this scenario in 2023 will not exceed 5 %, gradually increasing in the future. For the Russian economy, the realization of the global crisis simultaneously with the deterioration of the geopolitical background will significantly complicate structural adjustment and adaptation to new conditions. The output in 2023 will decrease even more than in 2022. In 2024, the decline will continue, and only in 2025, growth is possible – no more than 1 %.

Many experts agree that the crisis cannot be avoided, and it will match what was in our country in 2008–2009. That is why there are a number of activities that require a lot of effort, as well as a significant time interval. So, how to prevent a crisis and maintain balance?

1. Monetary policy alone is not capable of saving the situation. It is important to combine it with other measures and tactics of government agencies. It is also necessary to solve problems promptly in order to prevent their ossification.

2. It is important to maintain the stability of the banking system as the main regulator of monetary policy. It is wrong and reckless to put all the burden of hard time on the banking system, that's what many experts believe. It is impossible to solve all problems only through measures aimed at low interest rates and preferential lending. These problems should be dealt with by the State, which has every opportunity to implement this process. Otherwise, the banking system itself will fall into a crisis state.

3. Commercial banks, which form the basis for the financial sector of the economy, are of particular importance for monetary policy. That is why the Central Bank of the Russian Federation is taking important measures and actions that can stabilize the situation. In connection with the introduction of sanctions, many credit organizations were blacklisted, and this situation gave impetus to the development of small credit organizations that were not affected by the sanctions barriers. Here, the Central Bank of the Russian Federation has taken an important measure that should be supported in order to prevent the collapse of the banking system, namely, the Central Bank has reduced the rate of mandatory reserves – 2 % for many operations. This measure will reduce the total amount of mandatory reserves by about 2.7 trillion rubles.

4. Unemployment is something that our country will face one hundred percent and it is necessary to act radically and decisively here. There is a so-called minimum wage (minimum wage), and it should be increased. That's what many experts think. Prices are rising, the expenses of the population, respectively, too, which means it is necessary to "adjust" the salary to modern realities. In this area, experts also suggest resorting to pension reform and giving women the opportunity to retire at 55, men at 60.

5. It is no secret that the domestic economy has a pronounced raw material profile. That is why a long-standing important step is the construction and development of an industry in which the sphere of processing technologies and the service sector will prevail. The credit sector is an important support for business development. It is necessary to develop strategies to support these industries. Perhaps it is worth issuing loans at almost zero rates in order to subsequently get a response for the development of the entire economic system.

Summing up, it is noteworthy that monetary policy is the layer on which the entire domestic economy is now guided and based. It is important not only to monitor the situation that is developing in the world, but also in our country. In addition to this, it is necessary to take measures, but not just those that would be a "curtain", but also those that would really regulate the situation and act systematically and comprehensively. Of course, sanctions are currently a fairly effective tool capable of resolving conflicts without wars and human casualties. But, of course, they deal an incorrigible blow to the development of countries, thereby violating international cooperation.

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Денежно-кредитная политика РФ в условиях нестабильности и мировых санкций: как сохранить равновесие и не допустить масштабного кризиса

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Ключевые слова и фразы: безработица; ВВП; денежно-кредитная политика; инфляция; ключевая ставка; масштабный кризис; мировые санкции; монетарная политика; нестабильность; равновесие; ЦБ РФ.

Аннотация. В последнее время тема санкций является актуальной для всего мирового пространства, в особенности для нашей страны. Санкции сейчас касаются не только государственных органов, абстрагирующих граждан от проблем, но и каждого из нас. Целью данной работы является изучение денежно-кредитной политики Центрального Банка Российской Федерации (**ЦБ РФ**). В этой связи выделены следующие задачи: изучение основных показателей денежно-кредитной политики, их изменений за 10 анализируемых лет, анализ основных прогнозных вариантов, предусмотренных ЦБ РФ для различных версий развития событий на мировом рынке. В качестве инструментов анализа используются методы статистики, анализа теоретических и практических аспектов изучаемой темы, метод сравнения. В результате проведенных исследований были изучены те меры, которые предлагают государственные органы на данный момент, а также индивидуально были выделены дополнительные мероприятия по улучшению ситуации для экономики нашей страны.

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Alarming Indicators of Financial Statements in Management Accounting

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Key words and phrases: analysis of financial statements; management economics; management accounting; manipulations in reporting.

Abstract. The article is devoted to the study of manipulations with financial reporting in management practice. The purpose of the article is to identify the most common types of financial manipulation and identify markers indicating these actions. The hypothesis of the study is that the actual financial statements do not always indicate the problems in the company and it is necessary to additionally pay attention to a number of indicators that are indicators of trouble in the company. The main research methods in the article are the analysis of scientific and business literature and statistical data. As a result of the study, the authors identify a number of markers that can signal financial manipulation in the company, as a result of which it is possible to reduce financial risks.

Consumers of financial statements are creditors, authorities, investors and owners. The purpose of manipulations with reporting for creditors and government agencies, first of all, is to comply with covenants and reduce the tax burden. The Financial Director of the group of companies represents the interests of investors /owners of subsidiaries, therefore, the reliability of the statements is necessary to understand the current financial condition. The KPI system, usually used in assessing the effectiveness of the management of subsidiaries, is also based on the results of financial and economic activities reflected in the financial statements.

In management practice, there is often a gap between economic theory and actual processes [3, p. 147]. In particular, manipulations in accounting statements, incorrect reports of sales and procurement managers, data manipulation committed by a variety of stakeholders in the company can be observed. In this article, we will not touch on the facts of direct fraud. We will talk about those manipulations, the purpose of which is the desire of employees to embellish the picture, hide the shortcomings of the unit, increase KPIs, and absolve themselves of responsibility for incompetent actions. Such actions will be indicated to the manager by a number of economic markers that are likely to signal trouble in the company. In our work we rely on the following theses.

– There can be many ways of manipulation: from harmless to outright fraud. To create any classification means to limit yourself to a detailed analysis.

– The financial statements themselves do not indicate possible manipulations. During the express analysis, individual markers are marked, which are worth paying attention to for detailed work (examples of the main markers are presented below).

– The auditor's report reduces the number of manipulations with reporting, but does not exclude their presence within the accounting policy of the group.

When analyzing financial statements, it is necessary to rely on the tasks and goals set for subsidiaries [2]. Let's consider the most popular types of financial manipulation. Despite their wide range, the following species are most common.

1. Overstatement of the revenue part in the reporting period.

In order to achieve high financial performance, fictitious transactions are concluded for the provision of services or the shipment of goods. To increase the revenue side, intra-group transactions or transactions with friendly companies may be made, services for which were not actually provided. Often, for such transactions, documents are provided with a delay in the last place before the submission of accounting statements. It is possible to note transactions related to the shipment of goods, confirmed by primary documentation, but in fact the goods remain in the seller's warehouse. This transaction is not illegal, but the seller bears overhead costs for ensuring the safety of the goods transferred by the buyer for storage.

2. Incorrect reflection of obligations and expenses.

In fact, expenses may be underestimated purposefully in order to obtain a more acceptable financial result of the activity, for example, non-recognition of expenses in the reporting period and their attribution to later periods. We often encounter this problem in construction organizations when the work performed by the contractor was presented to the customer, but at the same time the costs associated with their performance (subcontractors' services) were attributed to later periods. As a rule, this is not a violation, but it misleads about the cost of work performed and distorts further financial planning. The purpose of incorrect reflection of obligations and expenses may be their overstatement for the sake of tax optimization, fictitious expenses (including to increase the revenue of a friendly company and withdraw funds), control of bankruptcy proceedings.

3. Incorrect reflection of the value of assets.

These manipulations are associated with an overestimation of the initial value of assets or delayed depreciation in order to achieve acceptable performance indicators of financial and economic activities [4, p. 140]. Undervaluation of assets is carried out to speed up the procedure for writing off and selling more expensive assets below market value.

What should we pay attention to when analyzing financial statements? Changes without objective reasons in such balance sheet indicators as: revenue, accounts receivable/ payable, inventories, current assets. The absence of objective reasons is understood as a disproportionate increase in these indicators in comparison with changes in prices for final products and production volume. A striking indicator is the sharp change in operating profitability and the net revenue ratio. When analyzing, it is important to track the dynamics of values for several comparable reporting periods.

Multidirectional movement of values between operating profit and operating cash flow. It is also important to pay attention to the gap between operating profit and operating cash flow, which is atypical for the industry in which the company operates. This gap may indicate that revenue is generated by fictitious transactions and is not confirmed by cash flow. Such transactions can be carried out to improve financial performance when preparing reports for owners or applying to credit institutions.

Accounts receivable overdue for more than 30 days or debt without movement. For each

industry, the repayment periods are different. For example, in construction, such a period is on average 60–90 days. However, in practice, you may encounter debt that has been without movement for more than a year. Collecting it is often either useless, or leads to large legal costs, or to the formation of reserves. Thus, the company loses both the debt itself and the cost of the diverted funds. The task of the CFO on a regular basis (at least once a week) should include monitoring the accounts receivable of the entire group for the presence of such anomalies.

Changes in inventory turnover and accounts receivable. First of all, the growth of these indicators should pay attention to itself. For example, a company purchases materials that are not involved in production and are "gathering dust" in a warehouse. As a result, current assets are growing, but they do not affect revenue and operating cash flow. In fact, the company withdraws funds from circulation without receiving a return. However, each case should be considered separately. Depending on the market conditions, the company may increase inventories to hedge the risks of price increases (including seasonal) or potential shortages. A striking example is the sharp growth of rolled metal and rebar in the second half of 2020. Against the background of rising prices and limited demand, many companies paid for materials in advance to fix the price (increase in accounts receivable) or filled warehouses (increase in stocks), a sharp increase in inventories also occurred after the introduction of economic sanctions caused by the beginning of a military special operation [1, p. 157; 5, p. 22; 6, p. 28]. This action made it possible to reduce the risks of their appreciation by 30–50 %, but the turnover period has increased significantly.

Intra-group settlements between subsidiaries affect their financial performance. Often, with such paper calculations, subsidiaries increase their financial results in order to fulfill or exceed the goals set by the owners. The formation of consolidated financial statements with the exception of intra-group calculations allows you to take a more objective look at the picture. But it is always necessary to pay attention also to settlements with friendly companies. To do this, the analysis of the traditional counterparties of subsidiaries is carried out and the dynamics of settlements with them is monitored, the contractual relations should be checked periodically and the analysis of the services/works performed should be carried out.

Thus, knowing about certain types of manipulation of financial statements can reduce possible risks. New manipulations and mechanisms for their detection are detected regularly, so there are no proven universal tools for all industries. It is possible to apply unscheduled inspections and monitoring of certain indicators of the company's activity, analysis of interim results and tracking of accounts receivable and accounts payable in real time. It is also advisable to keep records of stocks and fixed assets with the identification of persons responsible for this (not from among the employees of the financial unit and accounting department) and pay special attention to the annual revaluation of the company's assets.

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Тревожные показатели финансовой отчетности в управленческом учете

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Ключевые слова и фразы: анализ финансовой отчетности; манипуляции в отчетности; управленческая экономика; управленческий учет.

Аннотация. Статья посвящена исследованию манипуляций с финансовой отчетностью в управленческой практике. Целью статьи является выявление наиболее распространенных видов финансовых манипуляций и определение маркеров, указывающих на эти действия. Гипотеза исследования заключается в предположении, что собственно финансовая отчетность не всегда указывает на имеющиеся в компании проблемы и необходимо дополнительно обращать внимание на ряд показателей, которые являются индикаторами неблагополучия в компании. Основные методы исследования в статье – анализ научной и бизнес-литературы, статистических данных. В качестве результата проведенного исследования авторами выделяется ряд маркеров, которые могут сигнализировать о финансовых манипуляциях в компании, в результате чего возможно снизить финансовые риски.

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Surveys of the Historic Building in Khabarovsk

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Key words and phrases: architecture; historical value; historic building; cultural heritage; city appearance; monument; building plan.

Abstract. The article presents data on the survey of a historical building in Khabarovsk erected in 1910, as well as an assessment of the technical condition of the building. Historical buildings need regular repairs, restoration, strengthening and restoration. The purpose of the study is to identify the relative importance of each building, to rank the value properties according to their significance. The objectives of the study are to determine their priority in relation to the integral criterion of value for the city and this work must be carried out with the participation of many services. The hypothesis of the study is to substantiate the decision to include the object in the list of identified objects of cultural heritage, and subsequently – in the state register of objects of cultural heritage. As a result, the types of constructive solutions of their device are revealed. The value of the truss system and its significance for the preservation of cultural heritage are indicated.

Historic monuments, historic buildings, and historic centers are the cultural heritage of Russia, which displays the history of the country. Currently, it is difficult to find a city in which there would be no historical buildings or architectural monuments. The surveyed buildings are really valuable, but over time, any building becomes susceptible to destruction and begins to disrupt the appearance of the city. Most of these buildings are located in the central part of the city, and the problem of their effective use is becoming more urgent every year.

The survey of historic buildings and architectural monuments allows to solve the problem in each specific case. This is a necessary procedure that is required by developers seeking to refine the appearance of the settlement, to make it more comfortable. The survey of architectural monuments is a check of the technical condition of such buildings using the most sparing and non-destructive methods. In each specific case, during the inspection of the object, after studying the design, historical, archival documentation, an individual work plan necessary for a targeted expert opinion is developed.

A comprehensive survey of a monument is defined as a complex of scientific research and research work carried out before and during repair, conservation, restoration in order to comprehensively study the object of cultural heritage, to obtain information necessary for the

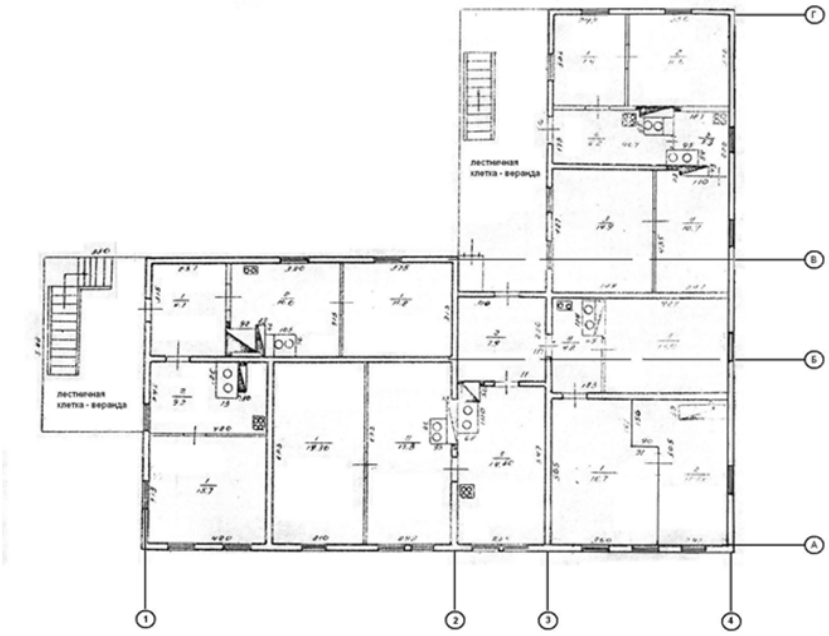

Fig. 1. Building plan with the applied coordinate axes

development and justification of design solutions.

This article discusses the surveys conducted by the author of the historic building in Khabarovsk. The building is located in the central historical part of Khabarovsk. The exact date of construction of the building is unknown, approximately the period of construction falls on the 1910s. The building was built by Khabarovsk landlord K.T. Likhoydov. The building on the lane. Dyachenko, accepted for state protection as a monument of history and culture of local (regional) significance according to the decision of the Small Council of People's Deputies of the Khabarovsk Territory No. 172 of 03/20/1993. The building is a two-storey wooden, frameless structural system, with longitudinal load-bearing walls, two-span, has an L-shaped shape in plan. The long side of the building faces the red line of the building lane . Dyachenko. The building has two stairwells, one is built in from the courtyard, the other is attached from Shevchenko Street. There is no design documentation for the building. For familiarization, the customer provided inventory plans of the building. The materials of previous surveys of the building were also studied by specialists of the State Unitary Enterprise Khabarovsk Citizens-Project and the NPC for the Protection and use of historical and Cultural monuments of the Khabarovsk Territory.

For the convenience of work, the building's coordination axes were assigned (the building plan is shown in Fig. 1).

It should be noted that in comparison with the presented plans, the building has undergone some changes at the moment.

Firstly, previously the basement housed living quarters – two apartments with separate entrances from Arsenyev Lane. At the moment, the basement is not used for living, it is almost impossible to detect traces of the existence of windows in the basement premises, since the ground level today is much higher than during the period of inventory plans.

Secondly, the space-planning solution of the stairwell located in the central part of the building has been changed. Previously, the staircase was located inside the building under the roof, now the staircase leading to the second floor is located outside. Now on the place of the staircase there are utility rooms. The basement in the building is made of clay brick, plastered

Fig. 2. Condition of the basement part of the walls

Fig. 3. Exterior of the building

from the outside. In general, the condition of the basement part of the walls can be described as emergency.

The main part of the walls (above the base) is wooden, made of timber, 250 mm thick. The exterior walls are sheathed with a board (board) and painted. The interior walls are

Fig. 4. The state of decorative platbands

Fig. 5. Exterior of the building

plastered with shingles. A wooden carved valance runs along the bottom of the crowning cornice. The window frames are also carved with figured wooden lambrequins in the upper part of the openings.

In addition, in one area there is a peeling of the cladding due to deformations of the bearing

Fig. 6. The condition of the floor beams

part of the wall. The window openings on the facade have deformed and have the shape of a parallelogram. Decorative platbands have been preserved only on one window.

The window openings are deformed due to the subsidence of the right side of the wall. On the first window on the right of the first floor, decorative platbands are partially missing.

The condition of the wood on the part accessible for inspection can be characterized as limited operable (unsatisfactory), there is blackening of the wood, its damage by rot, Part of the wall is upholstered with roofing material from the outside, which accelerates the process of its rotting. Decorative platbands are present on the window opening of the first floor.

The verandah wall along the axis is subject to deformations of frost heaving due to the fact that most of the verandah is unheated, and therefore the depth of the foundation is 1.8 m. in this case, it is insufficient to prevent heaving.

The wall is also subject to frost heaving deformations, especially its right side (from Shevchenko Street). Here, the reason for the deformations is the insufficient depth of the foundation (the low height of the basement of this part of the building). Also on the surface of the wall and cornices there are traces of prolonged locking, peeling of the paint coating. Window openings are slightly deformed, decorative platbands have been preserved on all window openings.

The wall is mostly internal because of the attached veranda. There is no planking on the outer part.

The internal load-bearing walls are also cobblestone, 250 mm thick. Cracks and destruction of the plaster layer are observed on many parts of the internal walls. Everywhere on the facades of the building there is a peeling of the paint layer, in some places its complete absence. Many decorative platbands have been lost, the preserved platbands and lambrequins are in poor condition.

In general, the condition of the load-bearing wooden walls of the building can be characterized as unacceptable, and the outer wall as an emergency.

Fig. 7. Attic floor

The ceilings in the building are wooden beams. The opening of the floors was not carried out, since the consent of the residents for this event was not obtained. In this area, a significant deviation from the horizontal plane of the floor beams is noticeable with the naked eye. This deviation is also observed from the attic space.

Measurements made in the attic showed that the maximum displacement (visually perceived as a deflection of the attic floor) is 450 mm. According to the materials of previous surveys, these deformations were 400 mm, which gives indirect grounds to assume that the deformations of the building continue.

The attic floor in the building is insulated with slag. The thickness of the insulation layer is so unstable that it is impossible to accurately determine it, in some places the insulation is completely absent. Moreover, there are through holes in the attic floor.

In general, the condition of the overlaps can be characterized as unacceptable. The standard service life of wooden beams has been significantly exceeded.

The roof in the building is pitched with hips. The crate is made of bars. The roof is made of painted roofing steel.

The condition of the cobblestone elements of the rafter system is generally operable, however, not all nodes were inspected due to their inaccessibility, especially the nodes of the connections of the rafter elements with mauerlats.

The condition of the roof is unsatisfactory, there are traces of drips on the crate and rafters. The outer paint layer of the roof is practically absent, there is a continuous corrosion of the roofing steel.

Drainage from the roof is organized externally. The water intake funnels of the downpipes have recently been replaced.

Based on the visual inspection of the building, the study of technical documentation, materials of previous surveys, the following conclusions can be drawn.

1. As a result of both waterlogging of the foundation soils and insufficient adhesion strength

Fig. 8. Condition of the paving elements of the truss system

of the rubble masonry mortar of the foundations, the protruding part sagged, all this led to:

– subsidence and loss of bearing capacity (stability) of the wall;

– the destruction of the brick plinth, largely weakened due to the fact that as a result of cultural layers, it turned out to be at ground level (and partially below), was subjected to intense moisture and variable freezing thawing;

– deformations of window and door openings in the walls;

– deformation of the floors above the basement and attic.

The reasons for the waterlogging of the foundation soils, apparently, are long-term leaks from the roof. However, with such an arrangement of the building for such a long period of operation of the building, flooding by stormwater or man-made waters could take place.

2. Briefly describe the condition of structural elements as follows:

a) foundations – partial loss of bearing capacity;

b) the basement part of the load-bearing walls – partial loss of load-bearing capacity;

c) wooden load-bearing walls above the base – the complete exhaustion of the operational resource of the material;

d) floor beams – complete exhaustion of the operational resource of the material;

e) elements of the rafters – working condition;

f) roof – 80 % exhaustion of the operational resource of the material.

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Обследование исторического здания в г. Хабаровске

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Ключевые слова и фразы: архитектура; историческая ценность; историческое здание; культурное наследие; облик города; памятник; план здания.

Аннотация. В статье приведены данные по обследованию в г. Хабаровске исторического здания, возведенного в 1910 г., а также приведена оценка технического состояния этого здания. Исторические здания нуждаются в регулярном ремонте, восстановлении, укреплении и реставрации. Цель исследования заключается в выявлении относительной значимости каждого здания, ранжировании ценностных свойств по их значимости. Задачи исследования состоят в определении приоритетности ценностных свойств по отношению к интегральному критерию ценности для города, эту работу необходимо проводить при участии многих служб. Гипотеза исследования состоит в обосновании решения о включении объекта в перечень выявленных объектов культурного наследия, а в последствии – в государственный реестр объектов культурного наследия.

В результате приведенного в статье обследования выявлены типы конструктивных решений исторического здания. Обозначены ценность стропильной системы и ее значимость для сохранения культурного наследия.

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