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CONTENTS

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ENHANCING THE STATIC AND DYNAMIC PERFORMANCE OF HIGH-SPEED SPINDLE SYSTEMS IN TURNING OPERATIONS THROUGH FINITE ELEMENT ANALYSIS AND CAD MODEL OPTIMIZATION

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Annotatsiya. Ushbu maqola yuqori tezlikda ishlaydigan tokarlik dastgohlari shpindel uzellari tizimining xususiyatlarini o‘rganish uchun yondashuvni taqdim etadi. Ishlov beriladigan detallarning aniqligi sezilarli darajada butun ishlov berish tizimining ishlashiga bog‘liq. Tadqiqot yuqori tezlikda va yuqori samarali kesish uchun mo‘ljallangan to‘g‘ridan-to‘g‘ri boshqariladigan shpindel birliklariga qaratilgan. Maqolada tokarlik dastgohining shpindelining statik xarakteristikalari tahlil qilinadi va bunday murakkab tizimlar uchun CAD modeliga kiritilgan yaxshilanishlar muhokama qilinadi.

Kalit so‘zlar: *Yuqori tezlikli shpindel tizimi, SAPR modelini takomillashtirish, rulman tizimi, strukturaviy qattiqlik, chekli elementlar usuli (FEM), dinamik xususiyatlar, termal xarakteristikalar, strukturaviy deformatsiyalar, ekvivalent stresslar.*

Аннотация. В данной статье представлен метод исследования характеристик системы шпинделя высокоскоростного токарного оборудования. Точность изготовления высокоточных деталей в значительной степени зависит от работы всей системы обработки, особенно от поведения шпинделя. Особое внимание уделено шпинделям с прямым приводом, предназначенным для высокоскоростной и высокопроизводительной обработки. В работе проведен анализ статических характеристик токарного шпинделя и описаны улучшения в CAD-моделировании для таких сложных систем.

Ключевые слова: *Высокоскоростная шпиндельная система, усовершенствование модели САПР, подшипниковая система, жесткость*

конструкции, метод конечных элементов (FEM), динамические характеристики, тепловые характеристики, деформации конструкции, эквивалентные напряжения.

Abstract. This paper presents an approach to examine the features of a high-speed spindle system used in turning operations. The precision of machined parts depends significantly on the performance of the entire machining system, particularly influenced by the behavior of the main spindle. The study focuses on direct-driven spindle units designed for high-speed and high-performance cutting. The paper analyzes the static characteristics of a turning machine spindle and discusses enhancements made to the CAD model for such complex systems.

Keywords: *High-speed spindle system, CAD model enhancement, bearing system, structural stiffness, Finite Element Method (FEM), dynamic performance, thermal performance, structural deformations, equivalent stresses.*

Introduction

The Finite Element Method (FEM) is crucial in engineering for analyzing both static and dynamic processes, especially when designing spindle-bearing systems. This paper specifically focuses on studying how the main spindle and its bearings behave under static conditions using FEM. High-speed machining offers significant advantages like faster production, smoother surface finishes, and less heat distortion in the workpiece. However, it also introduces challenges such as vibrations and potential spindle failures due to aggressive cutting speeds. To manage these risks, machine tools need to be extremely rigid, stable, and reliable.

Among all parts of a machine tool, the spindle system is the most critical because its performance directly affects cutting precision. Elastic deformations in the structure play a key role in this precision. This study takes a novel approach by modeling how the spindle deforms between its bearings and housing, which differs from simpler models that treat bearings as basic springs. In this research, advanced 3D models were used to simulate different bearing systems. These simulations were crucial for understanding how bearings interact under real-world conditions. The study's findings were compared with experimental data from technical literature to validate the accuracy of their mathematical model [1].

Overall, this approach not only enhances our understanding of spindle system dynamics but also contributes to improving the reliability and performance of high-speed machining processes.

The spindle headstock is critical for achieving the necessary precision and productivity in machine tools. Radial ball bearings with angular contact are commonly used in such setups. Analyzing the complex spindle-housing system is challenging due to its intricacies [2, 3]. The primary aim of theoretical research is to understand how the headstock performs under operational loads, particularly from equivalent cutting forces. To better assess the spindle-bearing system, a simplified assembly is proposed initially, excluding the contribution of the spindle housing. In this simplified model, the spindle housing is assumed rigid. A more comprehensive assembly, incorporating the spindle housing, will be detailed in future publications [4, 6].

Research Methodology

The research method used in the study likely involved a combination of experimental analysis and computer-aided design (CAD) simulations. The experimental analysis may have included measuring the static characteristics of the turning machine spindle, such as its stiffness, damping, and natural frequencies. Additionally, CAD simulations would have been used to model and analyze the behavior of direct-driven spindle units under high-speed and high-performance cutting conditions. The enhancements made to the CAD model for complex systems could involve modifications to accurately represent the dynamic behavior of the spindle during turning operations.

Overall, it is likely that this research employed a combination of empirical measurements and computational modeling techniques to comprehensively analyze the features of a high-speed spindle system used in turning operations.

Analysis and Results

Figure 1 illustrates the initial conceptual model of a pulley-driven spindle system designed for turning operations. In this configuration, the spindle is driven by a Poly-V belt transmission. The belt pulley is mounted directly on the spindle and subjected to the corresponding tensile belt reaction forces and torque.

In engineering, while spindle fatigue fractures leading to machine failure are rare, the deformation of the spindle significantly affects machine accuracy. Achieving an optimal design is crucial for developing a spindle system with high stiffness.

In the model presented, the spindle system was analyzed under a load equivalent to cutting forces typical for hard turning: F_x = 20000 N, F_y = 10000 N, and F_z = 30000 N, along with a tensile force in the belt transmission F_{tc} = 20000 N in the (-Z) direction. Finite Element Method (FEM) calculations provided insights into spindle deformations and stress distribution within the model.

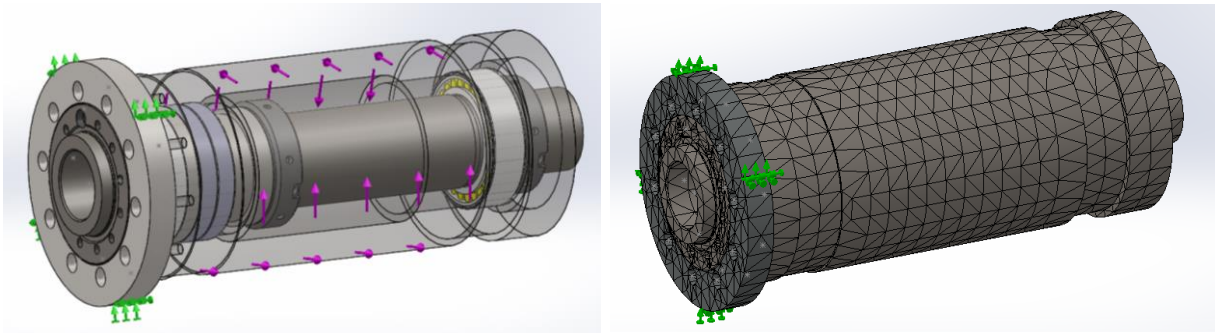

Figure 1. Preliminary analysis model.

The static design of the turning machine spindle unit primarily revolves around its static stiffness, often referred to as spindle stiffness. Spindle stiffness is crucial for assessing load capacity, a key performance indicator for belt-driven spindles. This stiffness encompasses both axial and bending characteristics, with bending stiffness being particularly critical under normal operating conditions.

The largest observed deflection measures 26.8 microns at the rear end of the spindle where the belt pulley applies force on its narrowest section. This deformation suggests potential vibrations at high spindle speeds. Conversely, at the spindle tip, deflection is minimal at only 8 microns, indicating robust bearing stiffness. High stiffness in the bearings is attributed to effective pre-stress application in their design, enhancing

component performance. However, conclusive findings await dynamic and thermal analyses. While increased bearing pre-stress improves stiffness, it also elevates friction between ball and bearing rings, leading to higher operational temperatures. These complexities underline the challenges in optimizing spindle performance and reliability.

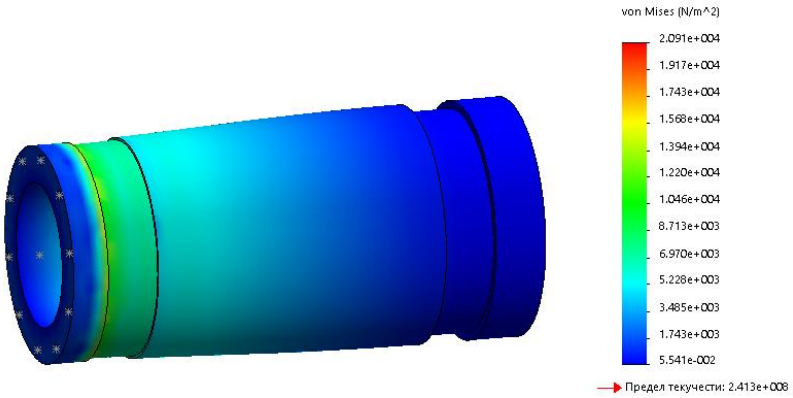

Figure 2. The structural deformations observed in the analysis.

The equivalent stresses, evaluated using the Von Mises criterion, are depicted in Figure 3, with the maximum value recorded at 96.8 MPa. This value remains below the permissible stress limit of the material used, indicating that all components can withstand the applied loading conditions effectively.

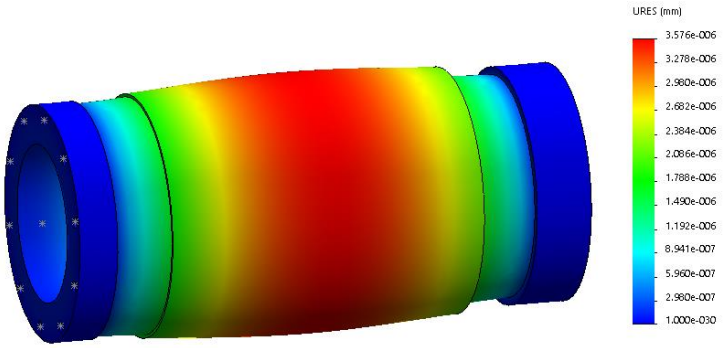

Figure 3. Equivalent stress distribution.

Based on the static analysis of the model presented, the initial conclusion highlights insufficient stiffness at the rear end of the shaft. These findings have prompted the next phase of the design process, where a revised model has been proposed to enhance the static behavior of the project.

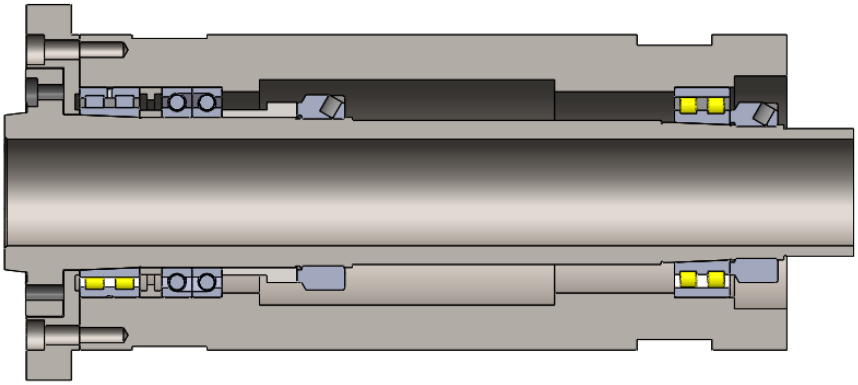

Figure 4. Used spindle model.

The new model, aimed at reducing deformation around the belt pulley region, is depicted in Figure 4. In this updated design, the belt pulley no longer directly supports the shaft but instead rotates freely on two type 7924A5 bearings fixed to the spindle housing. This configuration ensures that the pulley only transmits torque from the motor to the shaft without bending it.

Ceramic ball bearings are increasingly favored for high-speed spindles in machine tool production. These materials offer exceptional wear resistance, operate effectively across a wide temperature range, and exhibit high resistance to harsh environments.

In the subsequent phase of the analysis, the same model described previously was re-evaluated, this time incorporating ceramic ball bearings of identical dimensions to those with steel balls.

Under identical loading conditions as in previous analyses, the maximum deformation calculated using ceramic ball bearings is 11.8 microns, with a maximum stress value of 26 MPa. In conclusion, while ceramic ball bearings do not enhance the static behavior of the assembly, they offer significant improvements in dynamic and thermal performance. Ceramic bearings provide additional benefits such as reduced lubrication needs, enhanced reliability, lower energy consumption, reduced noise and vibration, and the capability to operate at higher speeds (at least 25% faster). These advantages make ceramic ball bearings a compelling choice for applications where dynamic performance and efficiency are critical factors.

Conclusions

The Finite Element Method (FEM) serves as a robust tool for static analysis of complex structures. The static analysis of the spindle system has provided crucial insights to enhance its assembly behavior. This paper aims to establish a comprehensive method for simulating the behavior of spindle-bearing systems, enabling designers to optimize machine tool designs before physical manufacturing.

The developed model allows prediction of bearing stiffness, contact forces on bearing balls, spindle deflection and its impact on accuracy, as well as material strength, among other factors. This paper specifically focused on static analysis, with ongoing research planned for dynamic and thermal analyses in subsequent publications.

Future studies will include modal and harmonic analyses to determine natural frequencies, frequency response functions, and time history responses under impact and cutting forces, considering preload conditions. Additionally, factors like rotary inertia and gyroscopic moments will be incorporated, which are crucial for high-speed spindle performance.

The finite element modeling method applied to the turning spindle system has demonstrated very high spindle stiffness using the proposed methodology. This study will be further developed in future research to provide a comprehensive analysis of spindle behavior.

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DETERMINATION OF THE LAW OF MOTION OF THE THREAD UNDER THE INFLUENCE OF DYNAMIC FORCES IN THE TECHNOLOGICAL PROCESS

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Annotatsiya. To‘qima hosil bo‘lish jarayonida harakatga qarshilik ko‘rsatish faktorlarini sifat va miqdor jihatdan bilish mahsulot sifatini yaxshilashga qo‘yiladigan talablardan biridir. Shu maqsadda ip harakatiga ta’sir qilayotgan kuchlarga mos keladigan adekvat matematik modellar qurish talab etiladi.
Mazkur maqolada turli holatlardagi ipni turli vaziyatlardagi hamda har xil ko‘rinishdagi kuchlar ta’siridagi harakat qonunini aniqlash usuli bayon qilingan. Buning uchun ipni qovushqoq-elastik material deb qaralib, harakat tenglamasiga kiruvchi mexanik parametrlar operatorlar orqali ifodalangan. Ip harakatining har bir holatiga mos keladigan integro-differensial tenglamalari yozilgan.

Kalit so‘zlar: *harakat, qonun, mexanik, parametr, usul, kuch, integral, elastik, nazariya, tajriba, faktor, model, grafik.*

Аннотация. В протсессе формирования ткани качественное и количественное определение факторов сопротивления движению является одним из требований повышения качества продуксии. Для этого необходимо построить адекватные математические модели, соответствующие силам, влияющим на движение нити.
В статье описан метод определения закона движения нити в различных ситуатсиях и под действием разных видов сил. Для этого нить рассматривается как вязкоупругий материал, а механические параметры, входящие в уравнение движения, выражаются операторами. Формируются интегро-дифференциальные уравнения, соответствующие каждому случаю движения нити.

Ключевые слова: *движение, закон, механика, параметр, метод, сила, интеграл, упругость, теория, эксперимент, фактор, модель, график.*

Abstract. In the process of cloth formation, qualitative and quantitative determination of movement resistance factors is one of the requirements for improving product quality. For this purpose, it is necessary to build adequate mathematical models corresponding to the forces affecting the thread motion.

The method of determining the law of motion of a thread in different situations and under the influence of different types of forces are described in this article. For this, the thread is considered as a viscous-elastic material, and the mechanical parameters included in the equation of motion are expressed by operators. The integral-differential equations corresponding to each case of thread motion are formed.

Keywords: *motion, law, mechanical, parameter, method, force, integral, elastic, theory, experiment, factor, model, graph.*

Introduction

Many problems of the thread mechanics are reduced to solving integral-differential equations. In particular, threads participating in the technological process are under the influence of dynamic forces and participate in oscillating motion [1]. As an example, it is important to determine the law of change of thread motion in a loom, to analyze the change in the tension force generated in the thread and its effect on the quality of the cloth.

In order to study the law of thread motion we use classical methods. In this case, the thread material is considered viscoelastic. The mechanical parameters included in the motion equation are expressed by operators [2, 3]. For each case of thread movement, its own integral-differential equations are written.

It should be noted that since the dynamic processes in the weaving process are a multifactor technological process, the construction of a mathematical model [4, 5] of this process remains a complex problem even with some simplifications. It requires the use of generalizing factors of theory and experience.

Research Methodology

Experimentation allows building an adequate mathematical model. The plastering process is a complex one, and it is important to choose the most perfect parameters of the participating links [6,7]. Qualitative and quantitative knowledge of movement resistance factors in the process of cloth formation is one of the requirements for improving product quality.

It should be noted that the forces affecting the movement of the thread are considered to be known, and it is required to build adequate mathematical models corresponding to it [8, 9]. Basically, such integral-differential equations have different forms for different thread states:

in the first interval no external force acts

$$a^2\frac{\partial^2 u}{\partial x^2}=\frac{\partial^2 u}{\partial t^2}+a^2\int_0^t \Gamma_1(t-\tau)\frac{\partial^2 u}{\partial x^2}d\tau+e\int_0^t \Gamma_3(t-\tau)\left(\frac{\partial^2 u}{\partial x^2}\right)^3 d\tau\ ;\ (0<t<t_1) \qquad (1)$$

in the second interval the force acts

$$a^2\frac{\partial^2 u}{\partial x^2}=\frac{\partial^2 u}{\partial t^2}+a^2\int_0^t \Gamma_1(t-\tau)\frac{\partial^2 u}{\partial x^2}d\tau+e\int_0^t \Gamma_3(t-\tau)\left(\frac{\partial^2 u}{\partial x^2}\right)^3 d\tau\ +f(t);\ (t_1<t<t_2) \qquad (2)$$

in the third interval, no force acts again

$$a^2\frac{\partial^2 u}{\partial x^2}=\frac{\partial^2 u}{\partial t^2}+a^2\int_0^t \Gamma_1(t-\tau)\frac{\partial^2 u}{\partial x^2}d\tau+e\int_0^t \Gamma_3(t-\tau)\left(\frac{\partial^2 u}{\partial x^2}\right)^3 d\tau\ ;\ (t_2<t<t_b), \qquad (3)$$

where t_1 is the time of force action; t_2 is the time when the effect of force stopped; t_b is the full movement time of batten. Integral-differential equations (1, 2-3) must satisfy the following boundary and initial conditions:

$$u_i /_{x=0} = q_1(t); u_i /_{x=L} = q_2(t);\ i = 1,2,3 \tag{4}$$

$$u_1 /_{t=0} = 0;\ \frac{\partial u_1}{\partial t} /_{t=0} = 0;\ u_2 /_{t=t_1} = u_1 /_{t=t_1};\ \frac{\partial u_2}{\partial t} /_{t=t_1} = \frac{\partial u_1}{\partial t} /_{t=t_1};$$

$$u_3 /_{t=t_2} = u_2 /_{t=t_2};\ \frac{\partial u_3}{\partial t} /_{t=t_2} = \frac{\partial u_2}{\partial t} /_{t=t_2} \tag{5}$$

Equations (1,2-3) are the task put in the Bubnov-Galerkin method, and are brought to the system of integral-differential equations of the form:

$$\ddot{T}(t) + 2b\dot{T}(t) + \lambda^2 T(t) + \gamma T^3(t) = \lambda^2 \int_0^t \Gamma(t-s)T(s)ds + \gamma \int_0^t \Gamma_1(t-s)T^3(s)ds + f(t);$$

$$T(t=0) = T_0;\ \dot{T}(t=0) = \dot{T}_0 \tag{6}$$

It should be noted that the longitudinal, transverse and torsional vibrational motions of threads and cloth are also brought to the system of integral-differential equations (6). The integral-differential equations of the form (6) are solved by means of averaging [10, 11], integral transformations of Laplace, exponential series methods of L.E. Maltsev [12]. In our work, method of L.E. Maltsev is generalized for nonlinear equations. For this, based on [13], we replace the integral-differential equations (6) with close differential equations:

$$\ddot{\bar{T}}(t) + a_1\dot{\bar{T}}(t) + a_2\bar{T}(t) + a_3\bar{T}^3(t) = \bar{f}(t)$$

$$\bar{T}(t=0) = \bar{T}_0;\ \dot{\bar{T}}(t=0) = \dot{\bar{T}}_0 \tag{7}$$

where

$$a_1 = 2b + \lambda\omega_s + \gamma\omega_{s1},\ a_2 = \lambda^2(1-\omega_c),\ a_3 = \gamma(1-\omega_{c1}). \tag{8}$$

$$\omega_{\tilde{n}} = \int_0^t \tilde{A}(s)\cos(\lambda s)ds; \omega_{\tilde{n}1} = \int_0^t \tilde{A}_1(s)\cos(\lambda s)ds; \omega_s = \int_0^t \tilde{A}(s)\sin(\lambda s)ds; \omega_{s1} =$$

$$= \int_0^t \tilde{A}_1(s)\sin(\lambda s)ds \tag{9}$$

We determine the solution of equation (7) by the numerical method presented in [14]. In general case, the coefficients of equation (1-3) are variable and a function of time

We solve the equation based on the three forms of the external force:

1. $f(t) = f_0 \sin \omega t$ is the force function in harmonic form.
2. $f(t)$ – is the force in the form of a triangular pulse
3. $f(t)$ – is the force in the form of a rectangular pulse.

Analysis and Results

Numerical results were obtained for the above three cases and they are presented in the form of graphs in Figure 1. In this case, the parameters included in the equation were determined as a result of experiments and the following values obtained by the Koltunov method were adopted:

$$A1 = 0.12;\ \ \alpha 1 = 0.15;\ \ \beta 1 = 0.005;\ \ A3 = 0.2;\ \ \alpha 3 = 0.2; e = 0.76;$$

$$\beta 3 = 0.005;\ b = 0.65;\ \ \gamma = 1.25.$$

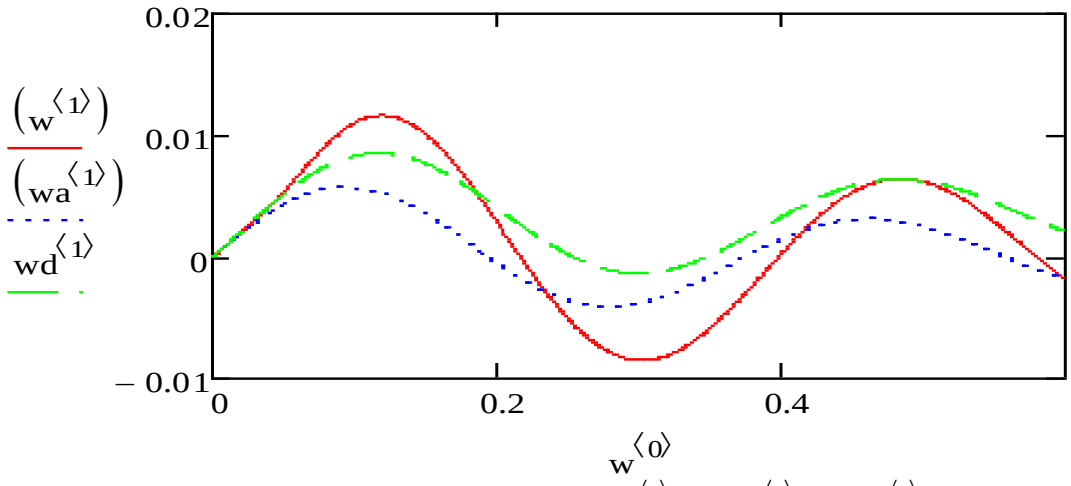

Figure 1. Graphs of changes of displacements ($w^{\langle 1\rangle}=u_1$, $wa^{\langle 1\rangle}=u_2$, $wd^{\langle 1\rangle}=u_3$) within the unit of t ($t = w^{\langle 0\rangle}$).

In the graph, $w^{\langle 1\rangle}$ is displacement under the influence of a triangular impulse; $wa^{\langle 1\rangle}$ is displacement under a rectangular pulse; $wd^{\langle 1\rangle}$ is displacement due to harmonic force. After *w* is known, we determine *u*, and then the deformation is found from the formula

$$\varepsilon = \frac{\partial u}{\partial x}.$$

Conclusions

The method proposed in the work fully determines the deflected mode of the considered mechanical system for values of the arbitrary time *t* and coordinate *x*.

Therefore, in this work, a methodology for determining the law of motion of the thread in different situations and under the influence of different types of forces has been created.

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FINITE ELEMENT ANALYSIS OF STRUCTURAL DYNAMICS IN HEAVY-DUTY LATHE MACHINES: IMPLICATIONS FOR LOAD CAPACITY, PRECISION, AND MACHINING PERFORMANCE

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Annotatsiya. Ushbu tadqiqot og‘ir tokarlik dastgohlarining strukturaviy dinamikasi va statik xususiyatlarinining ishlov beriladigan detallarning yuza tozaligiga bo‘lgan ta’sirini o‘rganadi. Ushbu tadqiqotning markaziy qismi old va orqa babkalar egallab, bular past tezlikda katta detallarni ishlov berish uchun ishlatiladi. Cheklangan elementlar modelidan foydalanib, biz turli xil konstruktiv elementlar stanokning turli yuklar ostida ishlashiga qanday ta’sir qilishini o‘rganib chiqildi.

Kalit so‘zlar: *konstruktiv dinamika, og‘ir yuk ko‘tarish stanogi, statik xususiyatlar, dinamik xususiyatlar, yuk ko‘tarish qobiliyati, aniqlik, sirt qoplamasi, kallak, pufakcha, chekli elementlar modeli.*

Аннотация. Это исследование углубляется в структурную динамику большого тяжелого токарного станка, подчеркивая существенное влияние его статических и динамических свойств на грузоподъемность, точность и качество поверхности обрабатываемых деталей. Центральное место в этом исследовании занимают передняя и задняя бабки, которые имеют решающее значение для поддержки крупных заготовок во время низкоскоростных операций. Используя модель конечных элементов, мы изучили, как различные структурные элементы влияют на производительность токарного станка при различных нагрузках.

Ключевые слова: *структурная динамика, сверхмощный токарный станок, статические свойства, динамические свойства, несущая способность, точность, качество поверхности, передняя и задняя бабки, конечно-элементная модель.*

Abstract. This research delves into the structural dynamics of a large heavy-duty lathe, highlighting the significant impact of its static and dynamic properties on load capacity, precision, and surface finish of machined parts. Central to this study are the headstock and tailstock, crucial for supporting substantial workpieces during low-speed operations. Employing a finite element model, we explored how various structural elements influence the lathe's performance under different loads.

Keywords: *structural dynamics, heavy-duty lathe, static properties, dynamic properties, load capacity, precision, surface finish, headstock, tailstock, finite element model.*

Introduction

In recent years, the rapid expansion of renewable energy infrastructure, particularly offshore wind farms, has driven substantial innovation in wind turbine technology. This includes the development of larger turbines that demand robust structural components and advanced manufacturing capabilities [1-3]. The evolution towards bigger turbines not only underscores the industry's quest for increased energy efficiency and output but also necessitates the use of heavy-duty turning machines capable of handling large-scale components with precision and reliability [4-6]. Ensuring these machines meet stringent standards for quality and efficiency is critical. The static structural integrity of these machines directly influences their load-bearing capacity and the accuracy of the parts they produce. Equally important are the dynamic characteristics that affect motion precision and stability during machining operations. Achieving optimal performance requires balancing high material removal rates with the maintenance of precise surface finishes, often through careful selection of machining parameters informed by stability lobe diagrams and frequency response functions [7-11]. Researchers have made significant strides in predicting and optimizing machining stability using analytical methods like stability lobe diagrams. These tools not only help identify optimal machining conditions but also highlight the complex interplay between machine dynamics, tooling, and workpiece characteristics. Such advancements are crucial as they enable manufacturers to push the boundaries of turbine size and efficiency while maintaining high standards of quality and reliability in their manufacturing processes. Overall, the convergence of renewable energy demands and advanced manufacturing capabilities presents both challenges and opportunities for the industry. By continually refining machining processes and machine tool designs, we can effectively meet the growing needs of the renewable energy sector while ensuring sustainable and reliable energy production for the future.

Finite Element Modeling Approach. Vibrations in lathe machines are critical factors that influence machining precision, tool wear, and overall productivity. Understanding and controlling these vibrations are essential for enhancing machine performance and ensuring quality in manufacturing processes. The finite element method (FEM) stands out as a powerful tool for comprehensively analyzing the dynamic behavior of lathe machines under various operating conditions.

The finite element method is a numerical technique used to solve complex engineering problems by dividing a structure into smaller, interconnected elements. In

the context of lathe machines, FEM involves modeling components such as the machine bed, headstock, tailstock, spindle, and tooling modules using finite elements. Material properties, boundary conditions, and meshing techniques are crucial parameters that influence the accuracy and reliability of FEM simulations.

Modeling a lathe machine for vibration analysis requires meticulous attention to detail. Each component must be accurately represented to reflect its physical characteristics and interactions within the system. The structural integrity and stiffness of components like the bed and spindle, as well as the dynamic characteristics of moving parts, play significant roles in determining vibration frequencies and mode shapes.

FEM facilitates several vibration analysis techniques: natural frequency analysis which determines the Eigen frequencies and corresponding mode shapes of the lathe machine, modal analysis which extracts dynamic characteristics, including modal damping and participation factors, transient and frequency response analysis which simulates dynamic responses to external forces and operational loads, providing insights into machine. To illustrate the practical application of FEM in vibration analysis, we consider a specific lathe machine model. The finite element model is developed by discretizing the machine into elements, assigning material properties, and applying boundary conditions. The analysis yields critical insights into: Eigen modes and their frequencies, mode shapes depicting the spatial distribution of vibrations, identification of resonance conditions and potential areas of structural improvement. Verification of FEM results against experimental data or analytical solutions is crucial to ensure the accuracy of vibration predictions. Comparisons with modal testing or operational measurements validate the FEM model's ability to replicate real-world behavior. Discussions on uncertainties and limitations in FEM analysis provide a comprehensive assessment of its reliability in practical applications.

Research Methodology

Model Development is the first stage of the proposed methodology. In the analysis of machine dynamics, especially for components like the tailstock in lathe machines, constructing a detailed and accurate Finite Element Model (FEM) is crucial. This section outlines the key aspects of model development, including geometric representation:

- Tailstock Components: The FEM model encompasses all relevant components of the tailstock, including the shaft, bearings (such as the front and rear bearings), housing, and any supporting structures. Each component is represented with geometric fidelity to capture its physical shape and dimensions accurately.

- Integration with Machine Structure: The tailstock model is integrated into the broader lathe machine structure, ensuring that interactions between components, such as load transfer and structural integrity, are faithfully represented.

Next stage is the investigation of the material properties which include:

- Stiffness and Damping: Assigning appropriate material properties is critical for accurately simulating the mechanical behavior of the tailstock. This includes stiffness coefficients that define how the material resists deformation under load and damping

coefficients that model energy dissipation due to internal friction and external damping mechanisms.

- Experimental Data: Material properties are often derived from experimental testing or manufacturer specifications. These data points are crucial for calibrating the FEM model to match real-world conditions and behaviors.

After that boundary conditions plays a crucial role in the research, including realistic constraints to simulate the operational environment realistically, boundary conditions are applied to the FEM model. These constraints include fixing certain degrees of freedom (e.g., rigidly fixing the tailstock base) and applying appropriate loads that mimic operational forces experienced during lathe machining operations. Loading scenarios include various loading scenarios are considered, such as the forces exerted by the workpiece, cutting tools, and other dynamic forces encountered during machining. These scenarios help in evaluating how the tailstock responds dynamically to different operational conditions.

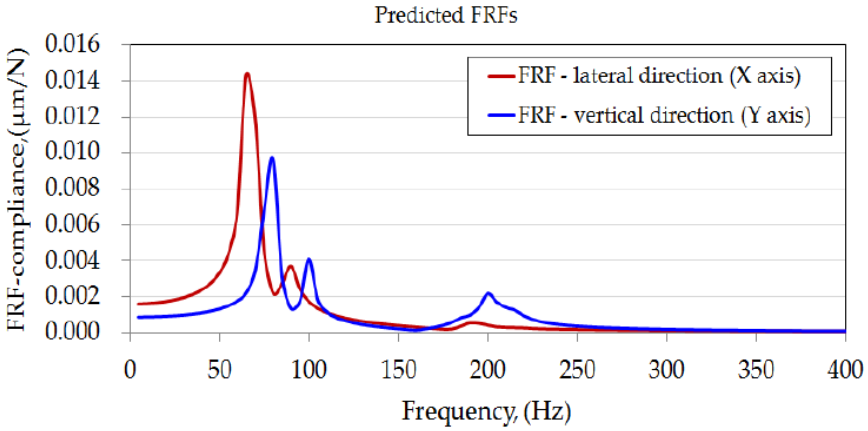
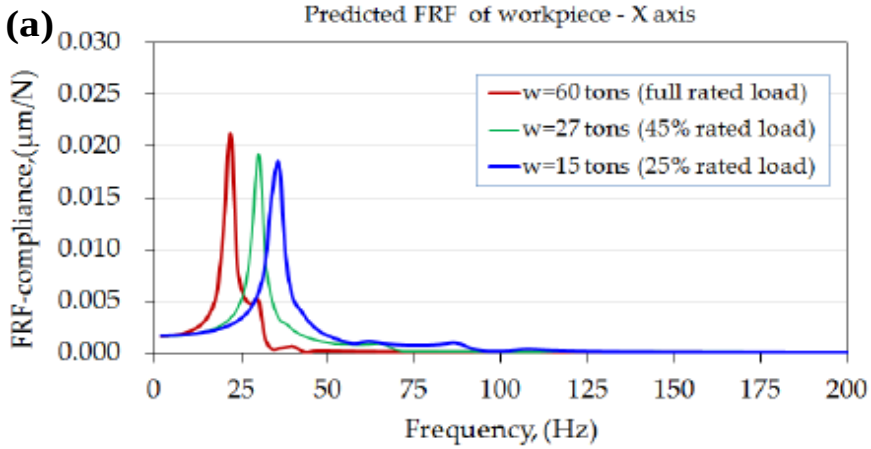


Figure 1. Predicted FRFs for the tailstock.

Analysis and Results

- Meshing: The FEM model is meshed with a suitable mesh density to ensure accuracy without excessive computational cost. This involves discretizing the tailstock geometry into smaller elements, such as tetrahedral or hexahedral elements, to capture localized stress and strain distributions effectively.

- Simulation Software: Advanced FEM software ANSYS is utilized for model creation, analysis, and visualization. These tools facilitate the iterative refinement of the model based on simulation results and experimental validations (see in Figure 2).



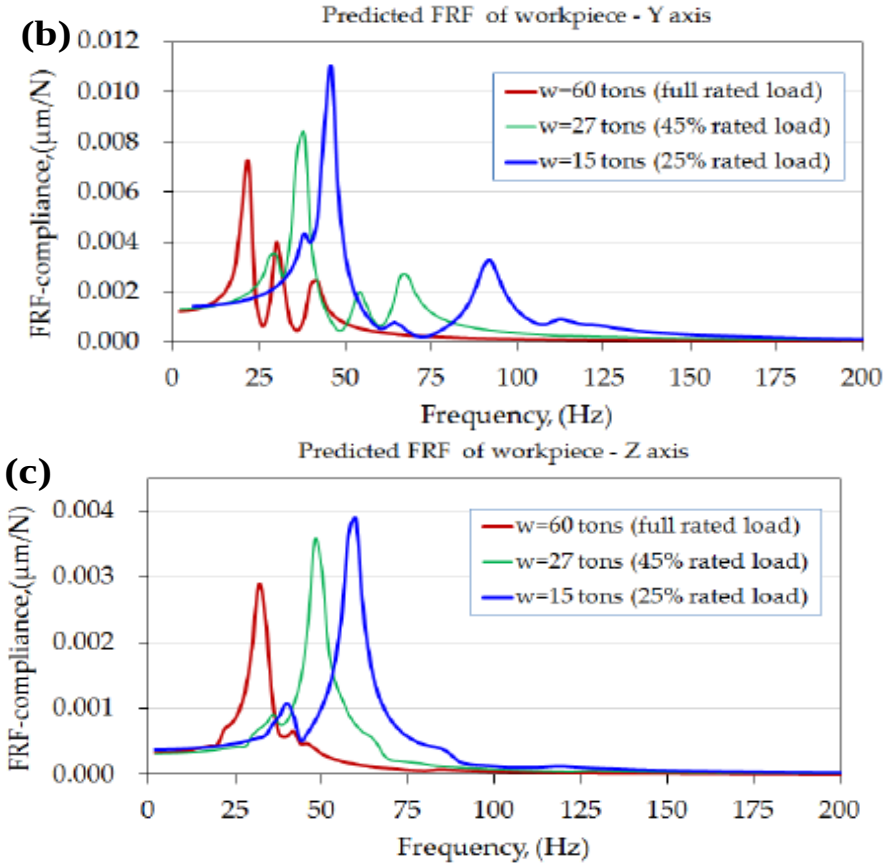


Figure 2. Predicted FRFs of the workpiece in the three orthogonal directions under force excitation: (a)-X axis, (b)-Y axis, and (c)-Z axis, respectively.

Conclusions

The study utilized a finite element model to analyze both the static rigidity and dynamic behavior of a large heavy-duty lathe machine under typical workpiece loads. Several significant conclusions emerged from this investigation:

1. Static Rigidity Evaluation:

- The machine bed exhibited excellent stiffness against workpiece loads, highlighting its robust support capability. Conversely, the headstock and tailstock were identified as critical components due to their substantial impact on load capacity.

2. Dynamic Analysis:

- Dynamic characteristics of the entire machine, particularly under simulated cutting forces, were influenced by changes in compliance and resonant frequencies corresponding to different workpiece weights. This sensitivity underscored the machine's response to varying operational loads.

3. Natural Frequency and Vibration Resonance:

- The lathe machine demonstrated a lowest natural frequency around 22 Hz, significantly higher than its maximum spindle rotational speed of 450 rpm. This discrepancy indicated favorable conditions for avoiding vibration resonance during machining, crucial for maintaining stability and precision.

4. Influence of Headstock and Tailstock:

- The headstock and tailstock modules played pivotal roles in determining the dynamic compliance of the workpiece under machining forces. They exhibited superior

rigidity longitudinally, with higher stiffness vertically compared to laterally, significantly affecting overall dynamic performance.

5. Comparison and Validation:

- Findings regarding static and dynamic stiffness were consistent with existing literature, confirming the effectiveness of the finite element model in evaluating structural performance.

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UDK 543, 543.2, 615, 615.2

DEVELOPMENT OF IONOSELECTIVE ELECTRODES FOR RAPID DETECTION OF DRUGS BASED ON HETEROPOLIMETALLO-PHOSPHATE IONOPHORES AND STUDY OF SENSITIVITY

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Annotatsiya. Ishni bajarish davomida qator dori vositalarini aniqlovchi yuqori sezgir elektrodlar yaratish maqsadida geteropolimetallofosfatli ionoforlar saqlagan membranalar asosida ISE (ion selektiv elektrod)lar tayyorlangan. Geteropolimetallofosfatli elektrodlar tayyorlashda jami 12 ta tibbiyot amaliyotida keng ishlatiladigan dori vositalari tanlab olingan. Tadqiqotlar davomida aniqlanuvchi komponent konsentratsiyasining 10^{-1} – 10^{-7} mol/l soxasida ishlab chiqilgan elektrodlarning aniqlash oralig‘i va sezgirligi o‘rganilgan. O‘tkazilgan tadqiqot natijalaridan kelib chiqqan holda dori vositasi-dodekomolibdofosfat kislotasi tarkibli ionoforlar asosida ishlab chiqilgan ISE larni dibazol va piridoksinni xamda dori vositasi-dodekovolframofosfat tarkibli ionoforlar asosida ishlab chiqilgan ISE larni diprazin va bromgeksin dori vositalariga nisbatan yuqori sezgirlikga ega bulishi isbotlangan.

Kalit so‘zlar: *Ionselektiv elektrod, ionofor, dodekomolibdofosfat kislota, dodekovolframofosfat kislota, dibazol, piridoksin, diprazin, bromgeksin, sezgirlik, aniqlash diapazoni.*

Аннотация. В ходе работы были приготовлены ИСЭ на основе мембран, содержащих гетерополиметаллофосфатные ионофоры, с целью создания высокочувствительных электродов для обнаружения ряда лекарственных препаратов. Всего для изготовления гетерополиметаллофосфатных электродов выбрано 12 препаратов, широко используемых в медицинской практике. В ходе исследований были изучены дальность обнаружения и чувствительность разработанных электродов в диапазоне концентраций детектируемого компонента 10^{-1} - 10^{-7} моль/л. По результатам исследований доказано, что ИСЭ, разработанные на основе ионофоров, содержащих препарат додекомолибдофосфатной кислоты, обладают высокой

чувствительностью к дибазолу и пиридоксину, а также ИСЭ, разработанные на основе ионофоров, содержащих препарат додекавольфсофосфат, дипразин и бромгексин.

Ключевые слова: *Ионоселективный электрод, ионофор, додекомолибдофосфатная кислота, додековольфрамофосфорная кислота, дибазол, пиридоксин, дипразин, бромгексин, чувствительность, дальность обнаружения.*

Abstract. In order to create highly sensitive electrodes that detect a number of drugs during operation Ion selective electrodes (ISEs) were prepared based on membranes containing heteropolymetallophosphate ionophores. A total of 12 drugs widely used in medical practice were selected for the preparation of heteropolymetallophosphate electrodes. The concentration of the component determined during the research in the range of 10^{-1} to 10^{-7} mol/l detection range and sensitivity of the developed electrodes studied. Based on the results of the research ISEs developed on the basis of drug-dodecomolybdophosphate acid-containing ionophoresi ncluding dibazol and pyridoxine ISEs developed on the basis of drug dodecatungstophosphate ionophores have been proven to be highly sensitive to diprazine and bromhexine drugs.

Keywords: *Ion-selective electrode, ionophore, dodecomolybdophosphate acid, dodecotungstophosphate acid, dibazole, pyridoxine, diprazine, bromhexine, sensitivity, detection range.*

Introduction

One of the promising directions for the development of ionometry is the study of PVC membrane ISEs containing heteropolymetallophosphate compounds as ionophores [1, 2]. These compounds are distinguished by their ability to form complexes with inorganic and organic ions in solutions and to pass the bound cation through various biological and artificial membranes [3, 4]. Membranes based on such ionophores make it possible to obtain electrodes for the quantitative determination of various ions in a wide concentration range [5, 6]. The best results in the development of ISEs with PVC membranes have been achieved in the field of creating electrodes that detect alkaline and alkaline earth metal ions [7, 8].

Such a membrane consists of a plasticized polymer (matrix) film into which an ionophore (a substance capable of selectively passing certain types of ions through the membrane) is inserted. In most cases, polyvinyl chloride (PVC) is used as a polymer matrix. Appropriate drugs and ionophores consisting of heteropolymetallophosphates added to the polymer matrix serve to increase the sensitivity of the membrane to drugs (as a result of increasing its electrical conductivity) [5].

Research Methodology

Film membranes of ISE were prepared by dissolving PVC, plasticizer - dioctyl phthalate and electrode active compound (EFB) in tetrahydrofuran with continuous stirring. The mass fraction of EFB in the membrane is 2-5%; The weight ratio of PVC-plasticizer is 1:2. During the experiments, ion-selective membranes were prepared based on heteropolymetallophosphate ionophores, the proportions of the components

of which were obtained in the mass fractions indicated above, for the detection of various drugs. The mass of these membranes varies in the range of 0.2 – 0.5 g, corresponding to the change in their dimensions (thickness and diameter). Prepared membranes are fixed to the electrode body and stored in distilled water.

The developed membrane electrodes consist of a cylindrical Teflon body, to the end of which a plasticized membrane is attached with a special glue. ~1.5 – 2.0 ml of internal reference solution containing potential determining ion ($1\cdot10^{-5}$ – $1\cdot10^{-4}$ M) and 1-2 drops of 3M KCl is placed in the electrode body. A platinum wire was used as the internal reference electrode. The function of the external reference electrode is performed by an ESR-10101 silver chloride electrode filled with a saturated solution of KCl. Before the measurements, the ISE with the plasticized membrane was conditioned for 12 – 24 hours in the solutions of the salts of potential detecting ions of different concentrations. In the next phase of the experiments, the electrochemical performance of the developed drug-detecting ISEs was investigated.

Analysis and Results

One of the main electrochemical indicators of any ISE is its sensitivity to the compound being detected. The sensitivity of the developed electrodes to the detectable component is determined by measuring the EC of the electrode system under investigation. Before measuring the potential, it is necessary to prepare the electrodes for work in the prescribed manner. During inspection and calibration, the following conditions must be observed: ambient temperature 25 ± 10 °C; relative humidity should not exceed 80%; The value of the electric and magnetic fields affecting the measurement accuracy must comply with GOST 8.213-76.

A visual inspection of the ISE is required before use. Visual external inspection is carried out by determining that its membrane is not damaged, there are no breaks and cracks in the electrode body, there are no changes in the connection system, and there are appropriate signs of the electrode. During the initial inspection, the electrode potential must correspond to the values specified in the corresponding document.

The slope and deviation from the linearity of the concentration dependence of the signal of the ion selective electrode are calculated using formulas (1) and (2). These values are found by measuring the potential in solutions A, B and C.

Solution A is a solution with a concentration that corresponds to the upper measurement limit of the electrode. (Highest concentration).

Solution B is a solution whose pX value is 0.7 – 1 unit less than the pX value of solution A.

Solution C is a solution whose pX value is 0.7 – 1 units greater than the pX value of the solution corresponding to the lower measurement limit of the electrode.

C is the slope of the ion characteristic of the electrode, unit mV/pH. B and C are determined by measuring the potentials in the solutions and are calculated by the following equation:

$$S = (E_2 - E_1) / (pX_2 - pX_1) \quad (1)$$

E_1 and pH_1 -S solution potential (mV) and pH. E_2 and pX_2 B- solution potential (mV) and pX value.

$$D = (pH_3 - pH_1) - (E_3 - E_2) / S \quad (2)$$

D - deviation from the linearity of the ion characteristic of the electrode, (deviation of the electrode signal from the linear appearance) is determined by measuring and calculating the potentials in solutions A and B

pH_3 and E_3 - observed results for solution B, in units of mV and pH; pH_2 and E_2 are the observed results in mV and pH units in A-solution; Slope description of the S-electrode calculated according to equation (1). The deviation of the ion characteristic value of the electrode from linearity should not exceed ± 0.2 pH unit.

In the course of this work, in order to create highly sensitive electrodes for the detection of a number of drugs ISEs were prepared based on membranes containing heteropolymetallophosphate ionophores. A total of 12 drugs widely used in medical practice were selected for the preparation of heteropolymetallophosphate electrodes. The concentration of the component determined during the research in the range of 10^{-1} to 10^{-7} mol/l detection range and sensitivity of the developed electrodes was studied. Table 1 shows the signal value obtained by ISEs with different ionophores over a wide range of drug concentrations.

Table 1. ISEs developed on the basis of various ionophores to drugs the results of studying relative sensitivity (n=5, p=0.95).

Ion concentration, mol/l	**Signal of ISE, mV**											
	Lidocaine	***Pyridoxine***	**Dibazol**	***Drotoverin***	***Diphenhydramine***	***Inozin***	***Paracetamol***	***Diprazine***	***Papaverine***	***Trimecain***	***Bromhexine***	***Diphenhydramine***
	Ionophore composition-Dodecomolybdophosphate and the drug											
10^{-1}	136	89.2	277.2	166.2	193.9	124.6	96.9	166.2	114.5	229, 1	137.4	91.6
10^{-2}	114	70.8	232.1	139.2	162.4	124.6	81.2	139.2	85.5	171, 1	102.6	68.4
10^{-3}	90.2	53.1	184.3	110.4	128.8	124.6	64.4	110.4	57.5	115.2	69.0	46.8
10^{-4}	67.6	36.5	138.4	82.8	96.6	124.6	48.3	82.8	30.5	60.2	36.4	24.0
10^{-5}	51.6	27.7	95.0	67.5	76.5	124.6	40.2	65.0	17.9	34.3	20.4	13.6
10^{-6}	45.3	24.2	72.3	60.2	63.4	124.6	35.2	54.2	7.5	15.4	9.8	6.8
10^{-7}	42.9	21.1	63.2	57.8	59.1	124.6	32.1	48.8	5.5	11.5	6.6	4.4
CRCSAS, mol/l	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-5}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-5}	10^{-1}-10^{-4}	10^{-1}-10^{-4}
	Ionophore composition-Dodecatungstic phosphate and the drug											
10^{-1}	136.8	119.7	88.4	171.0	159.6	25.4	179.1	285.0	128.3	111.2	283.3	88.4
10^{-2}	115.7	101.2	74.7	144.6	134.9	106.4	151.8	241.2	108.5	93.9	233.1	74.7
10^{-3}	96.0	84.7	62.0	120	112	88.0	126	200.1	90.2	78.1	182	62.0
10^{-4}	78.2	68.6	50.5	97.8	91.8	71.7	102.7	163.2	73.3	63.7	132.2	50.5
10^{-5}	66.9	60.2	43.6	84.6	77.6	60.6	86.5	131.3	61.9	51.9	92.1	43.6
10^{-6}	63.6	55.4	40.2	77.0	72.2	56.8	80.6	120.1	57.0	46.8	74.3	40.2
10^{-7}	61.7	52.8	38.3	75.4	68.8	53.6	77.8	114.2	55.3	44.6	68.4	38.3
CRCSAS, mol/l	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-5}	10^{-1}-10^{-4}	10^{-1}-10^{-4}	10^{-1}-10^{-5}	10^{-1}-10^{-4}

CRCSAS - concentration range corresponding to the straight-line area of the signal;

In the process of determining drugs from the results presented in the table ionophor composition -consists of dodecomolybdophosphate and drug. ISEs we see that the highest values of the signal and the wide concentration range of the straight line of detection are observed during the detection of the drugs dibazole and pyridoxine.

Conclusions

Dodecomolybdophosphatethe electrode developed on the basis can be used for the determination of dibazole and pyridoxine drugs in a wide concentration range. Also the composition A wide concentration range of detection and a high signal value corresponding to the same concentration of diprazine and bromhexine were observed from the electrodes developed on the basis of dodecatungstophosphate and the drug.

Based on the results of the research ISEs developed on the basis of drug-PhMA-containing ionophores including dibazol and pyridoxine the possibility of using ISEs developed on the basis of drug-PhTA-containing ionophores in the detection of diprazine and bromhexine was proven.

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DIAGNOSIS OF ECG SIGNALS BASED ON DIGITAL PROCESSING ALGORITHMS

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Annotatsiya. Axborot texnologiyalarining ilg‘or yo‘nalishlaridan biri tibbiyot sohasini kompyuterlashtirishdan iborat. Tibbiyot amaliyotida axborot texnologiyalarini o‘lchash va nazorat qilish uskunalari bilan hamkorlikda qo‘llash bemorning ahvoli to‘g‘risidagi ma’lumotlarni avtomatlashtirilgan holda yig‘ish va uni real vaqt rejimida qayta ishlash uchun yangi samarali vositalarni yaratish imkonini bermoqda. Axborot-kommunikatsion texnologiyalardan foydalanishning asosiy maqsadi-statistik ishlab chiqarish jarayonlarini avtomatlashtirishdan iborat bo‘lib, bunda har qanday tizim faoliyatining samaradorligi uning zamonaviy axborot- kommunikatsiya texnologiyalaridan foydalanish darajasidan iboratdir. Bugungi kunda yurak-qon tomir kasalliklarini tashxislashni samaradorligini oshirish uchun ko‘plab elektrokardiografik signallarni avtomatik aniqlashning zamonaviy usullari, modellari, algoritm va amaliy dasturiy majmualari ishlab chiqilgan. Tibbiy biosignallarni qayta

ishlashning maqsadi- olingan axborotni foydalanish qulay bo‘lgan shaklga aylantiradigan ma’lum ma’lumotlar asosida bemorlarga tashxis aniqligini oshirishga xizmat qilishi to‘g‘risidagi izlanishlardan iborat.
Mazkur maqolada biosignallarni qayd qilish va filtrlashda shovqin darajasini pasaytirish hamda olingan ma’lumotlarni raqamli qayta ishlash orqali bemorlarning tashxis aniqligini kuchaytirish haqida ma’lumot keltirilgan.

Kalit so‘zlar: *Elektrokardiografiya, biosignalni qayta ishlash, diskret signal, past amplitudali elektr signallar, past chastotali elektr signallar, differentsial kuchaytirgich, Furye transformatsiyasi, filtrlash, spektral baholash.*

Аннотация. Одним из передовых направлений информационных технологий является компьютеризация медицинской сферы. Применение информационных технологий в медицинской практике совместно с измерительной и контрольной техникой позволяет создавать новые эффективные средства автоматизированного сбора информации о состоянии пациента и ее обработки в режиме реального времени. Основной целью использования информационно - коммуникационных технологий является автоматизация статистических производственных процессов, при которой эффективность функционирования любой системы складывается из уровня ее использования современных информационно-коммуникационных технологий. Сегодня для повышения эффективности диагностики сердечно-сосудистых заболеваний разработаны современные методы, модели, алгоритмы и прикладные программные комплексы автоматического обнаружения многих электрокардиографических сигналов. Целью обработки медицинских биосигналов является получение информации.

Ключевые слова: *Электрокардиография, обработка биосигналов, дискретный сигнал, электрические сигналы низкой амплитуды, низкочастотные электрические сигналы, дифференциальный усилитель, преобразование Фурье, фильтрация, спектральная оценка.*

Abstract. One of the advanced directions of information technologies is the computerization of the medical field. In medical practice, the use of information technologies in cooperation with measurement and control equipment makes it possible to create new effective tools for automated collection of information about the patient’s condition and its real-time processing. The main goal of using information and communication technologies is to automate statistical production processes, and the efficiency of any system depends on its level of use of modern information and communication technologies. Today, modern methods, models, algorithms and practical software packages for automatic detection of many electrocardiographic signals have been developed to improve the efficiency of diagnosing cardiovascular diseases. The purpose of processing medical biosignals is research on how to improve the accuracy of diagnosis for patients based on certain information that transforms the received information into a form that is convenient to use. This article provides information on reducing the level of noise

in recording and filtering biosignals and increasing the accuracy of diagnosis of patients through digital processing of the received data.

Keywords: *Electrocardiography, biosignal processing, discrete signal, low-amplitude electrical signals, low-frequency electrical signals, differential amplifyer, Fourier transform, filtering, spectral estimation.*

Introduction

One of the advanced directions of information technologies is the computerization of the medical field. In medical practice, the use of information technologies in cooperation with measurement and control equipment makes it possible to create new effective tools for automated collection of information about the patient's condition and processing it in real time.

The main goal of using information and communication technologies is to automate statistical production processes, and the efficiency of any system depends on its level of use of modern information and communication technologies.

Cardiovascular diseases are one of the main causes of death worldwide in recent decades. According to the World Health Organization, one of the effective ways to prevent heart attack death is timely diagnosis based on digital processing algorithms of modern electrocardiographic (ECG) signals. The biosignal recording process from each patient is important for recording this biosignal and processing the patient's analysis results. Early diagnosis of cardiovascular diseases helps to reduce complications in critically ill patients. In this regard, the electrocardiogram (ECG) is an effective auxiliary tool that provides accurate information about various heart diseases of the human heart. Evaluation and interpretation of the ECG signal has become a major goal of current research for the early detection and mitigation of dangerous cardiovascular conditions [1].

Literature Review

Digital signal filtering and processing methods widely covered in the world scientific literature are provided by N.K. Smolentsev, P.S. Addison, S. Malla, A. Oppenheim, A.V. Merkusheva, R. Decatrina and others. scientific research is devoted to the improvement of biosignal processing algorithms and tools. Scientific works on the creation of a hardware and software complex in real time, effective algorithms for digital signal processing and transmission S.D. Kurgalin, D. Dazhion, K. Blatter, Уа. A. Turovsky, S.M. Arbuzov, I.S. Gubarev, A.V. Maksimov and a number of other scientists' scientific articles.

The main scientific works of scientists and researchers of our republic V.K. Kabulov, B.N. Khidirov, M.M. Musaev, Kh.N. Zaynidinov, J.Kh. Djumanov, B.B. Mominov, O'.R. Hamdamov, F.F. Rajabov and others who have contributed to research in the field of digital processing of biomedical signals and diagnosis based on identified indicators.

Today, modern methods, models, algorithms and practical software packages for automatic detection of many electrocardiographic signals have been developed to improve the efficiency of diagnosing cardiovascular diseases.

The purpose of processing medical biosignals is research on how to improve the accuracy of diagnosis for patients based on certain information that transforms the received information into a form that is convenient to use.

The electrocardiography device is a method of examination that provides information on the state of its rhythm, conductivity, size and shape, and blood supply by recording the biopotentials generated during the heart's activity. Any ECG consists of several teeth, segments and intervals, which represent a complex process such as the propagation of an excitation wave throughout the heart. By analyzing ECG biosignals, they mean not only mathematical changes, but also drawing conclusions based on these changes in relation to the specific features of these processes and objects. The purpose of signal analysis is usually to determine or evaluate the numerical parameters of signals, to divide signals into elementary components in order to compare the characteristics of different signals, to compare the proximity, similarity, and interdependence of different signals, including their specific quantitative indicators [2].

It is intended to pay great attention to the issue of accuracy in the design of software for increasing the accuracy of the diagnosis of patients by digital processing of the data obtained from the electrocardiography device. Today, in the era of modern information technologies, one of the main problems faced by software developers is to create new software that separates effective ones from large volumes of information [3].

Algorithms for automatic detection of R waves of the ECG signal (Figure 1) are of particular importance for the automatic diagnosis of diseases of the cardiovascular system. An algorithm for detecting the ECG signal is proposed. The difference between the algorithm and the existing ones is that the initial filtering is performed on the basis of wavelet denoise. This provides consistent filtering without introducing shape distortions. ECG also differs in that instead of squaring the value of the signal, the modulus of the signal is obtained. This algorithm reduces the computational power required. The QRS detection algorithm (Figure 1) is based on wavelet filtering, the five-point derivative of the signal and the calculation of the value of the module to determine the complex in the II connection of the ECG. In this case, the QRS complex is determined three times in a row, and heart rate (heart rate) is calculated from the average value of three RR intervals [4]. After wavelet filtering, the following steps are used to detect R waves and calculate heart rate:

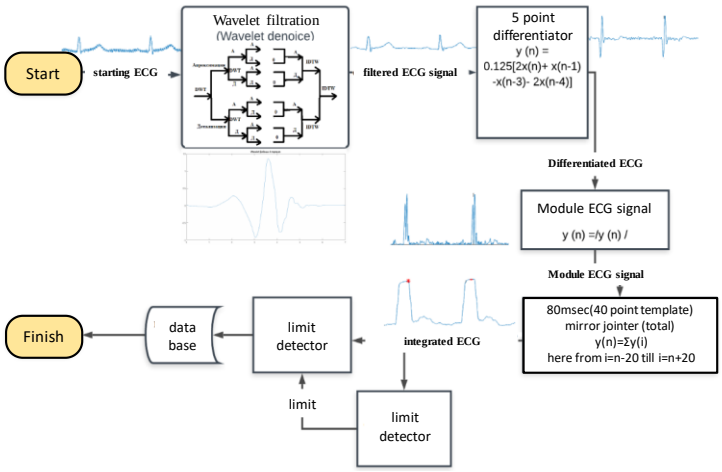

Figure 1. Block diagram of the automatic recognition algorithm for finding the R-waves of the ECG signal.

The problem of reducing the number of factors, minimizing the problem of digital processing of the signals recorded in the devices is being studied, and systematic software algorithms are being designed for the digital processing of the data obtained from the analysis of the problems of a sharp increase in the number of calculations. One of the simple ways to solve problems is to reduce the size of the problem under consideration, but it should be taken into account that reliable factors and parameters should not be neglected [5].

Biosignals are very low-amplitude and low-frequency electrical signals that can be measured in medical organisms, i.e., humans. Bioelectrical signals are generated by a complex self-regulation system and can be measured by changes in electrical potential across a cell or organ. An ECG measures the electrical representation of the biopotential of the heart and is recorded non-invasively using standard equipment. An ECG is measured with a differential amplifier that records the difference between two electrodes attached to the skin. Research related to electrical biosignals such as EKG has advanced by developing methods for remote measurement of electric fields using new sensor technology. As a result, technologies are being created that can be measured without electrical contact with the skin.

Also, the use of portable and connected devices, as well as Internet tools and wireless technologies, as an innovative tool for the transfer of information that allows remote access to the health status of the patient, provides a detailed analysis of the health system with greater efficiency and convenience.

The power of today's computer systems makes it possible to distinguish and recognize individual events on the ECG and to organize their mathematical processing not only with personal computers, but also with the help of microprocessor controllers built into ECG reading devices, while making examinations more efficient, accurate and in a shorter time. The transfer also allows to improve the working conditions of the doctor when performing routine methods related to the measurement of parameters and detection of events.

It is envisaged to pay great attention to the problem of accuracy in the design of software for increasing the accuracy of diagnosis of patients by digitally processing the data obtained from the electrocardiography device [5].

Missing and misidentifying QRS complexes during recording of biosignals can especially reduce the quality of diagnostics. Such errors occur in conditions of interference during registration, as well as due to difficulties in distinguishing images of different parts of the cardiac cycle of a pathological ECG (for example, it is difficult to distinguish a T-wave from an early ventricular extrasystole). In the automatic diagnosis of arrhythmias, it is difficult to detect low-amplitude ECG P-waves in real time, which especially affects the analysis of complex cases of combined types of arrhythmias. A large part of automated arrhythmia diagnosis is the recognition of life-threatening arrhythmias. The small amount of time (up to 10 seconds) available for detecting these patterns and the very strict requirements for both types of diagnostic errors make it difficult to automate this task [6].

It is especially important to recognize emergency contractions of the heart ventricles, which begin with foci of excitation in the ventricles (ectopic contractions). They have great prognostic value and are manifested in the form of various ventricular

extrasystoles and episodes of paroxysmal ventricular tachycardia. In addition, their dynamics should always be monitored during antiarrhythmic therapy. On the ECG, such arrhythmias are mainly manifested in the form of characteristic changes in the form of the QRS complex and the sequence of RR intervals, so it is very important to take these signs into account with the diagnostic algorithm [7].

Research Methodology

Biomedical signal processing uses digital signal processing techniques such as Fourier transform, filtering, spectral estimation, and wavelet conversion to biomedical complications. Low-pass, high-pass, band-pass, and band-stop filters are commonly used to filter signals. Digital signal processing (DSP) concepts can also be applied to other biomedical applications such as biomedical imaging (MRI, CT, X-ray, PET, ultrasound) and genomic signal processing.

Analysis and Results

In frequency domain filtering, the signal is filtered in a certain frequency range using a discrete Fourier transform. The Fourier transform is a transform that compares functions of some real variable, and this function represents a transform that describes the phase or amplitude of each sinusoid corresponding to a certain frequency. In some cases, it makes it possible to identify regular components in complex vibration signals that occur under the influence of biopotentials generated in the human body. With its help, spatial or temporal functions are divided into sinusoidal components with their own frequency, phase and amplitude. These changes are obtained by two different mathematical methods. The first of them is used when the original function is continuous, and the second is used when it is represented by a set of discrete individual transformations. If the expression is obtained from values defined by discrete intervals, it can be divided into several sinusoidal expressions with discrete frequencies, and so on. If the initial expression is given a value for every real number, then it can be decomposed into multiple sinusoids of all possible frequencies. It is usually called the Fourier integral, and the solution involves integral transformations of the function. Regardless of how the conversion is obtained, two numbers must be specified for each frequency: amplitude and frequency. These values are expressed as a single complex number. The theory of expression of complex variables, together with the Fourier transformation, made it possible to perform calculations in the design of various electric circuits, in the analysis of mechanical vibrations, in the study of the mechanism of wave propagation, etc [8].

Conclusions

Modern electrocardiographic methods are used to analyze the heart with the help of an automated computerized ECG diagnosis with today's intellectual daily practice. Computer technology is an important occupation for recognition and important parameters of various update processes in ECG signals. There is great potential to support the population supported by innovative technologies.

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DYNAMIC GROWTH MEASUREMENT RESULTS OF PRESCHOOL BOYS IN THE REPUBLIC OF UZBEKISTAN

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Annotatsiya. O‘zbekistonda milliy qonunchilik bazasini mustahkamlash, aholining huquqiy savodxonligini oshirish orqali bolalarni zo‘ravonlik, ekspluatatsiya va zo‘ravonlikdan himoya qilish maqsadida bolalarni himoya qilish tizimida muhim islohotlar boshlandi. Ota-ona qaramog‘isiz qolgan bolalarni, shuningdek, nogiron bolalarni internat muassasalariga joylashtirishni kamaytirish va oldini olish maqsadida bolalarni deinstitutsionalizatsiya qilish masalalariga alohida e’tibor qaratilmoqda. Dinamik qulay bolalar kiyimlarini loyihalash uchun harakatdagi tana hajmining o‘zgarishi o‘rganildi va bola eng xarakterli harakatlarni amalga oshirganda o‘lchovli xususiyatlarning dinamik o‘sishi qiymatlari aniqlandi.

Kalit so‘zlar: *yillik o‘sish, o‘lchov belgilari, bola figurasi, yoshga bog‘liq xususiyatlar, tanlab olish, o‘lchovli tipologiya, antropomorfologik so‘rov, yosh dinamikasi.*

Аннотация. В Узбекистане начались важные реформы в системе защиты детей с целью защиты детей от насилия, эксплуатации и насилия путем укрепления национальной правовой базы и повышения правовой грамотности населения. Особое внимание уделено вопросу деинституционализации детей с целью сокращения и предотвращения помещения детей, оставшихся без попечения родителей, а также детей-инвалидов в интернатные учреждения. С целью проектирования динамичной удобной детской одежды было изучено изменение размеров тела в движении и определены значения динамического роста размерных характеристик при выполнении ребенком наиболее характерных движений.

Ключевые слова: *динамика, годовой прирост, признаки измерения, фигура ребенка, возрастные характеристики, выборка, размерная типология, антропоморфологическое обследование, возрастная.*

Annotation. In Uzbekistan, important reforms have begun in the child protection system in order to protect children from violence, exploitation and abuse by strengthening the national legal framework, increasing legal literacy among the population. The use of the systematic child labor in cotton harvesting has been discontinued. Particular attention is paid to the issues of de-institutionalization of children with the aim of reducing and preventing the placement of children left without parental care as well as children with disabilities in residential institutions. In order to design dynamically comfortable children's clothing, the changes in body size in movement were investigated, and the values of dynamic

increments of dimensional features when a child performs the most characteristic movements were established.

Keywords: *annual increments, dimensional traits, child figure, age-related features, sampling, dimensional typology, anthropomorphologic survey, age dynamics.*

Introduction

Designing children's clothing is a complex and specific process, which is a more challenging task than designing clothing for adults. The scientific basis for designing children's clothing is based on dimensional anthropological standards and the dimensional typology of the child population [1]. To develop a dimensional typology for the purpose of clothing design, a detailed characterization of the variety of morphological types found among the child population will be required, i.e. the values of anthropometric features characterizing these types by sex and age, structure, proportions, volume, and size, the limits of variability of the child's features should be known. This information can be obtained as a result of anthropometric studies according to a specific measurement program [2]. The anthropometric survey methodology was developed in accordance with the existing methodology [3] and included solving the following tasks: determining the list of dimensional features for measuring children; selecting the leading dimensional features that most fully characterize the figures; establishing the indifference interval for each of the leading dimensional features; establishing the optimal number of typical figures for clothing production; determining the subordinate dimensional features for typical figures selected by the combination of the leading dimensional features.

Literature Review

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Research Methodology

In this paper, an anthropomorphological study of children's figures was carried out in order to identify the peculiarities of their development in different periods of life. The object of the study was selected figures of boys and girls of preschool age from 3 to 7 years old.

In accordance with the objectives of the present study, dimensional features characterizing the features of growth, physique, proportions and posture of children were selected from the general program. The scheme of measurements of dimensional features corresponds to GOST 17917-86 and GOST 17916-86.

The following devices were used in the study: a metal portable anthropometer of the Martin system for measuring the height of points above the floor, a cloth centimeter

tape, a set of special rulers for measuring the features, a set of special rulers for measuring the height of points above the floor.
rulers for measuring the signs determining the posture (body position,
waist depths first and second). Measurements were made with an accuracy of 1 mm.

The method of individualizing (longitudinal) studies was adopted as a method of examination [3]. The essence of the method is to measure the same people at certain time intervals; the resulting data are compared with each other. Longitudinal studies, establishing the dynamics of growth and development within one generation, provide a more objective assessment of age-related changes.

According to the method adopted, the study was conducted in three phases. The first stage took place in March 2021 and consisted of measuring children in four regions of Uzbekistan

Analysis and results

A comprehensive measurement program was used to conduct anthropometric surveys of the child population. It included features that determine total body dimensions, features characterizing body proportions and girth dimensions, as well as a number of special features measured on the body surface. The dimensional features were selected as a result of analyzing the current design methods developed not only in the post-Soviet space, but also abroad [3].

In order to obtain reliable comparable anthropometric data, the measurements were carried out in accordance with the standard method of measuring the child population by contact method [3]. The sample for the construction of the dimensional typology of the child population includes children of preschool age group, i.e. from 3 to 7 years old. The sample size from the general population is 3000 children (Table 1).

Table 1. Composition of the sample of the child population for anthropometric studies.

Region	3-4		5-6		6-7		**Total**
	B	G	B	G	B	G	
Tashkent	70	60	80	70	50	50	380
Samarkand	100	100	150	150	50	50	600
Namangan	70	70	70	60	50	50	370
Bukhara	120	130	100	100	60	60	570
Urgench	200	200	200	150	150	180	1080
Total	560	560	600	530	360	390	3000

As a result of the appropriate mathematical processing of anthropometric materials, data are obtained that make it possible to proceed to the development of an anthropometric standard. Mathematical processing of the measurement results was carried out using the methods of mathematical statistics [4]. The scheme of the algorithm of mathematical processing of the measurement results is shown in Figure 1.

In the primary statistical processing three main points are emphasized:

(a) Determination of calculated dimensional features. The calculated features include, firstly, dimensional features, the values of which are used in the methodology of clothing design and are determined by arithmetic operations with the values of

measuring features, and secondly, features for checking and correcting anthropometric material (for example, the difference between the values of hip circumferences with and without taking into account the protrusion of the abdomen). The list and number of calculated features are determined in the course of the work.

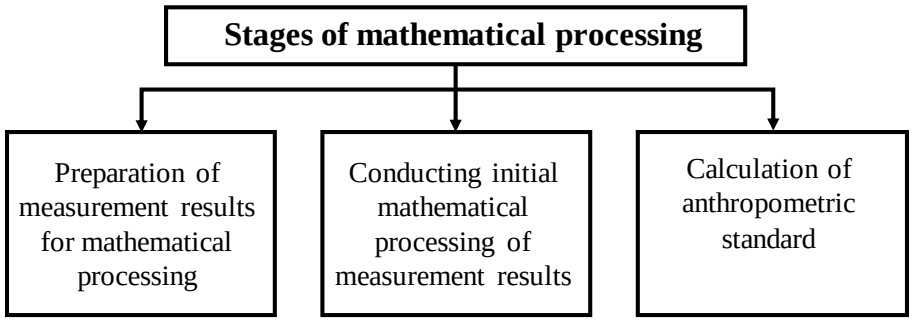

Figure 1. Scheme of the algorithm of mathematical processing of the measurement results.

b) Information control. After entering the information into the computer, the material was analyzed for minimum - maximum [5] to identify gross errors. For each calculated characteristic in each one-year group of children (boys and girls), the arithmetic mean and standard deviation were determined according to the methodology [3].

c) Determination of the main statistical parameters of the variation series. The statistical parameters are:

- maximum and minimum - X_{jmax} and X_{jmin} of the i-th dimensional feature;
- arithmetic mean - X_j;
- standard deviation - δ_j ;
- coefficient of skewness – γ_i ;
- coefficient of excess - γ_j ;
- coefficient of correlation of signs among themselves - τ_{ih}.

To calculate the statistical parameters, we used the method of moments, according to which the first four moments m_j are determined according to the formulas [6]:

$$m_{1j} = \frac{\sum_{i-1}^{n} X_{1j}}{n}; \quad m_{2j} = \frac{\sum_{i-1}^{n} X_{ij}^4}{n}$$

$$m_{3j} = \frac{\sum_{i-1}^{n} X_{ij}^3}{n}; \quad m_{4j} = \frac{\sum_{i-1}^{n} X_{ij}^4}{n};$$

where j = 1, 2, 3 - number of measurement attributes; - value of the j-th measurement attribute; X_{ij} - value of the j-th measurement attribute; i= 1, 2, 3...n - sample size. Then:

$$\bar{X}_j = m_{1j}; \quad \delta_i = \sqrt{m_{2j} + m_{1j}^2};$$

$$\gamma_{1i} = \frac{m_{4j} - 3m_{2j}m_{3j} - 3m_{1j}^4}{\delta_j^3}$$

$$\gamma_{2j} = \frac{m_{4j} - 4m_{1j}m_{3j} + 6m_{2j}m_{1j}^3 - 3m_{1j}^4}{\delta_j^4} - 3$$

$$\tau_{2j} = \frac{\frac{1}{n}\sum_{i=1}^{n} x_{ij}x_{ih} - m_{ij}m_{ih}}{\delta_j \delta_h}$$

where h = 1, 16, 18 are the main measurement signs.

The value γ_{1j} characterizes the position of the abscissa of the top of the distribution curve (it is called the mode - MOJ) near its mean value. If $\gamma_{1j} > 0$, then X_j > MOJ, when $\gamma_{1j} < 0$, X_j < MOJ, when $\gamma_{1j} = 0$, X_j = MOJ

The value γ_{2j} characterizes the position of the ordinate of the top of the distribution curve: $\gamma_2 > 0$ when the distribution is sharp or high vertex, $\gamma_2 < 0$ when the distribution is low or flat vertex, and when $\gamma_j = 0$ - normal distribution.

The value of γ_{2j} is a measure of the linear correlation relationship of the traits with each other. The degree of linear relationship of traits increases when it approaches ± 1. Based on the position that anthropometric features are distributed according to the normal or lognormal law with three parameters [7], to calculate the frequency of occurrence of the trait system, we take the distribution function of random variables distributed according to the normal law. The frequency of combination of three attributes (X_1, X_{16}, X_{18}) in the given indifference intervals can be defined under known assumptions as the probability of hitting a rectangular parallelepiped in three-dimensional normal (Gaussian) space, i.e. as a probability density in three-dimensional space [8].

The asymmetry coefficients were calculated by the formula:

$$\Gamma_{2j} = \frac{\frac{\sum x_j^4}{N} - \frac{3\sum x_j^2}{N} \cdot \frac{\sum x_j}{N} + 2\left(\frac{\sum x_j}{N}\right)^3}{S_j^4}$$

Calculation of kurtosis coefficients Γ_{2j}- by formula:

$$\Gamma_{2j} = \frac{\frac{\sum x_j^4}{N} - \frac{4\sum x_j^3}{N} \cdot \frac{\sum x_j}{N} + 2\frac{\sum x_j^2}{N}\left(\frac{\sum x_j}{N}\right)^2 - 3\left(\frac{\sum x_j}{N}\right)^4}{S_j^4}$$

Calculation of the matrix of pair correlations R_{kj}- by the formula:

$$R_{kj} = \frac{\frac{\sum x_k x_j}{N} - \frac{\sum x_k}{N} \cdot \frac{\sum x_j}{N}}{S_k S_j}$$

where k, j - number of a feature, at k=j R_{kj}=1, N - number of forms participating in the calculation.

Calculation of the correlation coefficient between anthropometric features by the method of moments.

1. Determination of the value of the main parameters of the variation series and S_x for body length using the formulas. Initial data *Minx*; *Max* determine the made variation series for body length.

$$v_{1x} = \frac{\sum P_x \cdot a_x}{n}$$

$$\bar{x} = A_x + i_x \cdot v_{1x}$$

$$v_{2x} = \frac{\sum P_x \cdot a_x^2}{n}$$

$$S_x = i_x \cdot \sqrt{v_{2x} - v_{1x}^2}$$

2. Determining the values of the parameters $\bar{U}$ and S_y for the chest circumference are derived from Min_y; Max_y ; n ; A_y ; iy ; v_{1y} . У, v_{2y}, S_y

3. Determination of the mixed moment using the formula:

$$v_{1.1} = \frac{\sum P_y a_y a_x}{n}$$

4. The correlation coefficient is calculated by the formula:

$$r_{xy} = \frac{v_{1.1} - v_{1x} \cdot v_{1y}}{S'_x \cdot S'_y}$$

where $v_{1.1}$- mixed moment; v_{1x}, v_{1y} - product of the first initial moments for each of the signs (necessarily taking into account the sign of the moment);
S'_x, S'_y - product of standard deviations without multiplication by the value of class intervals.

5. The correlation coefficient is checked by the formula

$$r_{xy} = \frac{\sum P_y a_y a_x n - \sum P_x a_x \cdot \sum P_y a_y}{\sqrt{n \sum P_x a_x^2 - (\sum P_x a_x)^2} \cdot \sqrt{n \sum P_y a_y^2 - (\sum P_y a_y)^2}}$$

The linear correlation coefficient can take values from -1 to +1. The tightness of the relationship between the traits was assessed using the Chadlock scale [8]:
0.1 < $r(x,y)$ < 0.3: weak;
0.3 < $r(x,y)$ < 0.5: moderate;
0.5 < $r(x,y)$ < 0.7: noticeable;
0.7 < $r(x,y)$ < 0.9: high;
09 < $r(x,y)$ < 1: very high.

The nature of correlation between traits can be different: as one trait increases, another trait can either increase or decrease. In the first case the correlation will be positive, or direct, and in the second case it will be negative, or inverse. Most anthropometric traits are related to each other by positive correlation. Conventionally, a large degree of close correlation (connection) can be said if the correlation coefficient varies from ± 0.750 to ± 0.999, medium correlation - from ± 0.450 to ± 0.749 and small correlation - from 0 to ± 0.449. When the correlation coefficient is equal to zero, there is no correlation between the traits [9].

Statistical processing of the study results was carried out by methods of variation statistics and correlation analysis, estimation of statistical significance (p) of differences in arithmetic mean values using the professional package Minitab, Microsoft Excel 2012 and SPSS 11.5 [8]. Variation curves of distribution by height and chest circumference of boys and girls were obtained. For comparative analysis we used GOSTs of typical figures of girls and boys for clothing design [10, 11].

Calculation of asymmetry coefficients (γ_1) and excess (γ_2) by the method of moments [3]. To calculate the coefficients of asymmetry (γ_1) and excess (γ_2) for the variation series on the chest circumference it is necessary to fill in Table 2.

Table 2. Coefficient of asymmetry and excess of dimensional features.

Name of statistical parameter	Boys			Girls		
	Height (T1)	Breast circumference (T16)	Hip circumference (T19)	Height (T1)	Breast circumference (T16)	Hip circumference (T19)
Mean	151.798	74.76563	85.28829	147.0878214	73.88769	84.98823
Standard error	0.681377	0.429747	0.429961	0.561492304	0.424446	0.443006
Median	150	73	85	149	74	86
Moda	172	66	89	156	62	96
Standard deviation	18.573	11.70617	11,71988	15,2639181	11,53837	12,04293
Sample variation	344.9565	137.0344	137.3557	232.9871957	133.1341	145.0322
Excess	-1.13619	-0.38295	-0.26254	-0.64747067	-0.73131	-0.50029
Asymmetricity	-0.00228	0.575428	0.423001	-0.0368847	0.23324	0.08396
Interval	86.5	63	70.5	89	58.6	76
Minimum	105.5	54	59.5	108	52	48
Maximum	192	117	130	197	110.6	124
Sum	112785.9	55476.1	63369.2	108697.9	54603	62806.3
Score	743	742	743	739	739	739

Conclusions

However, it does not follow that when γ_1, and γ_2 are not equal to zero, the distribution cannot be considered normal. The algorithm for calculating the coefficients was carried out according to the method [1]. Table 2 shows the boundary values of skewness and kurtosis coefficients depending on the sample size at different probability levels.

Next, by comparing age groups and arithmetic mean values of body length and corresponding ages, growth groups were distinguished. In each growth group, the body length values (cm) corresponding to it, corresponding to the established values for the main leading characteristic, were distinguished. The boundary of body length values as well as age groups in each new anthropometric material may not coincide.

The next stage of processing is the calculation of static parameters for each of the four growth groups (arithmetic mean values, standard deviations, and coefficients of asymmetry and excess) and calculation of the full matrix of correlation coefficients. All parameters were calculated using the formulas given above.

To calculate the anthropometric standard, a regression equation was prepared for each subordinate trait, taking into account their main statistical parameters - $\bar{U}$ and δ_j and the correlation between the subordinate traits and each of the leading ones (separately for boys and girls).

The anthropometric standards (values of each of the subordinate features) calculated by the multiple regression equations for each selected child type figure should correspond to the values of these features found in the child sample under study.

Thus, for the correct construction of anthropometric standard for children it is necessary to know not only the degree, but also the nature of the relationship between leading and subordinate features. The values calculated by theoretical equations for each trait should correspond to their empirical values. Otherwise (even with the correct choice of leading features) the detailed dimensional characterization of these figures will not correspond to reality.

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UDC:528.4, 531.4, 536.2, 685.2

ANALYSIS OF THE WEAR EROSION TOPOGRAPHY OF FIREFIGHTER SPECIAL CLOTHING

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Annotatsiya. Mazkur maqolada o‘t o‘chiruvchilar maxsus kiyimlarining yemirilish topografiyasi o‘rganildi. Topografiya jarayonining dastlabki bosqichlarida material yuzasida ko‘rinadigan va tuzatib bo‘lmaydigan o‘zgarishlar ro‘y berishi, bu kiyimning estetik xususiyatlarini keskin yomonlashtirishi, ushbu holat mahsulotning xizmat qilish muddatini qisqartirishi aniqlandi. Maxsus kiyimning tez yemiriladigan uchastkalariga maxsus yong‘inga chidamli qatlamlarni qo‘llash tavsiya etildi va maxsus kiyim loyixalashda uning

vazni va materialning bikrlik xususiyatini ham e'tiborga olish maqsadga muvofiq ekanligi aniqlandi.

Kalit so'zlar: *topografiya, ishqalanish, yemirilish, maxsus kiyim, o't o'chiruvchi.*

Аннотация. В данной статье исследована топография износа специальной одежды пожарных. Установлено, что на начальных стадиях процесса топографии на поверхности материала происходят видимые и непоправимые изменения, что резко ухудшает эстетические свойства одежды, а это состояние сокращает срок службы изделия. На быстроразрушающиеся части специальной одежды было рекомендовано наносить специальные огнестойкие слои, а также определено, что при проектировании специальной одежды целесообразно учитывать ее вес и однородность материала.

Ключевые слова: *топография, трение, износ, специальная одежда, пожарный.*

Abstract. This article examines the wear erosion topography of firefighters' special clothing. It has been established that at the initial stages of the topography process, visible and irreparable changes occur on the surface of the material, which sharply worsens the aesthetic properties of clothing, and this condition shortens the service life of the product. It was recommended to apply special fire-resistant layers to quickly deteriorating parts of special clothing, and it was also determined that when designing special clothing, it is advisable to take into account its weight and the uniformity of the material.

Keywords: *topography, friction, wear erosion, special clothing, firefighter.*

Introduction

Special protective clothing is one of the most widely used personal protective equipment and is considered a necessary condition for reducing the dangerous and harmful effects that occur in the production process and maintaining high work ability and health of workers. One of the main goals of the world's large competitive sewing enterprises specializing in the production of special clothing is to produce protective clothing that does not allow the human body to be affected by the harmful factors of the external environment, and has high ecological, aesthetic and operational characteristics [1].

According to the Law "On Labor Protection" adopted in the Republic of Uzbekistan in 2016, to create comfortable working conditions, it is established to develop special clothes that protect against harmful production and climatic factors and to provide workers free of charge [2]. For this reason, special clothing must meet complex and complex requirements of protective, hygienic, operational and aesthetic nature. At the same time, it is necessary to maintain the normal functional state and working ability of a person during an emergency situation. Issues of production of highly hygienic and operational special clothing intended for firefighters in the republic require special research such as studying and identifying the positive characteristics of special clothing proven by many years of experience and the opinions of workers [3].

Currently, in production enterprises, it is required to use not only general clothes, but also special clothes designed for each category of employees, taking into account their specific working conditions. Taking this into account, expanding the production of special clothes with a high level of protection and providing employees working in the rescue service of the Ministry of Emergency Situations with competitive special clothes is one of the urgent tasks [4].

The materials used in special clothes for firefighters cause their degradation as a result of encountering thermal, mechanical, physic – chemical and biological effects [5].

Wear erosion of individual parts of special clothing exposed to external influences occurs unevenly. In this regard, clothing is distinguished by general and local wear the most common areas of friction are knees, elbows, the seat area of the pants, the bend area, the leg of the pants, etc., and in order to increase the service life of the clothes, these areas of the products are reinforced with additional layers of materials [7].

Research Methodology

Taking into account the above, it was aimed to study the wear erosion topography of the existing special clothes of emergency workers. Topography is characterized by the ability of products to resist external and chemical influences. Friction occurs in special clothing under the influence of the external environment. The degree and type of wear and tear of clothing depends on the fiber content and surface density of the fabric, as well as the texture and size of the interacting surface. When choosing textile materials for special clothing, it is important to choose fiber materials that are most resistant to wear and repeated deformation [6].

Figure 1. An overview of available custom clothing.

At the initial stages of the topography process, visible and irreparable changes occur on the surface of the material (breakage and structure of the warp and weft threads of the fabric), which sharply deteriorates the aesthetic properties of the clothing and shortens the service life of the product [8].

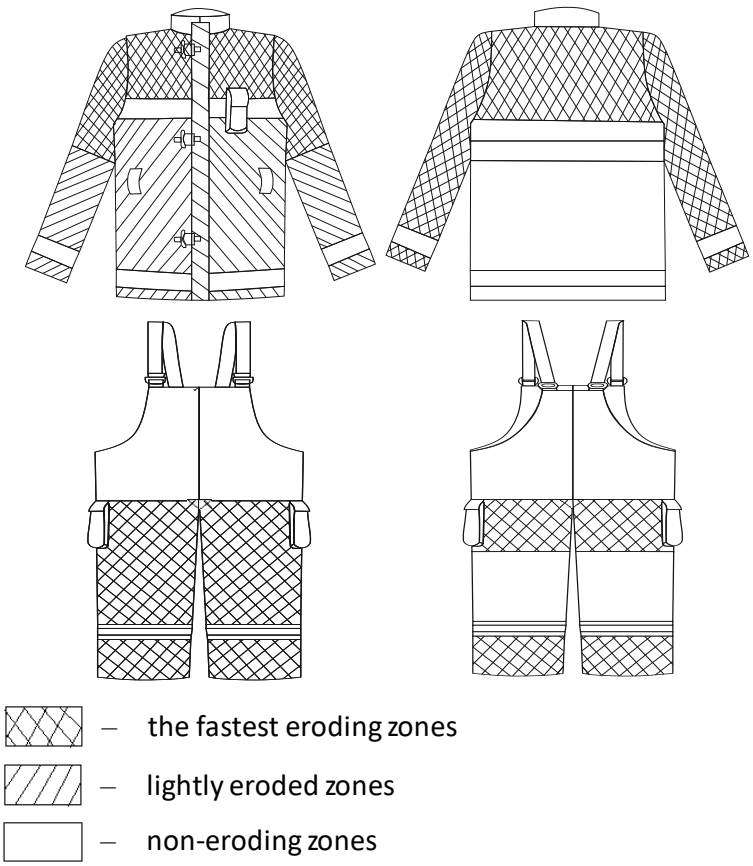

Figure 2. Degradation topography of firefighters' special clothing.

In order to study the topography of the existing special clothing of firefighters, the "Emergency Department - Fire - Rescue Department" of the Emergency Situations Department in Yakkasaroy and Chilonzor districts of Tashkent city was visited and research work was carried out [9].

A general view of the set of firefighters' clothing is shown in Figure 1, and the topography of wear erosion is shown in Figure 2 topography of erosion of special clothing of firefighters.

Analysis and Results

As a result of the research, the areas most affected by external influences are rapid wear erosion from the topmost part to the tip (100% of the rearmost part), rapid wear erosion from the frontmost part to the bending area, and light wear erosion from the bending part to the very tip (50% rapid wear erosion from the most anterior part and 50% light wear), special clothing jacket front, (30%) and back hem part (35%) and jacket front part slight wear (65%), pants front part from knee to leg (62%) and pants back seat and leg part (38%) was found to undergo rapid decay. Thus, it is recommended to use special fire-resistant layers reinforced in the fast-eroding areas of the special clothing. In addition, it was found that special clothing is uncomfortable to move due to its weight and its fabric is very coarse [10]. The analysis of topography of wear showed that the most important factor of wear is the damage caused by fire, acid and contamination of the fabric, as a result of breakage of warp and weft threads [11].

Examination of special clothes in the process of operation showed that the shoulder part of the front and back part of the jacket, the elbow part of the thigh, and the knee of the front part of the pants wear more due to friction during the fire [12].

In the process of operation, it was observed that the connecting sections of the clothing details, for example, the places where the pocket is attached to the front piece, the side seams, the front seams of the hem, were more eroded, and the sewing threads in the connecting seam were broken. In general, fabrics undergo repeated deformations due to friction. Based on this, it is appropriate to design reinforcing details in sections to increase the attachment strength of clothing pieces in these areas [13].

As a result of observation and question-and-answer study of the topography of the fire safety personnel's special clothing, the employees' opinions about the existing special clothing were determined. Based on the analysis, the following requirements were set for the new special clothing: increase the strength of the clothing, add additional pockets for tools, pay attention to the color of the material, put additional coating on the knee and elbow areas, use modern materials, create a new design of the special clothing [14]. One of the most important aspects in the development of special clothing for firefighters is the fire resistance of the clothing. In the development of new special clothes, the use of a package of materials that are light, have low uniformity, are fire-resistant, and are resistant to heat and wear increases the quality of the product [15].

Conclusions

Based on the results of the research, it can be concluded that, based on the study of the topography of wear and tear of the special clothing of firefighters, the most frequently rubbed areas are heavy wear from the back of the elbow to the tip, light wear of the front part, the front of the special clothing jacket and it was found that the back part of the jacket, the front part of the pants from the knee to the leg, and the back part of the pants meet with heavy wear erosion in the sitting and leg part. Thus, it is recommended to apply special fire-resistant layers to the fast-eroding areas of the garment.

In the next stages of this research work, when performing the functional tasks of firefighters, they will be devoted to studying the areas of thermal influence and forming special clothing packages.

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UDC: 504, 574, 6, 602

ANALYSIS OF THE INFLUENCE OF EROSION ON THE DESERTIFICATION PROCESS IN THE KHORAZM OASIS USING REMOTE SENSING DATA

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Annotatsiya. O‘zbekistondagi Xorazm vohasi uning nozik ekotizimiga jiddiy xavf tug‘diruvchi cho‘llanish va eroziya muammolari bilan kurashmoqda. Masofadan zondlash, sun’iy yo‘ldosh tasvirlari va havo ma’lumotlaridan foydalanadigan kuchli vosita bu mintaqada eroziyadan himoya qilish choralarini kuzatish va amalga oshirishda hal qiluvchi rol o‘ynashi mumkin. Ushbu maqola cho‘llanish va eroziyaga qarshi kurashda masofaviy zondlash texnologiyalarining imkoniyatlarini o‘rganadi, xususan, Xorazm vohasiga e’tibor qaratiladi.

Kalit so‘zlar: *USGS, RS, Oasis, Landsat 8, ESRI.*

Аннотация. Хорезмский оазис в Узбекистане сталкивается с проблемами опустынивания и эрозии, которые представляют серьезную угрозу для его хрупкой экосистемы. Дистанционное зондирование, мощный инструмент, использующий спутниковые изображения и аэрофотоснимки, может сыграть решающую роль в мониторинге и реализации мер по защите от эрозии в этом регионе. В этой статье исследуется потенциал технологий дистанционного зондирования в борьбе с опустыниванием и эрозией, уделяя особое внимание Хорезмскому оазису.

Ключевые слова: *USGS, RS, Oasis, Landsat 8, ESRI.*

Abstract. The Khorezm Oasis in Uzbekistan is grappling with the challenges of desertification and erosion, which pose significant threats to its delicate ecosystem. Remote sensing, a powerful tool that utilizes satellite imagery and aerial data, can play a crucial role in monitoring and implementing erosion protection measures in this region. This article explores the potential of remote sensing technologies in combating desertification and erosion, specifically focusing on the Khorezm Oasis.

Keywords: *USGS, RS, Oasis, Landsat 8, ESRI.*

Introduction

More remote recognition is gathering and analyzing data from a distance, typically using satellites or aircraft outfitted with sensors. These sensors gather information about the Earth's surface, such as vegetation cover, soil moisture, and land use patterns. More distant recognition data might provide valuable interactions in erosion-prone areas, allowing targeted trade for deterioration security.

Disintegration and desertification are closely related forms, and they regularly happen together or contribute to each other in certain situations.

Disintegration can contribute to the method of desertification by evacuating prolific topsoil and degrading the land. When disintegration expels the nutrient-rich beat layer of soil, it decreases the soil's ability to bolster vegetation development. As vegetation cover decreases, the land gets to be more uncovered to wind and water disintegration, encourage accelerating the degradation handle. Disintegration can create barren or sparsely vegetated areas that are helpless to getting to be desertified.

Addressing disintegration is crucial for anticipating and mitigating desertification. Executing disintegration control measures, such as terracing, form plowing, reforestation, and soil conservation practices, can offer assistance to anticipate the misfortune of soil, secure vegetation cover, and maintain the judgment of biological systems. By managing disintegration, it is conceivable to diminish the hazard of desertification and advance the sustainable utilize of land in arid and semi-arid locales.

Study area: Khorezm oasis is an ancient oasis in the lower part of Amudarya. The Khorezm oasis includes the Khorezm region of Uzbekistan, the southwestern part of Karakalpakstan, and the northeastern part of Tashkhovuz region of Turkmenistan. It borders (conditionally) Kungirot latitude from the north, Ustyurt plateau and Karakum deserts to the west and south, Kyzylkum desert to the south.

The formation of the surface of Khorezm oasis is related to the Amudarya accumulative activity. Sediment and clay deposits of the river accumulated in this area for thousands of ears and formed deltas (see Amudarya delta). The Khorezm oasis continued to the south until the Tuyamoin Strait. The oasis stretches for more than 300 km to the north and northwest. Its width is 10–12 km in the southern part of the edge (in the Tuyamoyn strait), 120–130 km in the northern part, 70–80 km in the western part of the Sultan Uwais ridge (in the Takhtatash strait). To the north of the Tuyamoyin Strait is the Khorezm Taskhovuz Plain. The surface of the Khorezm oasis was formed in the Quaternary period as a result of the gradual accumulation of alluvial delta deposits and the growth of the delta towards the Aral Sea and the Sarikamish depression. They are not uniform in terms of age and lithological composition. Lake deposits are also found in some small depressions. Agro-irrigation layers (thickness of 2-3 m) have accumulated on the lands cultivated since ancient times.

The Khorezm oasis is mainly a flat plain with a slight slope to the north and north-west. Due to the low slope, the Amudarya (especially in the northern part of the oasis) branches and flows slowly. Therefore, several qad. Uzans (Kokhnadaryo, Daryolik, Davdon, Shortonboy, Kreitozak, Itkraozak, Karaozak, etc.) were created. Among them there are several hills and ridges of different heights [1-3].

Literature Review

Until now, there have been a number of scientific works that analyzed desertification and its specific aspects in different directions. In particular, foreign scientists such as Atman Ait Lamqadem, Biswajeet Pradhan, Hafid Saber, Abdelmejid Rahimi, Marani Barzani and S. Khairulmaini [7], Hou J., Fu B., Wang S., Zhu, H. [9], Bouhata R., Kalla M. [10] conducted studies on the issues of desertification and soil erosion using

geospatial methods. Moreover, local scientists M. Matchanov [1, 5, 6], M. Sultanov [2], Q. Todjiyev conducted research in Khorezm oasis and its parts.

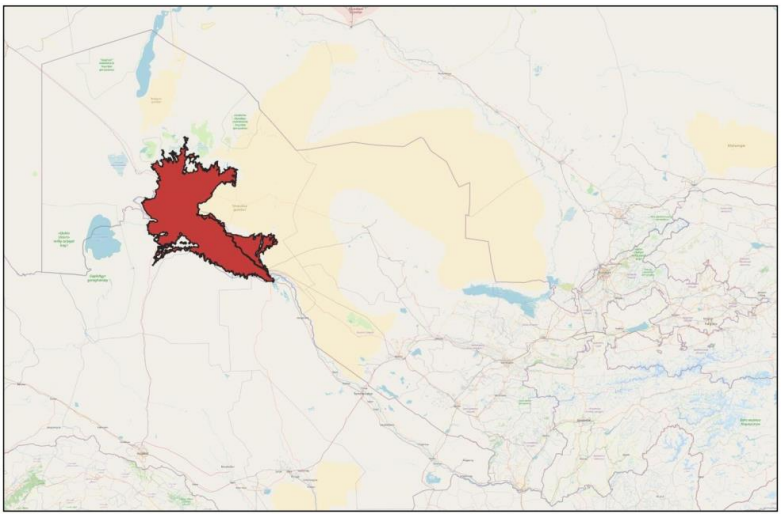

Figure 1. Boundary of Oasis Khorezm [1].

Research Methodology

To download Landsat 8 data from the United States Geological Survey (USGS), we are able to download Landsat 8 data from the USGS Earth Explorer website for use in your erosion protection mapping or other remote sensing applications.

These data were processed using QGIS 3.28.2 software [3]. That is, at the first stage, satellite images were combined, and then the land cover was classified [6, 8]. The area of the classified areas was determined.

QGIS provides a range of tools and plugins that facilitate these processing steps, including image preprocessing algorithms, mosaicking tools, and classification algorithms. These tools allow you to manipulate and analyze the Landsat 8 data to derive meaningful information about land cover and land use patterns, including areas prone to erosion.

By utilizing Landsat 8 data and QGIS software, you can effectively process and analyze satellite imagery for erosion protection mapping and other remote sensing applications, aiding in the understanding and management of erosion-prone areas.

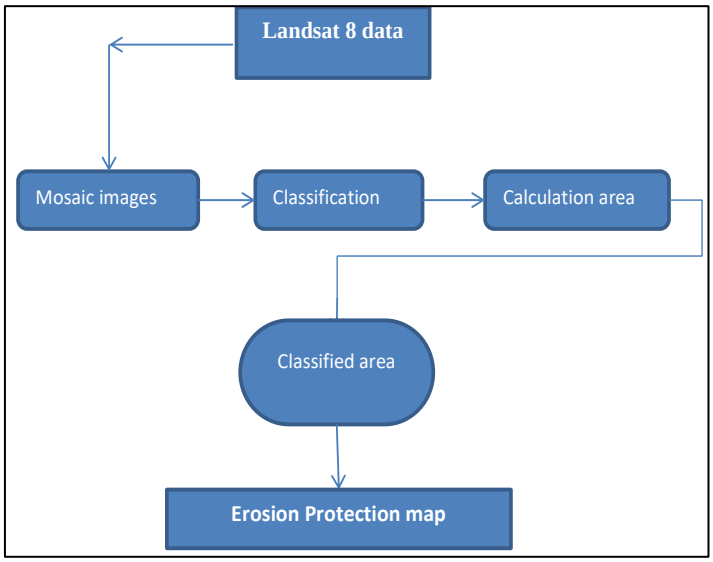

Figure 2. Flowchart of the methodology.

Analysis and Results

The assessment of disintegration security levels inside the Khorezm Desert garden yields interesting results. The results indicate that 35.1% of the region is rated as having a high level of protection against disintegration. This suggests that effective disintegration control measures are in place in these areas, lowering the risk of soil debasement and erosion-related consequences.

Besides, the examination demonstrates that 48.9% of the Khorezm Desert spring has a normal level of disintegration assurance. Whereas disintegration control measures are display in these ranges, there may be room for enhancement to upgrade their adequacy and scope.

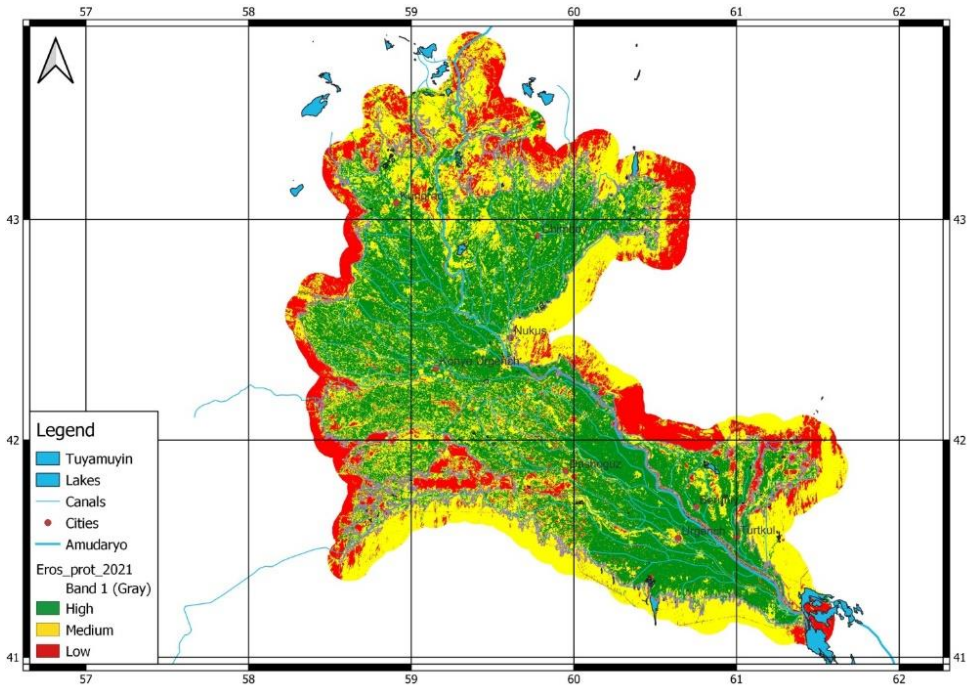

Figure 3. Erosion Protection map.

Be that as it may, it is concerning that roughly 16% of the domain encompasses a moo level of assurance from disintegration. These ranges are more prone to disintegration forms, placing them at greater risk of soil loss, reduced rural efficiency, and natural corruption (Figure 3).

To address this issue, it is necessary to prioritize disintegration control efforts in sensitive locations. Implementing cost-effective arrival management strategies including as terracing, reforestation, and soil preservation procedures can assist to reduce disintegration risks and protect impacted regions.

Also, raising mindfulness among nearby communities around the significance of disintegration avoidance and including them in preservation endeavors can contribute to long-term victory.

Proceeded monitoring and appraisal of disintegration security levels are basic to track the viability of existing measures and recognize regions that require quick consideration. By receiving a comprehensive and proactive approach to disintegration control, the Khorezm Desert spring can defend its biological systems, keep up agrarian efficiency, and guarantee the economic advancement of the locale.

Conclusions

Desertification is the process by which a wealthy land transforms into a desert by losing its flora and fauna. This might be caused by the dry season, deforestation, climate change, human activities, or unethical agriculture. Desertification is a process of land degradation. It happens because of man-made activities and climate change. Desertification takes place when a particular sort of biome changes over into a leave biome.

Based on the above, it can be said that it is necessary to ponder the dynamics of desertification and its geographical features and create ways to avoid it as before long as conceivable. One of them is by planting more trees – the roots of trees hold the soil together and offer assistance to diminish soil disintegration. The other strategy one can think about is Progressing the quality of soil, this can be managed by encouraging individuals to diminish the number of grazing animals they have and develop crops instead. The animal manure can be utilized to treat the crops developed. Developing crops in this way can make strides the quality of the soil as it is held together by the roots of plants and ensured from disintegration. This sort of farming is more sustainable. Another important strategy is water management. Typically done by putting away water in earth dams within the damp season, hence it can be utilized to irrigate crops amid the dry season.

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ACTUAL PROBLEMS OF HISTORY, PHILOSOPHY AND SOCIOLOGY

UDC: 93/94, 908, 551, 551.7, 7.036

DEVELOPMENT OF NEW LAND AND CONSTRUCTION OF IRRIGATION FACILITIES IN KHORAZM REGION
(The second half of the 20th century)

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Annotatsiya. Ushbu maqolada Xorazm viloyatida ikkinchi jaxon urushidan keyingi XX asrning o'rtalaridan to XX asrning oxirigacha bo'lgan davrda qishloq xo'jaligini tiklashda qaxramonlik namunasini ko'rsatgan xalqning fidokorona mexnati va soxa mutaxassislarining yangi yerlarni o'zlashtirish, sug'orish inshootlari qurish va qishloq xo'jaligida xosildorlikni oshirish maqsadida olib borgan fidokorona mexnatlari to'g'risida xikoya qilinadi.

***Kalit so'zlar**: agrotexnik tadbirlar, melioratsiya ishlari, suv bo'lgich inshootlari, shlyuz-boshqaruv to'siqlari, kollektor-drenajlar, Mashinyorgan, Sredazgiprovodxoz, Toshsoqa , Perepad, sug'orish tarmoqlari.*

Аннотация. В данной статье речь идет о самоотверженных усилиях людей, подавших пример героизма в восстановлении сельского хозяйства Хорезмской области, и самоотверженных усилиях специалистов отрасли по освоению новых земель, строительству ирригационных сооружений и повышению урожайности. в сельском хозяйстве. в Хорезмской области с середины 20 века до конца 20 века после Второй мировой войны.

***Ключевые слова:** агротехнические мероприятия, мелиоративные работы, водораспределительные сооружения, шлюзовые заграждения, коллекторно-дренажные системы, Машинярган, Средазгипроводхоз, Ташсака, Перепад, оросительные сети.*

Abstract. In this article, the speech goes on about the selfless efforts of the people who set an example of heroism in the restoration of agriculture in Khorezm region and the selfless efforts of the experts in the field to develop new lands, build irrigation facilities and increase productivity in agriculture.in Khorezm region from the middle of the 20th century to the end of the 20th century after the Second World War.

Keywords: *agro-technical activities, reclamation works, water distribution structures, sluice-control barriers, collector-drainages, Mashinyargan, Sredazgiprovodhoz, Tashsaka, Perepad, irrigation networks.*

Introduction

We can see that in order to end the consequences of the Second World War and to improve the economic situation of the people of Khorezm region, the leadership of the republic and the region has done a lot of work.

During this period, the leadership of the republic paid special attention to the implementation of irrigation and melioration works along with agro-technical measures in order to increase the productivity of newly acquired lands.

In fact, irrigation melioration was used in places where the natural moisture of the soil in Khorezm region was not enough for crops, and on the contrary, drainage melioration was useful in places where the moisture was excessive. The method of cleaning large canals with the help of mechanisms and irrigating fields with pumps, where excavation works were organized 2-3 times a year to clean irrigation facilities from mud in the region began to reduce manual labor. The equipment became widely used in the expansion of irrigation facilities and construction of new ones.

Literature Review

On August 17, 1950, the Central Government passed a decision on “Transition to the New Irrigation System”. According to it, small canals and ditches were finished and temporary tributaries were made instead of them. Instead of flood irrigation, the use of ditches and furrows, closed drainage, lowering of the groundwater level with the help of collectors, the use of local and mineral fertilizers for high yields have been implemented on a large scale.

By the 1950s, the Inter-Republican Tashsaka Main Canal was built in the bed of the Palvan Canal, which was re-excavated in 1939 by hashar method. 35,000 people participated in the construction of the canal, including 14,000 of them from Tashkhavuz region [1]. The structure built in the 34th kilometer of the canal, in the place called Topchi, on the border of Khanka and Baghat districts, made it possible to distribute the water flowing into the Palvan and Shavat canals according to the need.

Research Methodology

In the documents of the 14th Extraordinary Session of the Uzkompartiya, held on January 7-8, 1959, it was noted that along with the improvement of irrigation networks in Khorezm region, it is necessary to improve land reclamation and to complete construction of engineering structures at the head of canals and watersheds. In addition, a special instruction was issued “On the continuation of works aimed at the repair of

irrigation networks and development of irrigation in the Lower Amu Darya" [2]. By this time, 15 water separation structures, 80 sluice-control barriers were built in the water management system of Khorezm region and 80% of the land was supplied with running water [3].

Analysis and Results

In the early 1960s, 98% of the agricultural products grown in Uzbekistan came from irrigated areas. Therefore, attention was paid to the importance of irrigation and land reclamation in the development of production forces in the agricultural sector.

In the 7-year plan for 1959-1965, the task of developing 600,000 hectares of new land was set in the republic. Although the main focus was on the development of Mirzachol, the work of opening new lands and providing them with sufficient water was continued in other regions. In particular, in 1959-1965, the water supply of 50 thousand hectares of land in Khorezm region was improved, 2900 km as a result of the construction of collector-drainages, the land reclamation status of 90,000 hectares has changed. As of November 1, 1965, there were 32,260 hectares of non-agricultural land in Khorezm region, of which 4,290 hectares were reserved land, 21,442 hectares were pastures, 25,970 hectares were forests and thickets and 24,550 hectares were occupied by wetlands [4]. Expenditures for irrigation and land reclamation construction amounted to 50.0 mln soums [5].

Table 1. Allocated funds by the state for Khorezm region water management (million soums) [6].

Years	Total
1918–1932	6,4
1933–1940	3,7
1941–1950	2,7
1951–1960	9,3
1961–1970	117,3
1971–1980	550,0
1981–1985	361,1
1986–1990	214,4
1991–1995	754,6
1996–2000	2503,3

In May 1960, Fakhriddin Shamsiddinov, who served as the chairman of the executive committee of Fergana region, was elected as the head of Khorezm region. This person, who is an engineer-hydraulic technician, once served as the Minister of Water Management. The main attention of the new leader was focused on measures to solve the problems of acquiring additional land, further expansion of irrigation and reclamation networks. The advanced initiatives of prominent water management leaders in the region Juma Atashev, Madrahim Vafaev, Khudaybergan Mukashev [7], Ivan Dukhno, Akop Avanesov, Atabay Babajanov, Islam Eshchanov [8], Bazarbay Kengesbaev [9] and others to develop irrigation and land reclamation works were supported. As a result, Khorezm region rose to the top positions in the republic in cotton and rice fields. In 1960, 31.2 centners of cotton was harvested in the region.

During this period, most canals and ditches in Khorezm were dug by hand and thousands of people were involved in it. Excavation was an extremely difficult and

laborious exercise, which lasted from mid-September to March of the new year. After the digging of large canals and channels, cleaning of internal water networks began. 90-95% of the existing workforce, including women, were involved in this excavation and desalination of land. In addition, farmers with lands were forced to participate in the digging of inter-farm canals in order to earn a living.

In 1958-1968, 56 million soums was allocated from the republican budget for the construction of irrigation and melioration in Khorezm region and it was 12.9 times more compared to the previous decade [10]. By this time, there were large water structures such as 34 km length inter-republic Tashsaka, 160 km length Shavat, 140 km length Yarmish, 120 km length of Kilichbay, 102 km length Palvan, 90 km. length of Ghazavat, 17.1 km length Toranghisaka, 15 km length Bayramsaka, 12 km length Karamazi and Mashinyargan canals. Almost all of them were dug by hand with the cooperation of Uzbeks, Turkmens, Karakalpaks and other peoples.

In 1961-1962, water became scarce. Pumps were installed in the “Mashinyargan” [11] canal on the border of Baghat and Khanka districts, and additional water from the river was removed to the Shavat canal. One tractor, pumping equipment and 7-8 people from each collective farm participated in it.

In the distance from Tuyamoyin to Jumurtav, 44 ditches for 33 canals were taken from the left bank of the river and their capacity was also different. River water consumption was 1400 m^3 per second while Tashsaka canal was able to get 210 m^3 water, Kilichbay-arna and Toranghisaka – 150, Karamazisaka – 55, Daryalik-arna – 50, Bayramsaka – 41 and Urganch-arna – 30 [12]. In turn, 198,000 hectares were irrigated from the Tashsaka canal, 19,000 hectares from the Urganch-Daryalik-arna system, 90,200 hectares from the Kilichbay-arna (including 32,960 hectares in Khorezm region, 35,777 in the Tashkhavuz region, and 21,538 in the Amudarya district), 4.3 thousand hectares of Amudarya district and 3.0 thousand hectares of Tashkhavuz region were irrigated from the Kipchak-Bozsuv system [13].

In order to improve water intake from the Amu Darya river, the water carrying capacity of the existing canals was expanded and new hydro-technical facilities were built. In addition to the inter-republican Tashsaka canal, the Palvan-Ghazavat canal system was renovated. The abandoned old Bayramsaka and Mashinyargan irrigation canals were restored.

In 1964-1965, based on the “Sredazgiprovodkhoz” project, a new Toshsaka main facility was built in PK-1+85. The water carrying capacity of the canal, located 140 m from the old Toshsokha facility, is 89 m^3/sec. The structure consists of 2 gates, 12 m wide, open type, monolithic reinforced concrete. For the entry and exit of ships, a 43-meter-long sluice is installed, and 1 of it is taken to the shore. The sluice chamber is made of reinforced concrete walls that raise the high-water level up to the mark of 115.50 m and the lowest mark is 109.10 m. A 6 m wide road is made for vehicles to pass over the structure.

DER-250 dredges brought from Czechoslovakia with a capacity of 1,100 liters of water per second became very important in cleaning rivers and canals, as well as throwing additional water into canals and channels when the water level was low. The floating water lifting station had 3 pumps, each with a capacity of 2.5 m^3/sec. An 800-

horsepower diesel engine was installed to drive them. The first of these earthworks was assembled and put into operation in 1965 by the specialists of Tashsaka KMK.

In 1965-1967, expansion and reconstruction of major main canals in Khorezm – Tashsaka, Palvan, Ghazavat, Shavat, Kilichbay-arna, Urganch-arna were carried out. Later, such events were also held in Daryalik-arna (previously "Oktyabr-arna") supplying water to Yangibazar district, Khanka-arna in Khanka district and "R-8" in Yangiarik district, Kulavat in Urganch and Koshkopir district, Palvan and Zeyap canals in Khiva district [14]. The use of mechanisms in the construction of water structures in the oasis had been expanded. Dredgers were a great help in cleaning Palvan, Ghazavat and Shavat canal networks and digging ditches.

In 1968, main dams were built on Daryalik-arna, Khanka-arna (formerly "Saburzak") and Toranghisaka canals (the length of the canal is 7.1 km, the dam is 6.8 km from the river). The Toranghisaka canal provided additional water to farms in Kilichbay-arna and Gurlan districts. In 1969, the team of the Gurlan KMK carried out the laying of one underground reinforced concrete pipe with a volume of 15 cubic meters per second in three places under the Gurlan canal and 35 cubic meters per second from the bottom of the Kilichbay-arna canal. As a result, the land reclamation of all state and collective farms in the district improved and productivity began to rise.

On June 25, 1968, by order No. 339 of the Ministry of Reclamation and Water Management of Uzbekistan, the "Directorate of Irrigation and Water Management" was established within the Khorezm Regional Water Management Department [15]. Experienced specialist Egambergan Kadirov was assigned the task of designing construction objects, preparing estimate documents, and carrying out control work to the employees of the directorate [16]. Among the initial works, attention was paid to connecting the waters of Akkum and Gavdasha lakes in the Shavat district through new drains to Shavat-Andreevsk and the Chinese branch to the Ghazavat-Davdan collector.

Later, the Amu Darya banks were strengthened, tetrahedrons and spurs in the Ding area of Kilichbay-arna and Gurlan section were installed, Ulli Shorkol, Devonkol and other collectors were renovated, lands for "Karakum" state farm were developed, the city "Suvchilar" was constructed in Urgench and constructions of buildings of Urgench hydromelioration technical school, reinforced concrete and excavator plants, a silicate plant in Khiva district were carried out. In addition, the trust's specialists worked selflessly in the development of new lands, construction of hydrotechnical structures, construction of farms, residential houses, schools, medical and trade outlets in the newly established state farms.

In 1968, the team of the Urganch construction and assembly department built the Varangzon hydrostructure, which distributes water to the Akyap, Pirnakhos, Pishkanik, Ghavuk canals in Khiva district. As a result, opportunities were created to provide additional water to collective farms named "Uzbekistan", "Agahi", "Frunze", "Khiva" and "Al-Khorazmi" in the district [17].

Increasing the volume of water, in addition to significantly reducing the density of salt washing, had a positive effect on reducing the duration of field works and improving its quality. According to the Head of Khorezm Regional Public Enterprise K. Sapaev, in 1972, 11.2 million soums was allocated on construction and repair works. In that year, the "R-8" canal, which supplied water to Khanka and Yangarik districts,

was renovated. Reinforced concrete works worth 1.1 million soums were completed to strengthen the banks of the Amu Darya [18].

In 1972, Rajabboy Sobirov [19], who was the head of Khazorasp district, took the initiative to build a new "Khazorasp" channel. The length of the channel receiving water from the place "Perepad" (the place where the canal water passes over the mountain and falls into the oasis) of the left bank Tuyamoyin canal was 26 km long and 40 m^3 of water flowed from it per second. 9 km of channel at the head of the channel was dug completely anew. The remaining parts were expanded by connecting to 12 canals such as Yangibazar ("R-1"), Karvak ("R-2"), Avshar, Muhaman, Khassa. The excess water from farms in Khazorasp district was transferred to the lands of Baghat district.

A veteran of the water industry S. Rozimov [20] remembers with interest About the exciting events that took place during the canal's more than 40 years of use, (breaking the ice in front of the hydroelectric facility in the spring, the water passing through (rat) mouse hole at night splashing under the asphalt of the inspector's road on the bank of the canal, fair treatment of the requests of the heads of collective farms during the water shortage, etc.).

In the ninth five-year period, the material and technical base of the water construction sector was strengthened, along with state capital funds for irrigation and reclamation works, collective farms also received 25 million allocated funds of sum. The number of earth digging and levelling machines in construction organizations reached 1112, including 265 excavators, 271 bulldozers, 398 bulldozers and 174 scrapers.

Reconstruction of R-5 and R-8 canals in Khanka and Yangarik districts, Naiman-11 in Baghat district, Urganch-arna, Kulavat, Gurlan network in Urganch district, Palvanyap, Akyap, Sayatyap in Khiva district, Komunizmyap, Bozyap, Davdan canals in Shavat district was done. The length of the established irrigation networks was 440 km and 535 km collectors were dug and 1329 hydro-technical facilities were built in them. By 1975, the length of irrigation networks in the region was 6.5 thousand km and collectors exceeded 5.7 thousand kilometres. They had 5257 hydro facilities [21].

Table 2. The length of irrigation networks in Khorezm region (km) [22].

Years	Inter-republic channels	Inter-farm channels	Internal ditches of farms	Total
1920	No data	975	18525	19500
1940	446	2335	26000	28781
1950	278	2755	23460	26493
1960	292	842	20190	21234
1970	341	1100	16710	18151
1980	349	1664	16960	18973
1985	349	1962	11642	13953
1990	349	2051	11901	14301
1995	349	2239	12428	15136
2000	349	2374	13931	16654

In the water management system of Khorezm region, attention had been paid to the implementation of the results of scientific researches and conducting experiments.

With the help of Bazarbay Khudayberganov, the chairman of the board of “Pravda” collective farm in Khanka district, irrigation of cotton fields with hydro-automatic machines was started and horizontal drainage was built. With the support of Rozmat Madaminov, the chairman of Frunze collective farm management in Khiva district, the laying of polyethylene pipes for irrigation of cultivated fields has begun. An experiment of capillary water distribution was conducted at the Karakum state farm [23]. Construction of vertical and vacuum drains began in the Karl Marks collective farm in Khazorasp district [24].

In 1975, Khanka KMK was established and its team carried out renovation works of “R-9” and Nukusyap canals, Jirmizkol and Oblkol collectors. The part of Mollayap canal passing through the center of Khanka district was concreted among the first in the region. With the construction and repair of canals and collectors, a number of bridges, water management structures were installed, inspector roads were built.

In the late 1970s, the idea of placing Khorezm regional water management offices in a single building was put forward. He was supported by the heads of the regional water management department – Kalandar Sapaev, Oktam Muhammadiev, Yoldash Ismailov, Akop Avanesov and the Minister of Water Management of Uzbekistan, Salijon Mamarasulov. As a result, according to the instructions of the Chairman of the Khorezm Regional Executive Committee, Rahim Eshjanov, land was allocated for the construction of the building. In a relatively short period of time, the “Watermen's House” with all the amenities was built, and the regional “Xorazmsuvqurilish” trust, the “Xorazmsuvloyiha” group and its land reclamation department, customers and the construction directorate were placed in it. Experienced specialists working in one building often meet, exchange ideas and consult, creating new opportunities for working together for the oasis perspective.

Between 1946 and 1965, one third of the construction of the water industry was funded by collective farms. Nevertheless, in the years after the war, the volume of capital funds allocated to the field of irrigation and land reclamation increased sharply. 402 million sums were spent on this system in 1956-1960 whereas 5 billion 750 million sums were allocated in 1976-1980 and 6.4 billion sums in 1981-1985. [25]. In addition, only 20 percent of the above funds were used for land reclamation [26]. Treating this field as secondary was strongly criticized at the 27th Congress of the former CPSU, the 16th (1984) and 5th plenums (1987) and 21st Congress (1986) of the Central Committee of the Uzkompartiya.

Despite the increased economic and ecological tension, necessary conditions for the development of all branches of agriculture were created thanks to the selfless work of specialists working in the water management system of Khorezm region. Khorezm farmers achieved remarkable results, especially in terms of high yields of cotton and rice. The effectiveness of irrigation works depended to a large extent on the conduct of reclamation activities. A lot of work and expenses were also spent on building a system of collectors and ditches for draining, cleaning them on time.

Conclusion

In conclusion, the continuous development of agricultural production in Khorezm oasis was mainly dependent on the level of irrigation and land reclamation. This was

fully confirmed by the experience of irrigated farming culture, the effectiveness of mechanization and chemicalization, and the rapid development of cotton growing.

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SOCIOLOGICAL ANALYSIS OF THE DEVELOPMENT OF TEACHINGS ABOUT PUBLIC SERVICE AND MANAGEMENT IN UZBEKISTAN

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Annotatsiya. ushbu maqolada O‘zbekiston hududida davlatchilik va davlat boshqaruvi hamda shakllanishi bilan bog‘liq yondashuv va nazariyalar tahlil qilingan. Xususan, davlatchilikning paydo bo‘lishi bilan davlat xizmatining institutsional asoslari shakllanishi jarayonida antik davr va Sharq olimlarining davlat boshqaruvi hamda bu boradagi qarashlarining rivojlanish tendensiyalari yoritilgan. Bunda boshqaruvning ilk bosqichlarida davlatni idora etish va jamoa tartibini saqlash, boshqaruv shakllari, rahbari va boshqa mansabdorlarni tanlash, muhim qarorlar qabul qilishda oqsoqollar kengashiga tayanish, jamiyat manfaatlarini e’tiborga olish, muammolarni adolatli hal qilishga oid yondashuvlari ochib berilgan. Boshqaruv rahbarlarining xulq-atvori, aql-zakovati, zarur fazilatlar va sifatlarga ega bo‘lishi to‘g‘risidagi fikrlari ko‘rsatib o‘tilgan. O‘rta asrlarda davlatni idora etish va jadidlar davrida boshqaruv sohasini isloh qilishga oid jihatlar yoritilgan.

Kalit so‘zlar: *davlat boshqaruvi, davlat xizmati, hokimiyat, siyosat, adolat, ideal davlat, vazir, arbob, devon, jadidlar, modernizatsiyalash.*

Аннотация: в настощей статье проанализированы подходы и теории, связанные с государственностью, государственным управлением и их формированием на территории Узбекистане. В частности, освещены тенденции развития взглядов античного периода и мыслителей Востока о государственном управлении в процессе формирования институциональных основ государственной службы с возникновением государственности. При этом раскрыты подходы в отношении правления государством на ранних этапах управления и соблюдения общественного порядка, выбора форм управления, руководителя и других должностных лиц, опоры на советов аксакалов при принятии решений, учета интересов общества и справедливого решения проблем. Указаны мнения о характере, сообразительности руководителей, обладании их необходимыми достоинствами и качествами. Освещены аспекты правления государством в средневековье и реформирования сферы управления в период джадидов.

Ключевые слова: *государственное управление, государственная служба, власть, политика, справедливость, идеальное государство, министр, деятель, администрация, джадиды, модернизация.*

Abstract: this article analyzes approaches and theories related to statehood, public administration and their formation in the territory of Uzbekistan. In particular, it highlights the trends in the development of views of the ancient period and Eastern thinkers on public administration in the process of forming the institutional foundations of civil service with the emergence of statehood. At the same time, approaches are revealed regarding the governance of the state at the early stages of governance and maintaining public order, the choice of forms of governance, the leader and other officials, reliance on the advice of aksakals when making decisions, taking into account the interests of society and a fair solution to problems. Opinions are indicated on the character, intelligence of leaders, their possession of the necessary virtues and qualities. Aspects of government in the Middle Ages and reform of the sphere of governance during the jadids are highlighted.

Keywords: *public administration, civil service, power, politics, justice, ideal state, minister, figure, administration, jadids, modernization.*

Introduction

In each country, public civil service, regardless of state construction, existing political system and types of state, is one of its integral elements as a mechanism for strengthening bonds with the deeper society. At this stage, the state stipulates the the need to determine its aspects as an institution in the study of civil service.

It is not only of scientific and practical importance, but it also serves to organize a state-of-the-art public service in the country, modern, efficient, transparent, competitive, prestigious and focused on efficiency.

Literature Review

The history of statehood and the formation of public administration on the territory of Uzbekistan dates back to ancient times. While it is worth noting that state and

community management in this region was formed in the middle of the third millennium BC, we consider that our people have a very extended history in the field of civil service. The main essence of Public Service and management is approached on the basis of a fair solution of problems and the interests of the community. In the contemporary world, steady reforms for the development of the Civil Service are being carried out in our country, the mechanisms of these activities are improving. In such conditions, the formation of a modern and effective public service is one of the priorities. In his address to the Oliy Majlis, the President of the Republic of Uzbekistan, Sh.M. Mirziyoyev, emphasized that "Today, life itself requires us to develop an effective system for the formation of a professional, fast and efficient public service system, and for the development of an effective system for opening a wide path to new-thinking, enterprising, loyal personnel" [1].

Research Methodology

The issues of public services are also being studied as an object of research in public administration, political science, psychology and other disciplines. In recent years, such problems have been proactively studied from a sociological point of view. It is important to analyze the concepts of "civil service", "civil services of the state", theoretical approaches and aspects of historical formation from a sociological point of view. In this, the concept of "state" from a sociological perspective was based on a new approach to its place and role in the implementation of administrative reforms, as "the state is the main reformer".

In the references, the state is analyzed as the main institution of the structural structure of society, which organizes, directs, and controls the interaction and activities of people, groups, strata, and organizations from a social point of view. Therefore, the concepts of "state", "public administration", "public service", "state civil service", "institute" are inextricably linked and interconnected.

Public service is a professional activity that ensures the implementation of functions and powers of state organizations and officials. During the regulation of the life of the state and society, the civil service acts as a socio-legal institution. It helps to strengthen relations between the state and citizens, to develop democratic norms in society, to observe law and order, and to ensure legitimacy.

Analysis and Results

The public service is a broader concept than the civil service. The public service includes the civil service, armed forces, parastatals, etc. Not every public servant is a civil servant, but every civil servant is a public servant. In the researches, public service is interpreted as the main direction in working with public servants, which represents a set of important principles and rules, which should be implemented in the state decisions in a certain period or perspective. In particular, the essence of the concept of working with civil servants also adds to this service such as selecting candidates, placing them in place, training, retraining and improving their skills, ensuring their growth in positions, forming a personnel reserve, planning their movement and evaluating their activities [2].

The history of statehood in the early years showed the necessity to protect the state from internal and external threats, ensure the orderly development of socio-economic

relations and ensure fair management, control, regulate the relations of different strata in society, form a system of public service and effective management. The need to solve such tasks led to the formation of respected individuals in the community, namely guides. The development of socio-economic relations laid the groundwork for the separation of a corps of individuals from a separate category in society. Thus, the introduced procedures created and practiced by the community of these individuals became the basis for the formation of Public Administration, leadership and public service [3].

In this region, the issues of the formation of statehood, the maintenance of Public Administration and order in the early stages of the emergence of government, the selection of the head of state and other officials, appointment were resolved largely by the decision of the community, the council of elders, the heads of government of the religious and military, livestock-peasant and craft classes.

The civil service can be included in the category of the phenomenon of civilization. With the emergence of statehood in the ancient world, the institutional foundations of the civil service began to take shape. Interests in this phenomenon can be found in the works of scientists of antiquity, in particular Plato and Aristotle. All theories related to the construction of the state and the development of society embody the essence of the principles associated with the implementation of the powers of Public Administration and power.

Looking back on history, the ancient Greek scientist Plato (427-347 BC.) created a model of ideal civil service, providing what qualities and behaviors a person serving in the field should possess. According to him, the state should be kept in the disposal of the aristocracy, and the people should be forced to obey to upper classes. Plato, in his theory of the “ideal state”, divides society into 3 classes: statesmen – philosophers; timocracy - guards (military); peasants and artisans. Here, philosophers with the potential of wisdom can judge and rule the country, warriors with a tendency to militancy are occupied with defense, and the owners of creativity (peasant, artisan) are occupied with the cultivation and production of material goods. It is necessary that philosophers and warriors do not have private property, since this situation threatens to abuse their duties and duties by them. It is necessary that philosophers and warriors do not have private property, since this situation threatens to abuse their duties and duties by them. By comparing the ideal state to the mandatory office, four principles such as wisdom, courage, moderation and justice should be prioritized in such a state. He interprets righteousness as a state-specific virtue. He highlights that individuals in the public service must first have the qualities mentioned [4].

The scholar of antiquity Aristotle (384-322 BC.). Analyzes the construction of a state known to itself, in contrast to Plato, and proposes a State-Building option that he considered acceptable. Aristotle distinguishes six types of state construction. In essence, they represent three manifestations of the form of government, each of which will have the right and wrong forms: royal power – tyranny, aristocracy – oligarchy and political – democracy. The scientist focuses on democratic governance in choosing a rational and perfect political form. It approves of the relative integrity of the state. He believes that the main goal of the state is to provide citizens with a comfortable life. He refers to the character of civil servants in his work “Politics”. The civil servants’

rule over free people, not slaves. A different aspect of civil servants than other people is their deliberative bid. The well-being of the state depends on two components, namely the correct laying of tasks and the final purpose of any activity. By itself, only thoughtful civil servants correctly define tasks, indicate ways to achieve the goal and provide them with means of implementation [5].

Oriental are aimed at creating a huge spiritual heritage on the secrets of state, public administration, leadership, and they are still relevant today. Theories have been put forward as to what qualities a civil servant may possess.

Notable are the views of Abu Nasr Farabi (870-950) on politics, the state, power, the civil service and the governor of the city of learned people. The scientist's views on a illuminated society, the demands of democracy and fair governance of the state were embodied in his work “The city of illuminated people” and “The aphorisms of a statesman”. Farabi divides city-states into “Illuminated” and “ignorant” types, and emphasizes in “Illuminated city” the need for an enlightened, wise ruler and his good manners and ethics, to act by relying on the opinions of sages and scholars of his time [6].

In his opinion, it is necessary that the first chief of the city of phosiles was primarily a wise man and united the twelve qualities in himself. They are as follows: 1) he is much healthy and should not have defects in any member in the performance of the tasks assigned to him; 2) by nature, he is thinly savvy and can quickly progress the words of the interlocutor and imagine what is the general situation in this area; 3) it is necessary that he fully stores in his memory what he understands, sees, hears, perceives, and does not forget all the details; 4) the mind is sharp, ingenious and can perceive the symptoms of anything and understand what he is communicating; 5) be able to explain his opinion in clear and beautiful words; 6) be passionate about education, knowledge and enlightenment from mentors, be enthusiastic for knowledge and avoid his hardship; 7) be able to indulge in entertainment, indulge in eating food, drink and intimacy with women, be away from gambling; 8) hate those who ardent, deceitful and truthful people, hate lies and liars; 9) to be a person of self-worth and non-authority, to rise above inferiority, to be high, to pursue great and high deeds; 10) not to chase after the world; 11) to be fair, to support the justifiable, to uphold the justifiable, to hate injustice, to oppressors and oppressors, to be equally fair to his people and others; 12) it is necessary for him to show determination in performing the action that he considers necessary, to be brave, courageous and brave, not to allow cowardice and hiccups.

Contrary to Plato, who believed that only rich people should rule the state Farabi states that any virtuous person who has more than half of the twelve qualities mentioned above can be the leader of a city. It should be noted that in this work, the scientist justified the management of the state in a collegial manner. The followers of the ruler of the illuminated city can observe the law and order issued before, and in them six qualities, namely 1) wisdom, 2) be able to keep in memory and follow the laws established by the previous rulers, 3) develop new rules if no order was established in any sphere under the previous rulers. 4) mentions the need to have sufficient physical strength and know the art of militarism so that he can understand the current situation and see what consequences it has in perspective, 5) have the art of oratory, 6) lead

military affairs. It has been shown that if a person is not found who sums up all of the characteristics mentioned, two people will come together or a group of individuals with these qualities will carry out the leadership of the land in an agreed order [7]. In our opinion, such thoughts are considered a very bold and progressive idea for that time.

Abu Ali ibn Sina (980-1037) in his work "Risolai tadbiri manzil", the main task in the study of the methods of implementation, leadership and organization of power in the cities of "illuminated" and "ignorant" was to highlight the reasons for their prosperity, decline, fall and change. In his view, if all men were made up of kings and sultans, or all were labourers and had no leaders, they would all have perished. The scientist also discusses on the fact that social relations are caused by differences and inequality between people. In particular, Ibn Sina argues that "inequality according to economic and social and personal characteristics is the cause of a person's social activity. And building an ideal state is associated with the spiritual and moral prosperity of the people of society". In his opinion, the high positive reception of spiritual and moral values ensures not only comprehensive well-being, but also justice and stability in society. It divides people into three groups, depending on their place and duties in society: a) those who serve in government agencies and are engaged in the management of society; b) those who are directly engaged in the production of raw materials, necessary products; c) the military, which provides for the protection of the state, its protection from various external attacks. These groups of society are interdependent and always communicate, unable to live without each other [8].

Abu Rayhan Beruni (973-1048) promoted ideas about the formation of a just society and the foundations of its functioning in the works "Monuments left over from ancient peoples", "India". He believes that the emergence of society is caused by people's mutual cooperation, the need and aspirations to live together. Building a just society should rely on moral values and be developed. The main task of the head of state is to establish criteria for justice between different segments of the population, the strong and the weak. This is achieved in his opinion by building an ideal social structure [9].

Yusuf Khass Hajib (1016-1070) in his work "Qutadgu bilig" ("Knowledge of bliss"), paid special attention to the procedures for the state system and governance, and to the decision-making of socio-political and political-moral relations in society [10]. The scientist focuses on the virtue of the manager, that is, the leaders, as a result of the dichotomy of society. Indicates two different methods of selection for office: on the basis of the leadership (leader) and on the recommendation of a leader of a certain level. It classifies the qualities of Public Administration and service figures in relation to what they should be, what characteristics they should have. In particular, "claimants to the kingdom are born with a wonderful talent from the mother, and they immediately have the Fitrat of separation of good and evil. Those to whom Allah bestows perception, insight, and a gentle indulgence, and in addition to a good study of stationery".

The scientist also defines the requirements for ministers as follows: the minister must be firm and righteous, and encourage others to follow this path. The ministry is a glorification, it needs confident, mature and advanced, well-groomed, wise and gentle soul, and at the same time, bold and courageous. The Ministry needs someone who is

honest and fully aware of writing and drawing. His behavior should be pleasing to many people, and his language should be the same. Those who have shame and have no dirty language are worthy of this. Those who are clear sighted, intelligent, wise, sensitive, and able to distinguish between good and bad are worthy of the ministry. If the boss keeps his language and heart right, his employees and subordinates will also choose the right path [11].

In "Qabusnoma", Kaykovus expresses his concepts on the administration of the state and the people, what aspects to pay attention to in the relationship with the society, the requirements for the leading person and perceived qualities.

A medieval scholar, statesman, Abu Ali Hasan ibn Ali Tusi – Nizam-ul-mulk (1018-1092), who served three Sultans at the Seljuq court.) His treatise "Siyasatnama" ("Siyar ul-muluk") is a huge scientific legacy on the creation of fair public administration, its perfect theoretical and practical rules

This work presents views on the choice of officials according to their moral qualities, the non-interference of people who trample justice and honesty in state affairs, work with the council in the management of the state, regular control of their activities, obedience, performance and qualities. It is also notable for its many examples of the requirements required for a person in the civil service to rise from a private to an army commander, with elements and technologies of Ghaznavid and Seljuk rule of the time. Nizam-ul-mulk's ideas, in particular, that "The decision which is accepted as a majority will be the most rewarding and should be done that way" are evidence that they paid great attention to the fair order of state building [12].

The views of Abu Zayd Abdurahman Ibn Khaldun (1332-1406) on the form of government of the state, society and its life are considered especially relevant for its time, for the development of subsequent social thought, and for the current period, especially on social and development [13].

As he mentions the statesmanship as a social phenomenon "defends the religious and secular interests of all in line with Sharia views. The authorities believe that it is not a natural need for a person, but the need for society. If people are allowed the opportunity to act according to their nature and essence, they will be selfish, arrogance and evil. If any of them had an eye for the property of their birth, he would have sought evil. This can only be stopped by the authorities and the ruler. It divides the types of power into forms such as caliphate, emirate, sultanate, which are distributed in Muslim states.

Ibn Khaldun notes that "in maintaining its economic life, the state first develops new types of taxes. Secondly, the state begins to interfere in market relations. It exerts direct and indirect control over trade". According to the scientist, the state is the mirror of society; it cannot exist without the material and spiritual production activities of people.

The "Instructions" by Sahibqiran Amir Temur (1336-1405) continue to be a model school in the field of public administration, carried out in a combination of enormous potential, skill, knowledge and experience in maintaining political, socio-economic, spiritual and ideological stability of the state. In this work, Amir Temur himself practiced and introduced twelve rules on compliance, both in the conduct of those who came to power after him and in the administration of the state. "In my experience, I

saw that if the state is not built on the basis of a religious game and does not bind to the principles, then the order of the glory, the power of the realm will disappear. It can be likened to a house with neither a roof, nor a door, nor bars that any villain can enter. Therefore, I fulfilled my realm on the basis of Islamic principles and instructions of work in management" [14].

Amir Temur prioritized the leader's reliance on Justice. In his opinion: "A leader must follow Justice in all things: he must appoint a person who is not sold and is the owner of virtue to the ministry, because a just Minister is limited in himself-the leader can correct injustices, but if the minister himself is so, then the catastrophe is imminent". The entrepreneur considered the ruler's ability to select officials and put them in place as an important condition for the exercise of power. For example, a person applying for the position of a minister must have four qualities: "the first is nobility, pure birth; the second is intelligence; the third is to be aware of the condition of soldiers and gentry, to be polite towards them; the fourth is patience and peace-loving". Whoever possesses these four qualities, let him be considered worthy of ministerial rank. Let them appoint him as a minister or adviser. Let them hand over the affairs of the country, the discretion of the soldiers and citizens to him. Such a minister should be given four privileges - trust, attention, discretion and power [15].

Mirzo Ulughbek (1394-1449) in his work "History of four nations" mentions a number of characteristics of people who are involved in the administration of the state in the Turkish khaganate. For example, the characteristics that led Turkkhan to leadership include the following, that is, he discovered new ways of managing the people; smart and polite; craftsman; an elegant man who can choose a good and safe place for the people who live on the move; benevolent benefactor; the man who invented centralized government; distributor of leadership; initiative in the development of new measures for peace and prosperity; followed and developed customs and rules; introduced the administration of the people in groups; indicates that it should have the same qualities as the introduction of a ruling - administrative office based on consultative management [16].

The great poet and Sultan of the realm of words, who lived in the 15th century, A. Navai (1441-1501) in his works argued that the problems of the socio-economic system can be realized only in a country ruled by a just ruler and where the law is a priority. In particular, in the epic "Saddi Iskandari", he creates the image of the ruler in his ideal, bringing a number of features that are prerequisites for him. In his "Khayrat-ul abrar" and "Mahbub ul-qooloob" [17], he expounds a number of descriptive-critical considerations typical of rulers and leaders.

Navai emphasizes that power should be governed mainly by a single person, while the ruler should rely on the opinion of wise advisers in the process of making important decisions on the socio-political issue. He believed that justice and law were the basis of social progress. In his concept, the personality of the ruler is of particular importance. Reflecting on the virtuous and ideal person, Navai creates a unique humane theory. In his theory, the scholar compares the ruler and gardener on the one hand, and the state and the park on the other. According to him, if the gardener is intelligent and hardworking, his garden will flourish. Likewise, if there is a ruler of the

country who is intelligent, wise, fair, who cares for his people and loves him, he will develop and prosper.

Khawaja Samandar Muhammad ibn Baha Termizi (1638-1740) was the son of Muhammad ibn Baha Termizi) in his "Dastur ul-muluk" [18], he also reflects on a number of qualities and characteristics that are a prerequisite for Public Administration and officials. He describes each quality and property necessary for management and compliance in a separate season, revealing their essence through various examples and "proverbs". The management of the service of the king by two categories of people emphasizes the fact that it is proven in experience: the first category – knowledgeable, intelligent, elegant, master of words and sweet, while the second category – weak, mentally retarded. Proverbs about the choice of leaders in the careers of the public administration system, the use of the opinions of citizens in the performance of a task, work worthy of ability and competence are classified in close connection with each other, in a logical sequence and depending on the degree of significance.

References to government and civil servants (officials) are found in the works of some medieval statesmen, figures of science, and poets.

Included there Husayn Voiz Koshifi's "Futuvvatnomai Sultani", Hafiz Tanish Bukhari's "Abdullanoma", Mir Muhammad Amin Bukhari's "Ubaydullanama" ("Book of Ubaydullakhan"), Abulghazi Bahadirkhan's "Shajarai turk", Mahmud Ibn Wali's "Bahr ul-asror fi manoqib ul-ahyor" ("Sea of secrets about the glory of noble men"), Mullo Yunusjan Munshi's "Amir history of Lashkar Alimqul", "History of Muqimkhani" ("History of Muqim Khan") by Muhammad Yusuf Munshi, "Muhit ut-Tavarikh" by Muhammad Amin ibn Muhammad Zamoni Bukhari, "Toohfat ul-Khani" ("Toohfa of Khan") by Muhammad Vafa Karmanagi, Sayid Homid Tura Kamyab's "Tavarikh ul-khavanin", Muhammad Yusuf Bayani's "Shajarai Khwarazmshahi" [19], extensively and comprehensively analyze the issues of state and community governance, leadership skills.

Conclusions

Derived from the abovementioned analytical data the following can be drawn.

1) The struggle for the desire to recover from the political and economic downturn of the 16th century was largely led by the jadidi movement by the end of the 19th – beginning of the 20th centuries. Their main goals were to attract the peoples living in this region to new ideas. Representatives of this movement, which mainly covered the local intelligentsia layer political awakening of the people, promotion of national, territorial and freedom aspirations together, opening new schools, developing youth the public service system in the means of teaching in countries, bringing the latest achievements and modern technologies of science to their homeland, establishing the publication of various newspapers and magazines, books, and, in short, striving to introduce world news in the country, will help people live every had tried to reform unilaterally [20].
2) The prominent jadid figures Mahmudhoja Behbudi, Abdurauf Fitrat, Munavwar Qori Abdurashidkhanov, Ahmad Donish, Fayzula Khojaev and other intellectuals in their works promoted views on the system of government, legal order, power structures, political regime, reform of Public Administration, Modernization. M.

Behbudi actively seeks to put it into practice at the beginning of the 20th century, developing his views on how public administration should be in the future in Turkestan. In particular, he handed over to the Muslim faction of the 3rd State Duma of Russia for the consideration of the "Behbudi's project of Turkestan cultural autonomy", developed in 1907 [21].

3) From the above, the history of Uzbek national statehood, whose historical roots go back to three millennia, has sealed very rare experiences in itself and makes it possible to draw the necessary conclusions. Therefore, the emphasis was increased on "The formation of a unified personnel policy aimed at attracting qualified specialists to the public service in order to increase efficiency in public administration".

4) As a result of the systematic analysis of national statehood and related theories, it can be seen that three different approaches to public service, namely scientific-theoretical, scientific-practical and practical, have been formed. It is also possible to divide sources related to public service and management into two groups. Public Service and management in the first group the issues are expressed in a holistic state, in connection with the activities of employees, the processes of socio-political, economic development of management. In the second group, theoretical views on this field are developed in the works of art and history, more and more a comprehensive picture of certain qualities and characteristics of employees in the field of Public Service is formed.

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EDUCATIONAL TECHNOLOGIES IN SOLVING ECONOMIC ISSUES

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Annotatsiya. Bugungi kunda uzluksiz ta'lim tizimini mazmunan modernizatsiyalash va ta'lim-tarbiya samaradorligini yangi sifat bosqichiga ko'tarishdan asosiy maqsad yoshlarimizning zamonaviy bilim va kasbga ega bo'lishiga qaratilgan. Avvalo bir yechimga kelishdan, qaror qilishdan oldin ushbu masalaga (sohaga) aloqador bo'lgan juda ko'plab ma'lumotlarni to'plash, ularni qayta ishlash va tahlil qilish zarur bo'ladi. Ba`zan bunday ma'lumotlar miqdori shu qadar ko'payib ketadiki, ularni qayta ishlash va tahlil qilishni maxsus texnik tizimlar yordamisiz amalga oshirib bo'lmay qoladi.

Kalit so'zlar: *Innovatsiya, ta'lim texnologiyalari, Texnik imkoniyatlar, globallashuv, axborotlar oqimi.*

Аннотация. Сегодня основная цель содержательной модернизации системы непрерывного образования и повышения эффективности образования на новый качественный уровень направлена на то, чтобы наша молодежь получила современные знания и профессию. Прежде чем прийти к решению, прежде чем принять решение, необходимо будет собрать огромное количество информации, относящейся к данному вопросу (отрасли), обработать и проанализировать ее. Иногда объем такой информации настолько велик, что ее обработка и анализ невозможны без помощи специальных технических систем.

Ключевые слова: *инновации, образовательные технологии, технические возможности, глобализация, поток информации.*

Annotation. Today, the main goal of modernizing the system of continuous education in content and raising the effectiveness of education and training to a new level of quality is aimed at the modern knowledge and profession of our young people. First of all, before coming to a solution, before making a decision, it will be necessary to collect a huge amount of information related to this issue (industry), process and analyze them. Sometimes the amount of such data increases so much that their processing and analysis cannot be carried out without the help of special technical systems.

Keywords: *innovation, educational technologies, technical capabilities, globalization, information flow.*

Introduction

If we start building our great future today, we should start it on the basis of innovative ideas and an innovative approach. Therefore, we established the Ministry of Innovative Development and set specific tasks for it. We believe that this ministry will play the role of a unique locomotive in the implementation of the most important projects not only in the field of economy, but also in the life of the whole society, said the President of our Republic, Sh. Mirziyoyev [1]. The emergence of mass production in the 21st century created the need to publish many textbooks, and thus created an opportunity for the formation of higher, secondary special and general secondary education systems. Modern electronic computing machines and telecommunication systems, created at the current stage of society's development, have become direct production forces. In addition, the current stage of scientific and technical development has led to the establishment of a unique system of training and retraining of personnel [2]. Thus, as a result of the expansion of the modern society and the higher education system, it is characterized by the increase in the popularity of education. The acceleration of scientific and technical progress has led to rapid growth and updating of scientific and technical information. At the moment, hundreds of thousands of books and magazines are published in the world every year, and hundreds of thousands of dissertations are defended. It is practically impossible to measure the flow of information in the global network of the Internet. It is not difficult to imagine the complexity of mass professional education in such conditions, training of specialists meeting modern requirements [3].

Literature Review

One of the main reasons for the increase in the amount of information and the acceleration of the flow of information is that the development of information technology and technologies has entered the stage of improvement due to the application of the latest modern technologies, the rational use of secondary raw materials, the economical use of energy resources, and the reduction of human labor. [4]. The observations made show that, firstly, the possibilities of this MICROSOFT EXCEL program are very colorful and rich. There are opportunities for almost every user to use it to solve many life issues. Secondly, the possibilities of MICROSOFT EXCEL allow to be used and more widely applied in scientific research, production, economy, business, commerce and many other fields [5].

Research Methodology

The capabilities of the MICROSOFT EXCEL program aimed at automating the process of solving a number of economic problems, as well as the ability to solve purely economic problems, are left out of consideration. Therefore, if a further study of the capabilities of this program is carried out, it should be noted that MICROSOFT EXCELL, which is part of the MIROSOFT OFFICE suite of programs, which is a component of modern computers, is enough for users to solve economic issues in exchange for purchasing new programs. it opens the way to learning and putting into practice their possibilities and saving them from the consequences [6]. This allows you to save resources such as money, time, and labor [7]. Implementation of the goals, tasks and principles set for general secondary education requires not only changing the

content of education, but also the need to improve its forms, methods, and teacher's work [8]. In cooperative learning technology, there are several methods of organizing cooperative learning of students:

In group teaching (R. Slavin, Ishmuhamedov), students are divided into two equal groups. Both groups perform the same task. Members of the group perform educational tasks in cooperation, and each student focuses on mastering the knowledge, skills and abilities provided by the subject.

Collaborative teaching in small groups: In this approach, small groups consist of 4 students. The teacher first explains the topic, and then students' independent work is organized. The educational assignments given to students are divided into 4 parts, and each student performs a certain part of the assignment. At the end of the task, each student thinks about the part he has completed and teaches his friends, then the group members make a general conclusion about the task [9].

Analysis and Results

The following Table 1 methods will be important in introducing innovations in the field of studying economic issues:

Table 1. Innovations in the field of studying economic issues.

News platforms and websites:	specialized news platforms for making economic news, such as Bloomberg, Financial Times, or the song can get the latest and most important economic news through pieces like the initial “Feedly” or “Flipboard”.
Social networks:	social networks, such as platforms like Twitter, LinkedIn, and Reddit, you can get news about the latest economic issues.
Podcasts and YouTube channels:	podcasts and YouTube channels for other forms of studying economic issues are also important sources, such as NPR’s “Planet Money”, “Freakonomics Radio” podcasts, or “TED-Ed” and “Khan Academy” channels on YouTube.
Majors and scientific journals:	broadly selected majors and scientific journals in the economic field, such as the “Economist”, “Harvard Business Review”, and “Journal of Economic Perspectives”, you can achieve new scientific education, new scientific works, and educational materials with innovations.
Mobile applications and electronic libraries:	mobile applications in the study of economic issues, such as “Flipboard” or “Feedly” applications, and electronic libraries, such as through “Kindle” or “Apple Books”, are ideal tools for searching and reading the latest economic news.

Note: Through these tools, you can reach economic news in your own modern way and help you keep track of news in the economic sector [10].

Conclusions

In conclusion, Our observations are that the MICROSOFT EXCEL program is usually used only in the processing of tabular data related to accounting. However, this program can be applied to solving a number of scientific problems, as well as to problems that are often used in banking practice.

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THE IMPORTANCE OF TEACHING PRIMARY CLASSES BASED ON MODERN APPROACHES

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Annotatsiya. Ushbu maqolada zamonaviy ta’lim texnologiyalaridan foydalangan holda fasilitatsion yondashuv asosida boshlang‘ich sinflarda pedagogik jarayonni yengillashtirish va tashkil etishning eng zamonaviy samarali usullari va kontseptsiyasi haqida ma’lumot berilgan.

Kalit so‘zlar: *Siyosiy iqtisodga oid risola, Fasilitatsiya, fasilitator, o‘qituvchi, pedagogik neologiya, fiziologik, somatik, aqliy, ma’naviy, sinegretik (yangicha alternativ) yondashuv, akmeologik (psixofiziologik) yondashuv, integrativ ishlarni olib borish.*

Аннотация. В этой статье представлена информация о самых современных эффективных методах обучения и концепции фасилитации и организации педагогического процесса в начальных классах на основе фасилитационного подхода с использованием современных образовательных технологий.

Ключевые слова: *Трактат по политической экономии, Фасилитация, фасилитатор, педагог, педагогическая неология, физиологический, соматический, психический, духовный, синергетический (по-новому альтернативный) подход, акмеологический (психофизиологический) подход, проведение интегративной работы.*

Annotation. This article explains about the most modern effective teaching methods and provides information on the concept of facilitation and the organization of the pedagogical process and teaching based on the facilitation approach through modern educational technologies in elementary grades.

Keywords: *Treatise on Political Economy, Facilitation, facilitator, pedagogue, pedagogical neology, physiological, somatic, mental, spiritual, synergetic (new alternative) approach, acmelogical (psychophysiological) approach, integrative work.*

Introduction

It is of particular importance to perfect the theoretical and methodological aspects of education, to create a model for deepening the formation of economic knowledge among students. This explains the need to create a methodical system aimed at organizing the educational process that forms economic knowledge among elementary school students. We can see from the educational experiences of a number of developed and now developing countries that the development of students' abilities and interest in the economy, and the effective use of didactic, creative, integrative, economic, and professional neologisms. Based on the requirements of our time, the issue of “To develop children who love their country, who are hospitable, generous, have legal knowledge who can do their job, who are modern thinkers and who have strong knowledge”[1] is defined as important tasks. In this case, the development of the student's intellectual qualities, the effective use of education and training resources are of great importance.

Literature Review

Each subject has its own research scientists of each field, and a number of scientists from around the world and Uzbekistan have studied and conducted research on the use of modern educational technologies and the facilitation approach in primary classes.

Antoine Moncretin, a French economist who lived and worked in the years 1575-1621, first wrote a small scientific work entitled “Manual on Political Economy” in 1615 and founded economics as a science. Another research work aimed at the scientific study of the effectiveness of the formation of economic concepts in primary school students in cooperation between school, family, neighborhood was carried out by Kh.J. Khudoykulov. The researcher works on the problems “theoretical and effective foundations of the development in the education of first school pupils”, to

develop a sense of creativity in students of junior school age and to use the literary heritage of thinkers in providing economic education and training, in which explained the role and importance of state economic policy. The concept of facilitation was brought into science and researched by psychologist Carl Rogers.

A lot of research scientists, such as B.S. Gershunsky, Y.Y. Lysenko, Y.I. Mashbits, M.N. Perova, O.K. Tikhomirov, have dealt with the issues of using this day's knowledge multimedia and approaches, fashion games in organizing the education of pupils of primary school young.

Research Methodology

Development of new knowledge in children with modern approaches serves as one of the pillars of the foundation for their personal development. To teach economics to elementary school students about the concepts that motivate the formation of the first economic knowledge, the world closest to them, the environment that surrounds them, things and events, and the activities of children in it. we can be sure once again during Economic knowledge is used not only in the production of material goods and services, but also closely related to the daily life of everyone. The main task of economic education is to provide a person with the skills of quick and easy adaptation to the new conditions of socio-economic life, to increase the experience of confidently overcoming unexpected obstacles of life with the economic knowledge and skills acquired throughout his life. is to serve.

Analyses and Results

In terms of physiological, somatic, mental, spiritual and physical development, today's elementary school students show that they are taller, stronger, and more resilient than their peers ten years ago. It is correct to express the fact that the children's adaptability to the rapidly changing social environment, the desire for free movement, and certain changes in the mental development of children of this age have taken place with the increasing acceleration (Latin acceleratio - acceleration) process. For this reason, the benefits of applying modern approaches that are suitable for them in imparting new knowledge to them are great. Modern teaching technologies are a complex integrated (whole, organically connected) system, in which the skills and competencies determined on the basis of educational goals are acquired by students of theoretical knowledge, they have certain spiritual and moral is reflected as a certain organized set of elements of pedagogical activity aimed at training qualities.

Large-scale educational reforms require the study of advanced technologies of the educational process and their introduction into the educational process. This, in turn, requires pedagogues to acquire a technological approach to the field of education, the method of pedagogical technology, and to apply and develop them in pedagogical practice, taking into account the national, spiritual and cultural characteristics and traditions of our region.

The approach to the didactic design methods created within the framework of the technological approach helps to effectively and creatively plan the educational process, enrich it with new ideas, and evaluate their results.

Traditional research, systematic research, functional, complex, technological, problem-based and facilitative approaches are distinguished based on the used educational methods and organizational forms.

The traditional approach is characterized by oral-visual teaching methods, which are mainly determined by the teacher's giving of information, students' acceptance, collection and memory of knowledge. The concept of “education” is understood as information stored in memory. Such knowledge is tested through the ability to restate it and apply it correctly. Knowledge in this approach is largely the result of memorization, consists mostly of formal information, and can often be superficial. They are stored in memory, that is, under consciousness, or in other words, they are remembered only when a direct question is put to them.

Facilitation in teaching school education, helping students in the educational process, creating conditions that have a beneficial effect on students in every way, increasing students' confidence in their knowledge, the need for independent work is aimed at motivation and should be understood as a growing educational method. method of support. Scientific evenings related to it can be used in the school system in both primary and upper classes. But the importance of this process used in elementary grades is several times higher than in upper grades. Because through this process, children's interest in the lesson increases several times, which helps them to get higher education. Simply put, facilitation is both a process and a way of doing things, as well as the organization of high-quality and effective group interaction, group cooperation and joint activity. The person who creates and manages facilitation is called a facilitator. The facilitator should have the following characteristics as shown in Figure 1.

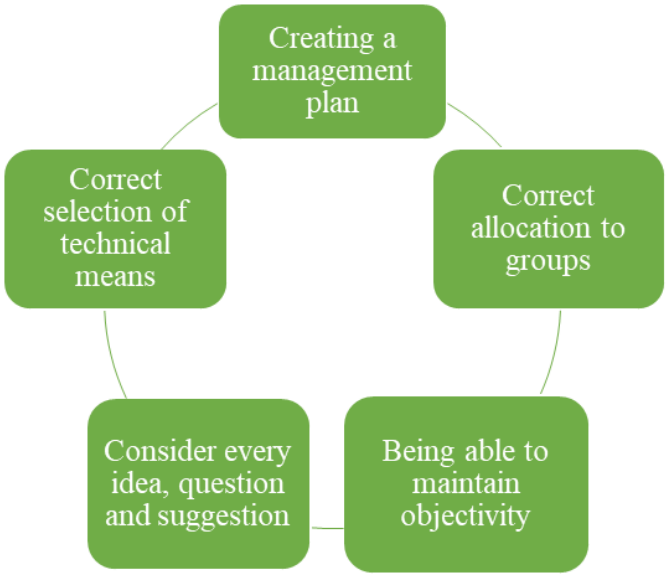

Figure 1. Facilitator characteristics.

All over the world, quality education is valued as the most important field. Therefore, at all stages of education, special attention is paid to the improvement of the effectiveness of the evaluation of educational results and the creation of opportunities for quality education for all people throughout their lives. The importance of the correct and appropriate use of effective methods and laws of education in the proper organization of the educational process in primary grades is incomparable. Of course,

the educational process should be carried out without separating it from the educational process. Where there is education and discipline, there will be growth in education.

Conclusions

Today, the increase of modern technologies requires further improvement of modern education. The reason is that today's children understand technologies very well and have already developed management skills. For such children, the old methods are not interesting and are not effective enough to attract their attention during the lesson. Therefore, modern teachers should also be familiar with modern technologies and be able to use new modern teaching methods through them. In order to carry out these activities, teachers are required to study and research incessantly. The analysis of educational practice, the effectiveness of the formation of economic knowledge in elementary school students, the correct organization of the educational process, the integration of the educational content of elementary school students in economic topics, advanced showed that it depends on the inter-level organic organization based on the application of teaching technologies.

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UDC:37.02, 37.09, 519.2

MODERN APPROACHES TO TEACHING THE ELEMENTS OF PROBABILITY THEORY AND MATHEMATICAL STATISTICS IN CONTINUING EDUCATION

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Annotatsiya. Ushbu maqola uzluksiz ta’limda ehtimollik nazariyasi va matematik statistikani o‘rgatishning zamonaviy yondashuvlarini o‘rganadi. O‘rganish jarayoni raqamli vositalar va amaliy ilovalarni o‘z ichiga olgan innovatsion metodologiyalarga o‘tishning yutuqli jihatlarini ochib beradi. Ushbu yondashuvlarning samaradorligi empirik dalillar va amaliy tadqiqotlar bilan tasdiqlanadi. Maqolada o‘qituvchilar uchun tavsiyalar berilgan va rivojlanayotgan ta’lim muhitiga moslashish muhimligi ta’kidlangan. Umuman olganda, ushbu maqola matematika fanlari bo‘yicha o‘qitish amaliyotini takomillashtirish uchun keng qamrovli manba bo‘lib xizmat qiladi.

Kalit so‘zlar. *Ehtimollar nazariyasi, matematik statistika, uzluksiz ta’lim, pedagogik yondashuvlar, raqamli vositalar, o‘quv dasturlarini ishlab chiqish, interfaol simulyatsiyalar, amaliyotga tatbiq etish, o‘qitish metodikasi, ta’lim texnologiyalari, amalga oshirish strategiyalari, kelajak tendentsiyalari.*

Аннотация. В этой статье исследуются современные подходы к преподаванию теории вероятностей и математической статистики в непрерывном образовании. Он подчеркивает переход к инновационным методологиям, включающим цифровые инструменты и практические приложения. Эффективность этих подходов подтверждается эмпирическими данными и практическими исследованиями. В статье представлены рекомендации для преподавателей и подчеркивается важность адаптации к развивающейся среде обучения. В целом, он служит комплексным ресурсом для улучшения практики преподавания этих математических дисциплин.

Ключевые слова. *Теория вероятностей, Математическая статистика, Продолжающее образование, Педагогические подходы, Цифровые инструменты, Разработка учебных программ, Интерактивные симуляции, Применение на практике, Методики преподавания, Образовательные технологии, Стратегии реализации, Будущие тенденции.*

Abstract. This article explores modern teaching approaches for probability theory and mathematical statistics in continuing education. It emphasizes the shift towards innovative methodologies, incorporating digital tools and real-world applications. The effectiveness of these approaches is supported by empirical data and case studies. The article provides guidance for educators and highlights the importance of adapting to evolving teaching environments. Overall, it serves as a comprehensive resource for enhancing teaching practices in these mathematical disciplines.

Keywords. *Probability theory, Mathematical statistics, Continuing education, Pedagogical approaches, Digital tools, Curriculum design, Interactive simulations, Real-world applications, Teaching methodologies, Educational technology, Implementation strategies, Future trends.*

Introduction

The importance of probability theory and mathematical statistics in analyzing data and making decisions has never been greater. These disciplines provide the tools to understand and extract insights from complex data sets, and their application extends to various fields such as economics, finance, science, and public health. The approach to teaching these subjects has evolved from a theoretical focus to a more practical, application-oriented approach that emphasizes real-world relevance. The use of digital resources, participatory platforms, and case studies enhances student engagement and deepens their understanding of the subject matter. By embracing innovative teaching techniques and technology, educators can empower learners to fully utilize the power of probability theory and mathematical statistics [1-3].

Literature Review

Recent research suggests that traditional lecture-based methods of teaching probability theory and mathematical statistics may not engage students effectively, particularly in continuing education. Critics highlight a lack of real-world application in these traditional approaches. Innovations in teaching, such as flipped classrooms, project-based learning, digital simulations, and collaborative learning, have been shown to improve engagement and understanding by emphasizing practical applications and interactive learning [3-5].

However, challenges remain in research, implementation, accessibility, and scalability of these innovative methods. There is a need for more studies on their long-term impact and for adapting these approaches to diverse learning styles [6-8]. The shift towards interactive and applied learning methods in statistics education is promising but requires further exploration and development. Based on a synthesis of available research and abstracts, here’s a comparative table summarizing the features, advantages, and disadvantages of traditional vs. modern teaching methods as given in Table 1.

Research suggests that modern teaching methods, tailored to students’ needs and educational objectives, can enhance learning. Techniques like the word-wall approach improve elementary students' comprehension, while the mix of lectures and video-based learning boosts understanding in subjects like biochemistry.

Table 1. Disadvantages of traditional vs. modern teaching methods [7-9].

Aspect	Traditional Teaching Methods	Modern Teaching Methods
Features	- Lecture-based instruction - Individual learning - Textbook-focused - Teacher-centered	- Technology-enhanced learning - Collaborative and interactive learning - Use of digital tools and resources - Student-centered
Advantages	- Structured environment - Direct control over learning pace - Emphasis on foundational knowledge	- Engages students with interactive content - Flexible access to resources - Encourages critical thinking and problem-solving - Personalized learning experiences
Disadvantages	- Limited student engagement - One-size-fits-all approach - Less emphasis on critical thinking and creativity	- Requires access to technology - Can be overwhelming with too many digital tools - Potential distraction from excessive technology use

Students favor these modern methods for their flexibility and engagement. Effective teaching in fields like probability theory and mathematical statistics, especially in continuing education, leverages current educational theories and technology use. This creates a more interactive and engaging learning environment, highlighting the importance of choosing the right teaching approach based on the subject, student demographics, and educational goals.

Theoretical Framework

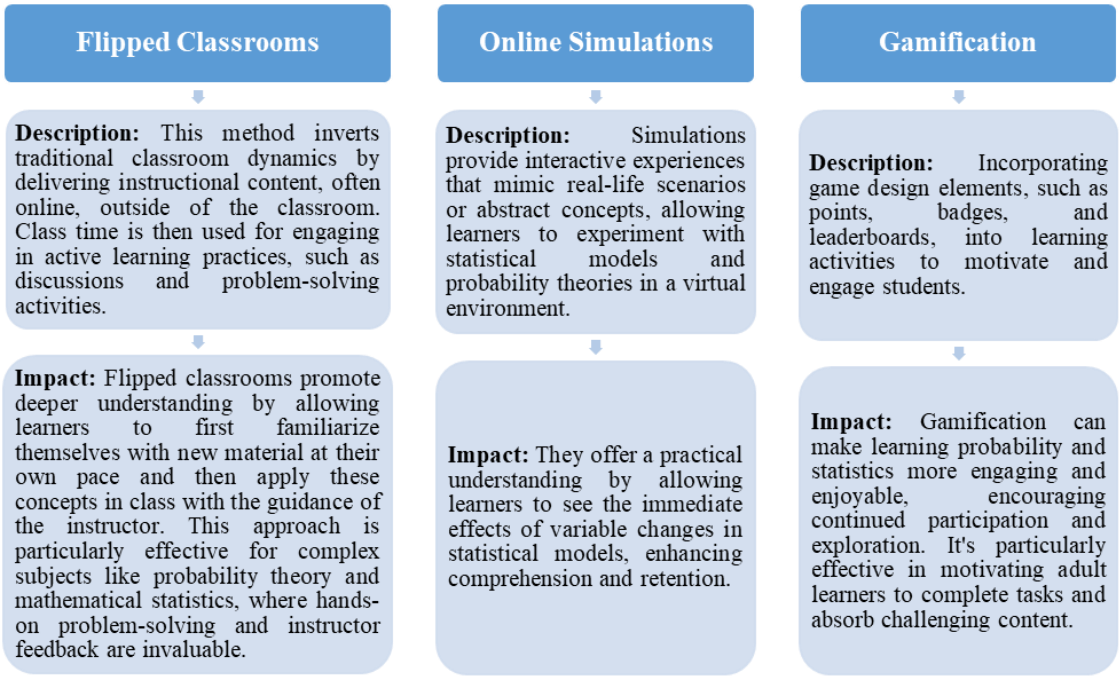
Table 2. Key features and benefits of educational approach [10].

Educational Approach/Technology	Key Features	Benefits
Learner-Centered Approach (Constructivism)	- Active participation in learning - Solving real-world problems	- Enhances understanding of statistical concepts - Makes abstract concepts relatable and understandable
Conceptual Understanding (Constructivism)	- Connecting new information to existing knowledge - Making abstract concepts more relatable	- Improves comprehension and retention of probability and statistics concepts
Interactive Simulations and Visualizations	- Tools like Desmos or GeoGebra for visualizing probability distributions and statistical models	- Makes abstract concepts tangible - Facilitates deeper understanding
Learning Management Systems (LMS)	- Platforms such as Moodle or Canvas - Serve as central hubs for course content, assignments, and discussions	- Supports blended learning model - Provides a structured yet flexible learning environment
Adaptive Learning Platforms	- Use algorithms to adjust problem difficulty based on performance	- Offers personalized learning experiences - Accelerates understanding and mastery of statistical principles
Collaborative Tools	- Applications like Google Workspace for real-time collaboration on projects and assignments	- Encourages peer learning and discussion - Beneficial in exploring complex statistical problems

The theoretical underpinnings of constructivism and blended learning, coupled with the judicious use of technology, form the cornerstone of modern approaches to teaching probability theory and mathematical statistics in continuing education. By focusing on active learning, real-world application, and personalized educational experiences, educators can significantly enhance student engagement, understanding, and retention of complex statistical concepts. As technology continues to evolve, so too will the opportunities to innovate and improve statistical education, making it more accessible, engaging, and effective for learners across all stages of life [10-11].

Modern Teaching Approaches - Modern teaching approaches, leveraging innovative methods and digital tools, have transformed the landscape of education in probability theory and mathematical statistics, especially within the context of continuing education. These approaches not only engage adult learners more effectively but also accommodate their diverse learning needs and schedules. Below is a detailed exploration of these methods, the digital tools employed, and case studies illustrating their successful implementation [10].

Innovative Methods - The integration of modern teaching approaches and digital tools in teaching probability theory and mathematical statistics has significantly enhanced the learning experience in continuing education. By adopting flipped classrooms, online simulations, and gamification, educators can create more engaging, flexible, and effective educational experiences. These innovations not only accommodate the unique needs of adult learners but also foster a deeper understanding of complex statistical concepts, preparing learners for professional success in a data-driven world [10].



Research Methodology

This study aims to evaluate how modern teaching methods like flipped classrooms and online simulations affect student comprehension and engagement in continuing education courses on probability theory and mathematical statistics. We'll use a quasi-experimental design with pre- and post-tests to compare traditional and innovative

teaching techniques among adult learners. Data will be collected through surveys, interviews, and classroom observations to measure changes in engagement, confidence, and understanding. The analysis will involve both statistical tests and thematic analysis of qualitative data. Our research intends to highlight the effectiveness of contemporary teaching styles in improving learning outcomes, offering insights for refining teaching practices, curriculum development, and professional training. Ultimately, this study will provide evidence on the benefits of integrating modern teaching approaches in statistical education, aiming to enhance the educational experience and success of adult learners.

Analysis and Results

Recent empirical studies indicate that employing modern teaching methods like flipped classrooms, online simulations, and gamification in teaching probability theory and mathematical statistics leads to increased student engagement, improved test scores, and higher retention rates. These methods, favoring active participation and practical application over traditional lectures, align with literature advocating for the integration of active learning and technology to deepen understanding and engagement in complex subjects.

Modern approaches create dynamic, interactive learning environments that encourage collaboration and active engagement, promoting a deeper grasp of statistical concepts through visualization, application, and problem-solving. They also offer flexibility and accessibility, catering to the varied needs of adult learners in continuing education by supporting different learning styles and schedules.

Key recommendations for enhancing teaching effectiveness in these areas include adopting pedagogical flexibility, thoughtful technology integration, collaborative learning environments, and ongoing professional development for educators. Curriculum developers are advised to incorporate real-world applications and align content with modern teaching methods. Meanwhile, policymakers and educational institutions should facilitate technology integration, ensure accessibility, foster industry collaboration, and invest in teacher training.

Implementing these strategies can significantly improve the teaching and learning experience in mathematical statistics and probability theory for adult learners, aiming to create a more engaging, inclusive, and effective educational environment conducive to professional and personal growth.

Conclusions

The adoption of modern teaching methods like flipped classrooms, online simulations, and gamification in continuing education for subjects like probability theory and mathematical statistics has markedly enhanced student engagement and understanding. Digital tools have modernized education by providing personalized, flexible learning experiences suited to adult learners. Evidence from research underscores the effectiveness of these approaches in boosting participation, critical thinking, and the application of statistical knowledge to real-world problems.

Despite challenges in integrating these innovations, solutions involving educator training, policy support, and resource investment have been proposed. This shift

towards learner-centered education is part of a broader evolution in teaching, promising to further advance continuing education.

To maintain the relevance and effectiveness of education in these fields, ongoing collaboration, innovation, and adaptation are essential. This will equip learners with the skills to tackle complex statistical challenges, fostering lifelong learning and contributing to personal and societal growth. The integration of modern methods and digital tools into statistical education is a continuing journey, pivotal for enhancing learning experiences and outcomes.

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EDUCATIONAL AND PSYCHOLOGICAL DIMENSIONS OF IMPLEMENTING ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN INTEGRATED INSTRUCTION AT MEDICAL HIGHER EDUCATION INSTITUTIONS

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Annotatsiya. Ushbu tadqiqotda tibbiyot oliy ta’lim muassasalarida sun’iy intellekt (SI) texnologiyalarini o‘quv jarayonlariga integratsiyalashning ta’limiy va psixologik jihatlari o‘rganiladi. Tadqiqotning maqsadi SI ning ta’lim jarayonini yaxshilash, o‘quv metodikalarini takomillashtirish va talabalar hamda o‘qituvchilarga psixologik ta’sirini aniqlashdir. Asosiy natijalar tibbiy ta’limda SI ni integratsiyalashning mumkin bo‘lgan afzalliklari va muammolarini ta’kidlaydi hamda samarali amalga oshirish strategiyalarini taklif qiladi.

Kalit so‘zlar: *Sun’iy intellekt, Tibbiy ta’lim, Integratsiyalashgan ta’lim, Pedagogik jihatlar, Psixologik ta’sir, Oliy ta’lim*

Аннотация. В данном исследовании рассматриваются образовательные и психологические аспекты интеграции технологий искусственного интеллекта (ИИ) в учебные процессы в медицинских высших учебных заведениях. Целью исследования является выявление способов, которыми ИИ может улучшить учебный опыт, повысить эффективность методик преподавания и решить психологические проблемы, как студентов, так и преподавателей. Основные результаты подчеркивают потенциальные преимущества и проблемы интеграции ИИ в медицинское образование, предлагая стратегии для эффективного внедрения.

Ключевые слова: *Искусственный интеллект, Медицинское образование, Интегрированное обучение, Педагогические аспекты, Психологическое воздействие, Высшее образование*

Abstract. This study explores the educational and psychological dimensions of integrating artificial intelligence (AI) technologies in the teaching processes at medical higher education institutions. The research aims to identify how AI can enhance the learning experience, improve teaching methodologies, and address psychological impacts on both students and educators. Key findings highlight

the potential benefits and challenges of AI integration in medical education, suggesting strategies for effective implementation.

Keywords: *Artificial Intelligence, Medical Education, Integrated Instruction, Pedagogical Aspects, Psychological Impact, Higher Education*

Introduction

The rapid technological development, digitalization, and informatization of various areas of human activity create favorable conditions for the development and implementation of new innovative technologies based on artificial intelligence (AI). AI technologies, which focus on the study and implementation of behavior algorithms, analysis of large volumes of data (Big Data), and the ability to self-learn, are highlighted in the Strategy for Scientific and Technological Development of the Russian Federation. This document outlines the vectors of development for science and industry in the coming decades, emphasizing that the priority for the Russian Federation over the next 10-15 years will be "the transition to advanced digital, intelligent production technologies, robotic systems, new materials and design methods, and the creation of systems for processing large volumes of data, machine learning, and artificial intelligence" [1-3].

Literature Review

The education system, which accumulates the most advanced scientific knowledge and promotes its dissemination among higher education students, is one of the frontiers of the creation and development of AI technologies and their implementation in various spheres of human life. On the one hand, the task of higher educational institutions at the present stage is to qualitatively prepare students for successful professional activities in the realities of the new technological world of tomorrow. On the other hand, the education system itself must promptly and flexibly respond to modern challenges of the time and be open to the introduction of advanced technologies that create more optimal conditions for student learning.

The scientific journal "Higher Education in Russia" is the country's largest and most authoritative open platform for discussing important issues in the modernization of education. The integration of AI technologies in education is one of the pressing problems, the discussion of various aspects of which was called for in their work by E.N. Ivakhnenko and V.S. Nikolsky [1]. Accepting the invitation of scientists to participate in a scientific dialogue, the author of this article presents the results of work, the subject of research of which is the awareness, readiness and ability of higher education teachers to use the potential of AI tools in teaching, since the efficiency and effectiveness of the implementation of AI technologies largely depends on this into education.

Purpose of the study: to identify the awareness of higher education teachers regarding the organizational, didactic and methodological potential of AI technologies, their willingness to use AI tools in teaching activities and the practice of using AI technologies in teaching.

Research Methodology

Achieving this goal includes solving the following research tasks:

1) Determine the didactic content of the construct “artificial intelligence in education”;

2) Develop a questionnaire to identify awareness, readiness and practice of using AI tools in teaching by higher education teachers;

3) Conduct an online survey of higher education teachers, analyze and interpret the data obtained.

Vectors of using artificial intelligence in education 1. Vectors of artificial intelligence use in education for training and provision of educational services (taking on many of the functions of the admissions committee); c) issuing all kinds of certificates, extracts and other documents (performing the function of a single “intellectual” dean’s office); d) maintaining and monitoring internal document flow in an educational institution (drawing up office memos, business trips, orders, acts, contracts, etc.); d) scheduling classes.

Analysis and Results

AI tools created on the basis of large database technology (data science) can be used to analyze large volumes of information in order to predict specific situations and develop proposals and recommendations based on the analytical work carried out [1-4]. Questions for analysis and forecasting solved by AI tools can be varied: from short- and long-term forecasts on the number of applicants to a university from a particular region in a particular year of admission depending on the birth rate, observed trends in the choice of universities, forecasting needs in the labor market, trends in social - economic development of the region, etc. to recommendations for changing curricula or teaching content in specific disciplines depending on the results of student testing. At the same time, it is important to understand that the quality of AI forecasts and recommendations will depend on a number of factors, from the completeness of the data volume to the accuracy of the problem statement.

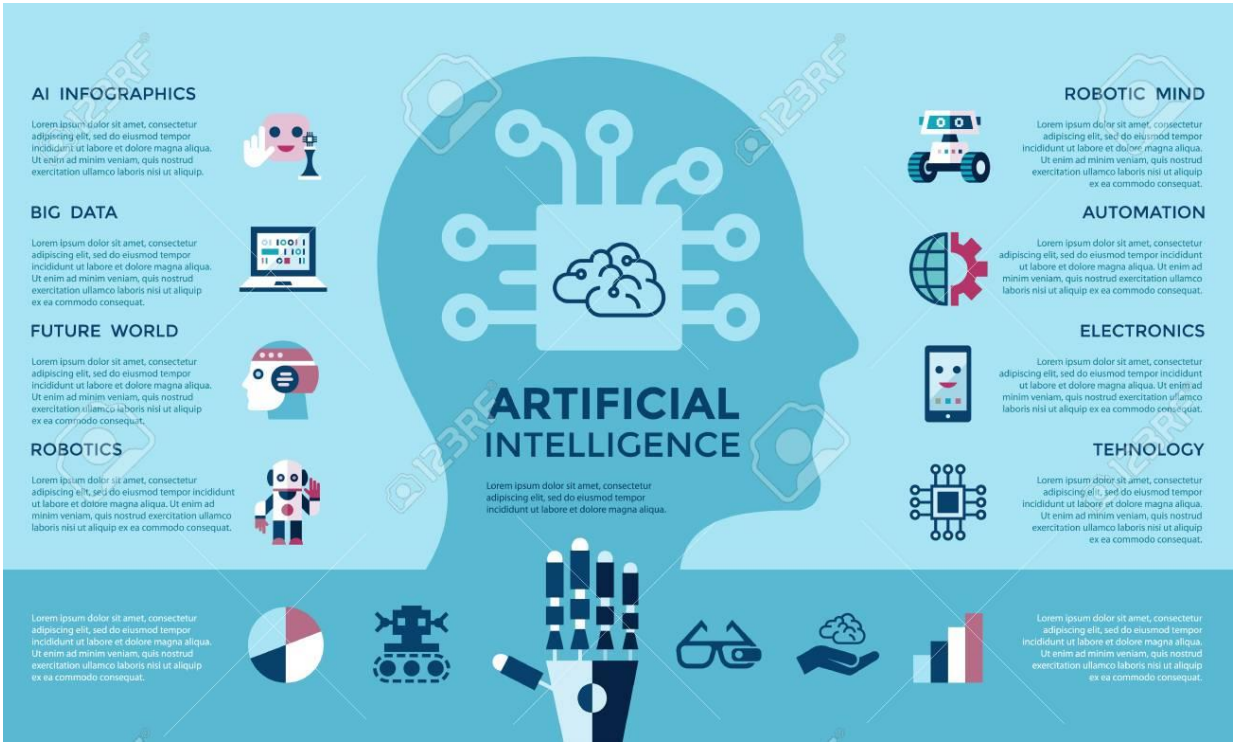

Figure 1. Vectors of artificial intelligence use in education [3].

Individualization of learning AI tools fully meet the needs of students for personalized organization of the educational process and individualized training trajectories [1-2]. Modern formats of face-to-face classroom training with some elements of blended learning only to some extent make it possible to implement training along an individual trajectory. AI technologies will allow, depending on interests, needs and the individual learner's ability to personalize education on at least two levels. On the first, on a more global level, AI tools will allow the student to develop an individual educational trajectory, including a sequence of disciplines within one main professional educational program (OPOP), as well as additional educational disciplines.

At the second level of a specific discipline, AI tools will make it possible to select the subject-thematic content of the material, develop a system of exercises and tasks, create a fund of control tools, flexibly changing the sequence, complexity of educational/test material and intensity of training in accordance with the results of mastering the material. For objective reasons of institutional basic general and higher education in our country, training along an individual trajectory will always be within a certain time frame. It is impossible for every student to study every discipline of the BOP curriculum for an unlimited amount of time. In this regard, an unlimited springboard for AI tools will be the implementation of individualized training for students in the system of additional education in conditions of lifelong learning.

Conclusions

The integration of artificial intelligence (AI) technologies into the education system, particularly in medical higher education institutions, holds significant potential for transforming teaching and learning processes. This study highlights the educational and psychological dimensions of implementing AI, emphasizing the importance of teacher awareness, readiness, and ability to effectively utilize AI tools.

The findings suggest that AI can enhance the learning experience through personalized education, improved teaching methodologies, and efficient administrative processes. AI tools can individualize learning paths, provide data-driven insights for curriculum development, and streamline administrative tasks, thereby creating more optimal conditions for student learning.

However, the successful implementation of AI in education requires addressing several challenges, including the need for comprehensive teacher training, ensuring data privacy and security, and maintaining the quality and accuracy of AI-generated recommendations. Teachers’ readiness to embrace AI and their ability to integrate these technologies into their teaching practices are crucial factors in realizing the benefits of AI in education.

Future research should focus on developing detailed frameworks for teacher training programs, exploring the long-term impacts of AI on educational outcomes, and continuously evaluating the effectiveness of AI tools in diverse educational contexts. By fostering a collaborative environment between educators, technologists, and policymakers, the potential of AI technologies can be fully harnessed to advance education and prepare students for the technological world of tomorrow.

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MODERN PROBLEMS OF PHILOLOGY AND LINGUISTICS

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STUDY OF THE JSSUE OF VERB FORMS AND THE ACQUISITION OF VARIOUS TENSE MEANINDS

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Annotatsiya. Harakat fe’llarini o‘rganish misolida o‘zbek auditoriyasiga rus tilini o‘rgatish amaliyotida funksional yondashuvni amalga oshirish. Funksional grammatika atama va tushunchalari bilan tanishtiriladi, harakat fe’llarining tipik kontekstdagi faoliyati bayon qilinadi, rus va o‘zbek tillarida harakatning funksional-qiyosiy tavsifini berishga harakat qilinadi.

Kalit so‘zlar: *Rus va o‘zbek tillarida qiyoslash, harakat fe’llari, funksional jihat, yaqinlashtirish.*

Аннотация. Реализация функционального подхода в практике преподавания русского языка в узбекской аудитории на примере изучения

глаголов движения. Введены термины и понятия функциональной грамматики, описано функционирование глаголов движения в типичных контекстах, предпринята попытка функционально-сопоставительного описания движения в русском и узбекском языках.

Ключевые слова: *Сопоставление в русском и узбекском языках, глаголы движения, функциональный аспект, приблизить.*

Abstract. A comparative study of the grammar of two languages helps to better understand the common and specific features of both languages, helps to draw attention to those phenomena that remain unnoticed by researchers studying only one language. Uzbek and Russian languages are representatives of two different languages with different grammatical systems - Turkic and Slavic

Keywords*: comparative grammar, verb in Uzbek and Russian, bring closer.*

Introduction

Learning other languages not only helps to exchange experiences and become familiar with the cultural achievements of other nations, but also creates opportunities [1-3]. Reveal in your native language more fully, more clearly its richness, beauty and expressiveness. Slovenian linguist Mikulas Dognani writes about it in this way: “Without studying other languages, people make a very false, one-sided and perverse judgment about their native language, because only through comparison we know the greater or lesser perfection, richness, beauty, clarity and diversity of one or another language!” [3, 4]. L.V. Shcherba asserts the same thing. I would say, without considering it a paradox at all, that fully master your native language i.e. You can only appreciate all its richness, its expressive means, and understand all its possibilities by studying a foreign language. He says that “By studying a foreign language of one or another people, we study its historically developed system of concepts through which it perceives reality. By studying this system and consciously comparing it with our own, we better comprehend this latter” [5].

A comparative study of the grammar of two languages helps to better understand the common and specific features of both languages, helps to draw attention to those phenomena that remain unnoticed by researchers studying only one language. Uzbek and Russian languages are representatives of two different languages with different grammatical systems - Turkic and Slavic. They contain many linguistic phenomena worthy of comparative study. Among them we can rightfully include the category of time, i.e. forms of verb tenses, their use.

Literature Review

The question of a comparative study of the meanings of the tense forms of the Russian and Uzbek verb is relevant, because it has not yet been developed at all. In Uzbek philology, the problem of systematic comparative study of this topic has not yet been raised [5-8]. There is not a single work specifically dedicated to it. Meanwhile, a detailed and in-depth study of it would make it possible to better understand the internal essence, specificity and commonality of the phenomena under consideration both in the Russian and Uzbek languages, which in turn would lead to the formulation in the near future of the problem of the form of verbs, closely related to this issue in the Uzbek

language and its solution The creation of such works is absolutely necessary in a purely practical sense, because both in secondary and high school, during the practical mastery of the Russian language by the Uzbek audience, a significant part of the errors falls on the use of verb tense forms.

This study has the following objectives:

1. Give a systematic comparative analysis of the meanings of all conjugated tense forms of the Russian and Uzbek verb.
2. Investigate the question of why the same verb form can acquire different temporal meanings.
3. It is possible to fully determine these diverse meanings of the tense forms of verbs.
4. Study the question of the relationship between the tense forms of verbs and their meanings in both languages.
5. Show general phenomena and specific features of verb tense forms and their meanings in the Russian and Uzbek languages,
6. Explore the possibilities and patterns of transferring the meanings of verb forms from Russian into Uzbek, and from Uzbek into Russian,

Research Methodology

Time and space are forms of existence of the actual, real world. The basic forms of all existence are space and time; being outside of time is the same greatest nonsense as being outside of space. Developing this position further, just as things or bodies are not simple phenomena, not complexes of sensations, but objective realities acting on our sense organs, so space and time are not simple forms of appearance, but objectively real forms of existence.

There is nothing in the world except moving matter, and moving matter cannot move except in space and time.

It is known that action in the abstract sense is nothing more than a conceivable movement in time, to which time must really be characteristic.

Analysis and Results

The grammatical category of time in language arises from the need for a chronological correlation of what is being communicated with the moment of speech. This is needed, first of all, by an action or state, the characteristic of the chronological correlation of which simultaneously transfers into a certain time plan all the words of the substantive associated with it.

In the grammatical structure of the Russian and Uzbek languages, temporal relations find expression in the tense forms of the verb. “The temporal factor is somehow contained in the very grammatical semantics of any verb as a part of speech.” A verb is, first of all, a temporal part of speech. In this sense, language directly reflects the forms of being.

What is the relationship between objective and grammatical time?

The category of time, being a reflection of objective time, directly includes the verbal action in real reality,” answers this question.

From the materialistic recognition of objective time as the "basic form of all being," its "objectively real form," it follows that the grammatical category of time, being a reflection of objective time, includes verbal action in the composition of real reality."

The concept of the category of verbal tense should be established not from the subjective point of view of the speaker in relation to the moment of his speech, but from the point of view of the direct reflection of reality in language as a social phenomenon.

It is impossible to draw a direct and complete correspondence between grammar and the phenomena of objective reality, since in this case the specificity of language as a special social phenomenon is ignored.

The identification of the category of grammatical time presupposes, on the one hand, the reflection in the language of objectively existing time, on the other hand, the result of the abstracting work of human thinking on facts.

The grammatical category of time is indeed a reflection of objective time in language, but not a direct and mirror reflection, but refracted through our consciousness, since before the phenomenon of the world is reflected in a linguistic fact, it must also be perceived by the consciousness of the speaker. This means that the grammatical category of tense depends on the speaker's awareness of the objective world, i.e. The grammatical category of time poisons objective time not directly, not directly, but through a series of abstractions and conventions.

Grammatical tenses are not a direct "reflection" of a priori or "natural" tenses such as "present", "past" or "future". Of course, verbal forms can be used to express those relations that in our everyday life are called "past", "present" or "future", but this not only exhausts their grammatical semantics, but is not decisively determined," says A.V. Isachenko [3].

The category of tense is organically and inextricably linked with the indicative mood. "A characteristic feature of the indicative mood is the indicative mood, which is expressed in the forms of the present, past or future tense," says the Academic Grammar. Any phenomenon of objective reality occurs in absolute time, and in human practice it is designated using segments, intervals of time related to some conventional point, coordinate. This means that in his practical activity (in communicative acts) a person denotes absolute time relative, which, however, does not at all prevent him from achieving the necessary accuracy. The speaker denotes time relative. This means that there cannot be a direct reflection of time in language. Coming to the disposal of grammar, the moment of speech acts as an objective point of reference. And in grammar it appears as an objective grammatical category.

The moment of speech is established not only from the point of view of the speaker. Several persons take part in this act: the speaker, the interlocutor, and the listeners. Consequently, they act as full-fledged witnesses who have the right to establish the objectivity of the moment of speech.

So, the moment of speech is a synthesis that includes the points of view of the speaker's face, the interlocutor's face and the listener's face.

In determining the moment of speech and grammatical time, linguists have developed a more or less unified view. Here is how some of our leading food languages define it:

A.A. Potebnya: “Grammatical time is the relation of an action or state to the moment of speech and (since thought is recognized by those thinking initially only in the form of speech) conscious thought about them” [4].

And this point of view on the moment of speech and its place is accepted by almost all researchers of the Russian language.

Conclusions

Only a few linguists sometimes put forward views’ opposite to this point of view. This is what N.S. Pospelov writes, for example: “The orientation in grammatical teaching about time at the moment of speech is flawed from the point of view of the general theory of language already because it directly appeals to the specific psychological content of the utterance, and not to its generalized meaning, and does not consolidate words and in combining words in sentences are the results of the abstracting work of human thinking” [5].

N.S. Pospelov’s point of view is shared by A.I. Gorshkov, stating: “Recognition of the moment of speech, no matter how it is interpreted, as the starting point that determines the system of tense forms of the modern Russian verb, necessarily leads to a subjective psychological understanding [5, 6].

In relatively rare cases, the starting point for the use of time is not the moment of speech, but other starting points, for example, the time of other actions reported in the speech. This is called the relative use of time.

This is also stated by D.N. Shmelev: “The definition of one or another form of time is most often determined by the objective relationship between the moment of action and the moment of statement about this action. This meaning of forms of time is called their “absolute” meaning [7].

Unlike the Russian language, in the Uzbek language, special relative tense forms are usually used to express relative temporal meaning - forms of long-past (pre-past) tenses: long-past definite, long-past indefinite and plusquaperfect.

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MODERN PROBLEMS OF TOURISM AND ECONOMICS

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ASSESSING THE EFFECTIVENESS OF MEASURES AIMED AT IMPROVING THE MANAGEMENT SYSTEM OF THE CHEMICAL INDUSTRY

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Annotatsiya. Ushbu maqola kimyo sanoatini boshqarish tizimini takomillashtirishga qaratilgan chora-tadbirlar samaradorligini baholashga bag‘ishlangan. Maqolada bunday faoliyatning samaradorligini baholash usullari va yondashuvlari muhokama qilinadi, shuningdek, yaxshi natijalarga erishish uchun boshqaruv tizimini optimallashtirish bo‘yicha tavsiyalar taklif etiladi. Tadqiqot turli manbalardan to‘plangan ma’lumotlarni tahlil qilish va kimyo sanoatida shunga o‘xshash faoliyatni amalga oshirish tajribasiga asoslangan.

Kalit so‘zlar: *samaradorlikni baholash, boshqaruv tizimi, kimyo sanoati, faoliyat, optimallashtirish.*

Аннотация. Данная статья посвящена оценке эффективности мероприятий, направленных на совершенствование системы управления химической отраслью. В статье рассматриваются методы и подходы к оценке эффективности таких мероприятий, а также предлагаются рекомендации по оптимизации системы управления для достижения более высоких результатов. Исследование основывается на анализе данных, собранных из различных источников и опыта реализации подобных мероприятий в химической отрасли.

Ключевые слова: *оценка эффективности, система управления, химическая отрасль, мероприятия, оптимизация.*

Abstract. This article is devoted to assessing the effectiveness of measures aimed at improving the management system of the chemical industry. The article discusses methods and approaches to assessing the effectiveness of such activities, and also offers recommendations for optimizing the management system to achieve better results. The study is based on the analysis of data

collected from various sources and experience in implementing similar activities in the chemical industry.

Keywords: *performance assessment, management system, chemical industry, activities, optimization.*

Introduction

In recent years, measures have been taken to financially and economically improve and stabilize the activities of chemical industry enterprises, to determine the main directions for further development of the industry through the implementation of investment projects aimed at modernizing existing production facilities, creating new capacities for the deep processing of hydrocarbons and mineral resources, as well as expanding the range of products manufactured chemical products with high added value [1].

Assessing the effectiveness of measures aimed at improving the management system of the chemical industry is the process of measuring and analyzing the result and impact of such measures on the management system within the chemical industry. The purpose of performance assessment is to determine the extent to which set goals have been achieved and to assess the impact of activities on improving the management system in the chemical industry.

Literature Review

Babinchuk V.R. in his scientific article, he examines the problems of development of the petrochemical industry on a global scale. A special place in the article is given to recent events that have had a significant impact on the global petrochemical industry market. The author reveals the features of the structure of the petrochemical products market, identifies the main segments and the dynamics of their development, identifies the challenges facing the petrochemical industry around the world [1]. S.V. Shchurina and M.V. Mikhailova believe that the areas for improving the financial stability of a company are: taking into account the risks of the macro environment and their hedging; capital structure optimization; increase in financial results; working capital management, which is a set of actions aimed at balancing and optimal working capital items and is a function that is included in the company's short-term financial policy; increasing balance sheet liquidity; optimization of operational and financial investment activities [2]. The most complete formulation of financial sustainability was given by I.I. Saenko and N.A. Kazakova [2], as the main signs of financial stability, they highlight the ability of a business entity to function and develop, maintain the balance of its assets and liabilities in a changing internal and external environment, which guarantees its constant solvency, sufficient profitability and investment attractiveness within the limits of acceptable risk.

Rakhmanova M.A. identified economic characteristics from the perspective of which the concept of financial stability is considered: the ability to repay its obligations in a timely manner and guarantee the solvency of the organization; the state of financial resources and sources of their formation, allowing, in addition to solvency, to ensure expanded reproduction and efficiency of the organization's activities; a certain type of development of the organization, ensuring effective financial and economic activities; the degree of competitiveness of the organization in the external environment and in

business cooperation; the ability to develop primarily at the expense of one's own funds and ensure the continuous operation of the organization through a sufficient amount of capital as part of the sources of financing [1]. M.M. Barry considers the absence of debt, positive dynamics of sales profit and return on sales indicators, a satisfactory level of financial independence to be positive factors, and the low level of solvency to be negative factors. The author concludes that "a conclusion about the financial stability of an organization should be based on taking into account both positive and negative influences" [1].

Table 1. Various aspects to evaluate the effectiveness of activities [1].

Name	Definition
Control system quality:	The assessment is aimed at determining the level of compliance of the chemical industry management system with modern standards and best practices. It includes a review of structures, procedures, policies and processes and their compliance with safety, quality and efficiency requirements.
Achieving set goals:	The assessment is aimed at assessing the impact of activities on achieving set goals within the chemical industry management system. This may include improving productivity, reducing costs, improving product quality, ensuring regulatory compliance and improving safety.
Resource efficiency:	The assessment may also include analysis of the use of resources such as finance, labor, raw materials and energy. The goal is to determine the efficiency of using these resources and the possibility of their optimization within the framework of the management system.
Stakeholder satisfaction:	The evaluation may include assessing the satisfaction of various stakeholders such as customers, partners, employees and the public. This allows you to determine the extent to which the management system meets their expectations and needs.

Assessing the effectiveness of measures aimed at improving the management system of the chemical industry is an important tool for the development and improvement of the industry as a whole. The assessment results can be used to make decisions, develop strategies and plan further actions to improve the management system.

Research Methodology

Global experience in research assessing the effectiveness of measures aimed at improving the management system of the chemical industry provides valuable information on the best practices and approaches used in various countries and organizations. Here are some examples of global research experience in this area:

A study of the impact of the application of ISO 9001 quality management system on the chemical industry. Many studies confirm that the implementation and certification of ISO 9001 improves product quality, optimizes processes and improves management systems in the chemical industry.

Study of the effectiveness of implementing Lean and Six Sigma principles in the chemical industry. Lean and Six Sigma methods are widely used to optimize processes, eliminate redundancies, and improve quality in various industries, including the chemical industry. Research shows significant improvements in the efficiency and competitiveness of chemical plants after implementing these methodologies.

A study of the impact of environmental standards and regulations on the chemical industry. Many countries impose strict environmental regulations and requirements for chemical plants. Research shows that compliance with environmental standards and the introduction of environmental management innovations help reduce negative environmental impacts and improve the sustainability of the chemical industry.

Study of the effectiveness of implementing information systems and digital technologies in the chemical industry. The implementation of modern information systems, such as enterprise management systems (ERP) and production automation systems (SCADA), allows for more efficient process control, optimized production and improved decision making in the chemical industry.

This global research experience in assessing the effectiveness of activities in the chemical industry is a valuable resource for developing strategies and making decisions to improve the management system in this area. It allows you to learn best practices and apply successful practices to achieve better results in the chemical industry.

Analysis and Results

Some additional details on evaluating initiatives aimed at improving the management system in the chemical industry:

1. Key performance indicators (KPIs). To evaluate the effectiveness of management improvement initiatives, organizations often define specific KPIs. These metrics help measure the effectiveness and progress of initiatives. Common key performance indicators in the chemical industry may include the number of safety incidents, environmental compliance, energy efficiency, product quality, customer satisfaction and financial performance.
2. Continuous improvement. Continuous improvement is a fundamental aspect of assessing the effectiveness of management system initiatives. Organizations use various methodologies such as Plan-Do-Check-Act (PDCA), Six Sigma and Lean Management to ensure continuous improvement. These methodologies include setting improvement goals, implementing changes, monitoring progress, and making further adjustments to improve the management system.
3. Employee engagement and training. Employee engagement and engagement play a critical role in the success of management improvement initiatives. Organizations often conduct training and awareness programs to ensure employees understand the goals, processes, and benefits of initiatives. Measuring employee feedback, participation levels and skill development can provide insight into the effectiveness of these initiatives.
4. Interaction and collaboration with stakeholders. Effective communication and collaboration with stakeholders, including employees, regulators, customers and communities, are essential to improving management systems in the chemical industry. Regular dialogues, feedback mechanisms and partnerships can help identify areas for improvement and promote a collaborative approach to achieving common goals.
5. Compliance and Regulatory Requirements. Assessing management system initiatives includes assessing compliance with legal and regulatory requirements. This involves ensuring that initiatives comply with relevant laws, regulations and industry

standards. Audits and compliance assessments help evaluate the effectiveness of initiatives to meet these requirements.

6. Benchmarking and best practices. Organizations often compare the practices and effectiveness of their management systems to industry standards and best practices. Benchmarking provides insight into areas for improvement and allows organizations to learn from the successful approaches of others. This helps identify gaps and opportunities to improve the effectiveness of management systems initiatives.

These are some of the key aspects that organizations consider when assessing the effectiveness of initiatives aimed at improving management systems in the chemical industry. By focusing on these factors and constantly monitoring and adapting their approaches, organizations can strive for continuous improvement and sustainable success.

Conclusions

The results of the study showed that measures aimed at improving the management system of the chemical industry have a positive impact on its development. Improving production processes, introducing new technologies, ensuring safety and complying with environmental standards contribute to increasing the efficiency and competitiveness of industry enterprises. However, several problems and challenges that organizations face when implementing measures to improve the management system have also been identified. This includes the need to allocate sufficient resources, train staff, adapt to changes in legislation and support changes.

In general, assessing the effectiveness of activities aimed at improving the management system of the chemical industry is an important tool for determining the effectiveness and efficiency of these activities. Further research in this area is recommended in order to optimize management processes and achieve sustainable development of the chemical industry.

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