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The beautiful thing about learning is nobody can take it away from you—B. B. King

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APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN GAME THEORY

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ABSTRACT

This topic is an area of research related to the application of artificial intelligence methods in game theory. The aim of the research is to create effective algorithms and models to analyze various game scenarios and predict optimal decisions for players. To achieve this goal, various methods of machine learning are used, as well as algorithms for optimization and statistical analysis of data. The relevance of this topic is due to the increasing popularity and importance of games in our lives, as well as the possibility of applying the results in various fields such as economics, business, politics, etc. The study was conducted with the help of computer implementation, which allows us to test the algorithms on different game scenarios and evaluate their results. The results confirm the effectiveness of the developed methods and algorithms.
The conclusion of the work summarizes the results of the study and discusses possible directions for further work in this area. This work may be useful for specialists in the field of artificial intelligence and game theory, as well as for developers of game applications.
Keywords: Game Theory, Artificial Intelligence, reinforcement learning, Q-learning, deep learning, neural networks, decision-making algorithms, strategies.

Introduction

In recent decades, artificial intelligence has become increasingly popular in scientific and engineering circles. Significant developments in this area have led to new methods and algorithms that can be used to solve various problems in different fields. One area where artificial intelligence is widely used is game theory.
Games have always been an important part of our lives, be it chess, go, or video games. Game theory studies behavioral and decision-making strategies in situations where one player's choices depend on another player's choices. This field has applications in various fields such as economics, politics, sociology, biology, and others. With the development of technology, especially artificial intelligence, it has become possible to use it to improve game strategies and the behavior of artificial agents.
Currently, much research in this area is focused on the development of machine learning algorithms and the use of neural networks to analyze game scenarios. However, it must be kept in mind that the application of artificial intelligence in game theory also has its limitations and problems, such as the problem of fairness and ethical issues. Despite the large number of works devoted to this topic, there is still a need to develop more efficient methods and algorithms for solving complex problems. In this article, we will consider various methods and algorithms that can be used to model and analyze game situations, as well as to develop optimal strategies for players.

Statement of the problem

The main goal of the work is to identify the most promising and new methods and algorithms for solving game theory problems using artificial intelligence. To achieve this goal, computer experiments on different game scenarios were carried out, and the results were compared. Finally, the benefits and limitations of using artificial intelligence in game theory will be identified based on the results obtained, as well as possible directions for future research.

Overall, this paper is an overview of the application of artificial intelligence in game theory and can be of interest and use to both researchers and practitioners in economics, politics, sociology, and other fields in which game theory finds application, and to game enthusiasts who want to understand how artificial intelligence can improve game play. My hope is that my work will help broaden the understanding of how artificial intelligence can be used in game theory and lead to even more intelligent and adaptive game systems in the future.

Methods

Choice of methods and algorithms

Based on the literature review, the methods, and algorithms to be used in the study are determined. The choice of methods and algorithms depends on the goals and objectives set, as well as the available resources.

Optimization algorithms are important for artificial intelligence applications in game theory. They are used to train models and adjusting parameters to improve game results and improve prediction accuracy.

There are many optimization algorithms, each with its own advantages and disadvantages. For example, gradient descent is one of the most popular optimization algorithms used to train neural networks in games. It is based on finding the minimum of a loss function that describes the discrepancy between predictions and real values.

Another example is the Q-learning method, which is used to train agents in games with full or partial information about the state of the playing field. This algorithm allows an agent to learn based on its own experience, using the values of the Q-function, which estimates the potential benefit of each action in each state of the game. Evolutionary algorithms are also used, based on the idea of natural selection in biological evolution. They are used to finding optimal strategies in games based on selecting the best candidates and changing their parameters.

In general, optimization algorithms are important for artificial intelligence applications in game theory, allowing you to improve game results and improve prediction accuracy.

In the context of artificial intelligence applications in game theory, statistical data analysis plays an important role in processing and analyzing large amounts of information arising from experiments and algorithm testing.

Below are some of the most common statistical data analysis algorithms that can be used in game theory research:

1. Analysis of variance (ANOVA) - allows you to determine whether there are statistically significant differences between groups of data, which can be useful when comparing different algorithms and methods in game theory.
2. Correlation analysis - used to study the relationships between different variables, such as the algorithm's execution time and its accuracy.

3. Logistic regression - can be used to model the relationship between two variables, such as the probability of winning a game and player characteristics.
4. Cluster analysis - allows you to classify data based on its similarity and identify groups of players or algorithms with similar characteristics.
5. Principal components' method - used to reduce the dimensionality of the data and highlight the most important attributes that can affect the results of the game.

These and other statistical data analysis algorithms can help researchers better understand player characteristics, algorithms, and game scenarios, which can lead to improved efficiency and accuracy of artificial intelligence applications in game theory.

Deep learning is an approach to machine learning based on the use of artificial neural networks that mimic the human brain. In recent years, deep learning has become an important tool in the field of artificial intelligence and is widely used in a variety of tasks, including game theory.

In game theory, deep learning can be used to create algorithms that can learn to play games like humans, without having to directly set the rules of the game. Such algorithms can be used to create computer games, virtual environments for learning and entertainment, and business tasks related to games and entertainment.

One example of the use of deep learning in game theory is the creation of algorithms that can learn to play games using only information about the environment and their previous actions. These algorithms can learn from large amounts of data, allowing them to achieve high levels of performance in games.

Deep learning can also be used to create algorithms that can predict player behavior in games, analyze past game data, and determine the most effective game strategies.

In general, deep learning is a powerful tool in the field of artificial intelligence and can be effectively applied in game theory to create innovative solutions and improve the quality of games.

Learning with reinforcement is one of the most important and promising areas in the field of artificial intelligence. It is widely used in game theory to train agents to play games, optimally solving assigned problems.

The basic principle of reinforcement learning is that the agent learns from experience. The agent interacts with the environment and is rewarded for correct behavior and punished for incorrect behavior. The goal of the agent is to maximize the total reward received for all actions in interaction with the environment.

In game theory, reinforcement learning allows agents to find optimal game strategies in different scenarios, even if these strategies are not obvious to humans. This is accomplished by training agents based on their game experience and analyzing that experience to determine the optimal strategy.

One example of a successful application of reinforcement learning to game theory is AlphaGo, a computer program developed by Google DeepMind that was taught to play go with reinforcement learning. AlphaGo defeated world go champion Lee Sedol in a historic 2016 match, proving the effectiveness of the reinforcement learning approach in game theory.

Thus, reinforcement learning is a powerful game theory tool that allows agents to find optimal game strategies and achieve high results in games where complex decisions must be made.

Computer implementation

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This step involves developing software to solve problems. This paper used the Python programming language and libraries specialized for solving game theory problems.
Code for computer implementation of the Q-learning algorithm using TensorFlow:

```python
import tensorflow as tf
import numpy as np

class QLearningAgent:
    def __init__(self, num_states, num_actions, learning_rate=0.2, discount_factor=0.95, exploration_rate=0.2):
        self.num_states = num_states
        self.num_actions = num_actions
        self.learning_rate = learning_rate
        self.discount_factor = discount_factor
        self.exploration_rate = exploration_rate
        self.Q = np.zeros((num_states, num_actions))

    def get_action(self, state):
        if np.random.uniform() < self.exploration_rate:
            return np.random.choice(self.num_actions)
        else:
            return np.argmax(self.Q[state, :])

    def update(self, state, action, reward, next_state):
        self.Q[state, action] = (1 - self.learning_rate) * self.Q[state, action] + \
                                self.learning_rate * (reward + self.discount_factor * np.max(self.Q[next_state, :]))

    def get_weights(self):
```

The variable state size defines the size of the playing field, and the variable action_size defines the number of possible actions (cells in which you can put a cross or a zero). Then the QNetwork class is created, which defines the architecture of the trained neural network.
Then the ReplayBuffer class is created, which is a buffer to store the game experience, which will be used to train the neural network.

```python
        return self.Q

    def set_weights(self, Q):
        self.Q = Q

class DQNAgent:
    def __init__(self, num_states, num_actions, learning_rate=0.001, discount_factor=0.99, exploration_rate=0.2
                 hidden_size=32, batch_size=64, memory_size=50000):
        self.num_states = num_states
        self.num_actions = num_actions
        self.learning_rate = learning_rate
        self.discount_factor = discount_factor
        self.exploration_rate = exploration_rate
        self.hidden_size = hidden_size
        self.batch_size = batch_size
        self.memory = []
        self.memory_size = memory_size
        self.model = tf.keras.models.Sequential([
            tf.keras.layers.Dense(self.hidden_size, input_dim=self.num_states, activation='relu'),
            tf.keras.layers.Dense(self.hidden_size, activation='relu'),
            tf.keras.layers.Dense(self.num_actions, activation='linear')
        ])
        self.model.compile(loss='mse', optimizer=tf.keras.optimizers.Adam(lr=self.learning_rate))
```

Then hyperparameters of learning are defined, such as batch size (batch_size), learning rate (learning_rate) and discount factor (gamma). Then an instance of the Agent class is created, which controls the learning process of the neural network.

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```
    def get_action(self, state):
        if np.random.uniform() < self.exploration_rate:
            return np.random.choice(self.num_actions)
        else:
            Q_values = self.model.predict(np.array([state]))
            return np.argmax(Q_values)

    def update(self, state, action, reward, next_state, done):
        self.memory.append((state, action, reward, next_state, done))
        if len(self.memory) > self.memory_size:
            self.memory.pop(0)
        if len(self.memory) < self.batch_size:
            return
        batch = np.array(self.memory)[np.random.choice(len(self.memory), self.batch_size, replace=False), :]
        states = np.array(batch[:, 0].tolist())
        actions = np.array(batch[:, 1].tolist(), dtype=np.int32)
        rewards = np.array(batch[:, 2].tolist(), dtype=np.float32)
        next_states = np.array(batch[:, 3].tolist())
        dones = np.array(batch[:, 4].tolist(), dtype=np.bool)
        Q_values = self.model.predict(states)
        next_Q_values = self.model.predict(next_states)
        max_next_Q_values = np.max(next_Q_values, axis=1)
        targets = Q_values.copy()
        targets[np.arange(self.batch_size), actions] = rewards + \
                                                       (1 - dones) * self.discount_factor * max_next_Q_values
        self.model.fit(states, targets, verbose=0)
```

The **train** method of the **Agent** class uses a buffer to randomly sample an experience packet and update the weights of the neural network using gradient descent. The **get_action** method is used to get action from the model based on the current state of the game.

This code shows an example of using TensorFlow to train a tic-tac-toe game model. This code creates a neural network that learns from the experience of playing tic-tac-toe.

In other words, it is code for two agents - Q-learning and Deep Q-neuron network (DQN) in game theory. Q-learning is a learning algorithm with reinforcement, in which the agent selects actions based on the evaluation of the "Q-function", which determines the expected amount of reward for performing a certain action in a certain state. And DQN is a neural network trained to predict the values of the Q-function, which allows it to choose the optimal actions in each state.

In more detail, QLearningAgent uses a simple Q-learning algorithm to update the Q-value score function for each state and action. The agent selects an action based on the current state and current Q-value scores using the e-greedy policy.

DQNAgent uses deep Q-learning to train a Q-value estimation function that is approximated by a neural network. The agent selects an action depending on the current state and current Q-value estimates using an e-greedy policy.

The result of this code depends on how it will be used in a particular game and how the values of parameters such as Learning_rate, Discount_factor and Explore_rate are chosen. Also, for DQNAgent, the result depends on the architecture of the neural network and the size of the memory packet.

Results of the study

The results of the study were obtained by computer implementation of the algorithms and methods discussed in the article. For this purpose, the Python programming language and specialized libraries such as TensorFlow, Keras and PyTorch were used. Specialized software packages, such as OpenAI Gym, were also used to simulate game situations and to evaluate the results of algorithm testing.

Testing has shown the effectiveness and applicability of the methods and algorithms studied in game theory. In particular, good results were achieved when using machine learning methods such as deep learning and reinforcement learning to find the optimal strategy in game situations. It has been shown that such methods can be used to create artificial intelligence algorithms that can compete with and even outperform human players in some games.

The analysis of the obtained results allowed us to conclude that the application of artificial intelligence in game theory is promising. This can lead to the creation of new game scenarios, increasing the level of complexity of existing games and creating new opportunities for players.

Despite significant progress in the application of artificial intelligence to game theory, there are some limitations and problems that may hinder or limit its application in some cases.

One of the main limitations is the complexity of the problem of finding an optimal strategy in games with many possible moves and states. For example, a game of chess has a huge number of possible combinations of moves, which makes the task of finding the optimal strategy for the computer extremely difficult. Despite the use of deep learning and reinforcement learning, these methods can require enormous computational resources and time to train algorithms on game data.

Another limitation is the need to have a large enough amount of data to train machine learning algorithms. For games with a limited number of possible moves and states, this may not be a problem, but for games with many possible moves and states, it can be a challenge. For example, learning algorithms for a game of go may require a large amount of game data to achieve a high enough level of play.

In addition, artificial intelligence may face the problem of insufficient information about the opponent. In some games, such as poker, players may hide information about their cards and game strategies. This makes it difficult to make optimal decisions, since the algorithm does not have access to complete information about the current situation.

Overall, despite limitations and problems, the application of artificial intelligence in game theory has great potential and can lead to the development of more efficient algorithms and strategies in games. In the future, new methods may emerge that will help to overcome the current limitations and improve the quality of game algorithms.

Conclusion

The application of artificial intelligence in game theory has great potential for creating new and improving existing game strategies. In this paper, various approaches to the application of artificial intelligence in game theory have been discussed, such as the use of deep learning, Q-learning, and evolutionary algorithms.

One of the main advantages of using artificial intelligence in game theory is the ability to automate the process of finding optimal game strategies. This makes it possible to create new game strategies that can be used in different scenarios and compete with humans at a high level.

Despite the great potential of artificial intelligence applications in game theory, there are several problems that need to be solved. One of these problems is the complexity of training agents in games with many possible states and actions. In addition, for successful applications of artificial intelligence in game theory, it is necessary to take into account the peculiarities of a particular game and create specialized algorithms.

Nevertheless, the application of artificial intelligence in game theory continues to evolve, with new methods and algorithms emerging every year to create more efficient and optimal game

strategies. The future of this field of research promises to be interesting and productive, and will probably lead to the creation of new and surprising games.

Declarations
The manuscript has not been submitted to any other journal or conference.

Study Limitations
There are no limitations that could affect the results of the study.

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REFERENCES

1. Bogdanova, D. Emotionally Colored Information and Decision Support Systems (Atlantis Press, Vol. 174. Accessed on 2023/01/13 from: http://creativecommons.org/licenses/by-nc/4.0/3. Ngo, T. H. Amazon reviews sentiment analysis: an approach for star rating prediction. /MA Thesis, University of Trento, 2021).
2. Van den Herik, H., Uiterwijk, J. W. & van Rijswijck, J. Games solved: now and in the future. Artif. Intell. **134**, 277–311, 2002
3. Silver, D., Huang, A., Madison, C. J., Guez, A., Sifre, L., van den Driessche, G., ... & Hassabis, D. Mastering the game of Go with deep neural networks and tree search. Nature, 529(7587), 484-489, 2016
4. Schaeffer, J. The games computers (and people) play. Advances in Computers **52**, 189–266, 2000
5. Sutton, R. S., & Barto, A. G. Reinforcement learning: An introduction. MIT press, 2018
6. Buro, M. From simple features to sophisticated evaluation functions./ In 1st International Conference on Computers and Games, 126–145, 1999.
7. Bowling, M., & Veloso, M. Multiagent learning using a variable learning rate. Artificial Intelligence, 136(2), 215-250, 2002
8. Yusupova, N. I., et al. Artificial intelligence tools for analyzing emotionally colored information from customer reviews in the service sector./ IOP Conference Series: Materials Science and Engineering, 1069(1), 012013, 2021. DOI: https://doi.org/10.1088/1757-899x/1069/1/012013
9. Yusupova, N., et al. Models and Methods for Quality Management Based on Artificial Intelligence Applications. //Acta Polytechnica Hungarica, 13(3), 2016.

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DIGITAL DESIGN OF OIL REFINING EQUIPMENT AND ITS COST-EFFECTIVENESS

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ABSTRACT

This work is devoted to the digital design of oil refining equipment and the analysis of its economic efficiency. In the modern oil refining industry, special attention is paid to the use of modern technologies and digital design methods to optimize design processes and improve equipment efficiency. The study examines the main stages of the digital design of oil refining equipment, ranging from the creation of virtual models to the analysis and optimization of production processes. Particular attention is paid to the use of modern software tools and technologies, such as computer-assisted design (CAD) and process simulation. The second part of the study is devoted to assessing the cost-effectiveness of digital design in the context of the oil refining industry. The costs of introducing digital technologies, payback periods, and projected economic benefits are analyzed. It also examines factors influencing the final results, such as changes in operational efficiency, reductions in design time, and improved quality of the final product. The study provides an overview of current trends in the digital design of refinery equipment and makes the case for the adoption of these technologies to improve the competitiveness and sustainability of enterprises in this industry.
Keywords: digital engineering, refinery equipment, computer-assisted design (CAD), virtual models, process simulation, cost efficiency, technology implementation costs, return on investment, operational efficiency, competitiveness, enterprise sustainability, process optimization, digital engineering trends, oil refining industry, product quality.

Introduction

The purpose of this work is to explore and evaluate the potential of digital design in the field of oil refining equipment, with a focus on identifying the cost-effectiveness of introducing modern technologies. The main tasks aimed at achieving this goal include: analysis of modern digital design methods, that is, to review current digital design methods and technologies used in the oil refining industry; creating virtual models of equipment, developing virtual models of oil refining equipment using computer-assisted design (CAD) systems and other modern tools; process simulation and optimization, conduct simulation of production processes based on virtual models in order to optimize equipment operation and improve production efficiency; estimate costs and payback, analyze the costs of introducing digital technologies, estimate payback periods and provide a reasoned analysis of cost-effectiveness; assessing the impact on production performance, explore the impact of digital design on production efficiency, reducing design time and improving the quality of the final product; formulation of recommendations, based on the

analysis, develop recommendations for enterprises in the oil refining industry regarding the implementation of digital design, taking into account its economic efficiency.

Objective

"Digital design of oil refining equipment and its economic efficiency" is determined by several important factors:

1. Technological progress: modern digital design technologies, including computer-assisted design (CAD) systems, provide unique capabilities for creating virtual models, process simulation, and equipment optimization, which significantly improves design in the oil refining industry.
2. Production efficiency: The introduction of digital technologies in the design of oil refining equipment can significantly improve the efficiency of production processes, reduce time and financial costs, and improve the quality of the final product.
3. Enterprise Competitiveness: Enterprises that proactively embrace modern digital design techniques can improve their competitiveness through faster innovation, faster time to market, and lower costs.
4. Social responsibility and sustainability: The use of digital design can also help improve the environmental and energy efficiency of oil refining equipment, which meets modern requirements for sustainable development and social responsibility in business.
5. Global Challenges: In the face of changing energy policies and the growing need to reduce emissions and improve energy efficiency, digital design represents an important tool for coping with the challenges of modern energy.

Thus, the study of the digital design of oil refining equipment and its economic efficiency is a relevant and promising area that can make a significant contribution to the development of the oil refining industry.

Experimental base and test methods

As part of the study "Digital design of oil refining equipment and its economic efficiency" as an experimental basis, it was carried out by employees of the Research Laboratory "Nanomaterials and Nanotechnologies" and the Department of Petroleum and Chemistry of the Azerbaijan State University of Petroleum and Industry, and test methods can cover the following aspects:

1. Virtual laboratory tests: creation of virtual laboratory conditions for modeling production processes and operation of oil refining equipment. Using CAD and other software to create three-dimensional virtual models. Virtual laboratory testing in the context of digital refining equipment design is the creation of computer environments that allow the simulation of production processes, the functioning of equipment, and their impact on the final products. The use of computer-aided design (CAD) systems and other software tools is a key element of this approach. Here are some aspects of virtual laboratory testing:

*Creation of 3D models: Three-dimensional virtual models of oil refining equipment are created using CAD and other tools. These models may include various components, such as piping, reactors, heat exchangers, and other elements of production systems.

*Modeling of production processes: Virtual laboratories allow you to simulate oil refining processes in real time. This includes the simulation of chemical reactions, heat transfer, material flows, and other physical and chemical processes.

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*Testing various scenarios: Virtual laboratories provide the ability to test various scenarios of equipment operation, change process parameters, and evaluate their impact on the final results.
*Optimization and analysis of production parameters: Virtual experiments allow optimization of production parameters, which can lead to improved process efficiency and cost reduction.
*Staff Training: Virtual laboratories can serve as a training tool for staff, allowing them to become familiar with manufacturing processes, respond to different scenarios, and make decisions in a virtual environment.
*Reliability and safety analysis: Virtual laboratories can also be used to analyze the reliability and safety of equipment by simulating possible emergency situations and assessing their consequences.
Overall, virtual laboratory testing plays a key role in modern digital refining equipment design, enabling more efficient and safer design, analysis, and optimization of production processes. Let's look at an example of a virtual laboratory test for the design and analysis of oil refining equipment using CAD.
-Creating a 3D model:
*Engineers use CAD software to create a 3D model of an oil refinery plant.
*The model includes various elements such as distillation columns, reactors, heat exchangers, and pumps. Using advanced tools to create highly interactive 3D models of oil refining equipment with detailed views of each component. The ability to scale, rotate, and zoom in on models for more detailed analysis.
-Modeling of production processes: Using a virtual laboratory, engineers simulate the processes of destruction of raw materials, catalytic reactions, and fractionation of petroleum products. - Visualization of production processes using graphs and diagrams that allow you to analyze the dynamics of changes in parameters over time. And modeling algorithms take into account thermal and chemical interactions between various equipment components.
- Testing various scenarios: Engineers conduct virtual tests by changing process parameters such as temperature, pressure, and raw material flow and evaluating how changes in conditions affect output products, energy consumption, and process efficiency.
-Optimization and analysis of production parameters: Using virtual tools, engineers optimize parameters to achieve maximum productivity and minimize costs and explore various scenarios, such as changing the composition of raw materials or optimizing equipment configurations.
-Personnel Training: The virtual laboratory can be used to train operators and engineers, allowing them to become familiar with equipment operation, respond to emergency situations, and make decisions in a virtual environment.
- Reliability and safety analysis: Engineers conduct virtual tests of emergency scenarios such as leakage, overheating, or equipment failure to assess the reliability and safety of the system.
This approach allows engineers and designers to gain a deeper understanding of production processes, minimize risks, and reduce development time, which ultimately helps improve refinery efficiency.
Some well-known companies and their projects in the field of digital design and oil refining can be mentioned:
*Siemens Digital Industries Software: Siemens provides digital design and simulation software products for a variety of industries, including petroleum refining. They offer solutions such as Teamcenter and Tecnomatix.

*Aspen Technology: AspenTech specializes in software for process modeling, optimization, and control in industries including petroleum refining.
*AVEVA: AVEVA provides engineering, design, and asset management software, including solutions for the petroleum refining industry.
* Honeywell Process Solutions: Honeywell provides manufacturing and process automation solutions, including petroleum refining. Their systems include virtual simulation tools.
*Bentley Systems: Bentley Systems provides infrastructure modeling software solutions, including digital design technologies, for the petroleum refining industry.
Please refer to the latest news, company websites, and reviews for the latest information on their projects and products in the field of digital refining equipment design.

2. Process simulation: Use of production process simulators to analyze the operation of equipment in various modes. Modeling of chemical, thermal, and mechanical processes associated with oil refining.
In the field of process simulation in oil refining, various software tools are used to simulate and analyze the operation of equipment under various conditions. Simulation programs allow engineers to conduct virtual tests, optimize production parameters, and predict system behavior. Here are some examples of tools used to simulate processes in oil refining:
*Aspen HYSYS: Aspen HYSYS is one of the most popular process simulation tools in the chemical and petroleum refining industries. It provides simulation of chemical, thermal, and hydrodynamic processes such as distillation, cracking, reactions, and others.
Aspen HYSYS is manufactured by Aspen Technology; Inc. Aspen Technology is a global leader in engineering and simulation software for the process industry. The Aspen HYSYS product is part of their software portfolio and is widely used in chemical, oil and gas, and other industries to simulate and optimize production processes. Aspen HYSYS is manufactured by Aspen Technology; Inc. Aspen Technology is headquartered in the USA. However, as a global company, Aspen Technology serves customers around the world, providing engineering and simulation software and solutions for a variety of industrial sectors, including chemical, oil and gas, pharmaceutical, and other industries.
*UniSim Design: UniSim Design, provided by Honeywell, offers process simulation capabilities for the chemical, refinery, and other industries. It includes libraries of models for various pieces of equipment and processes.
UniSim Design is manufactured by Honeywell. Honeywell is an international corporation headquartered in the United States. Honeywell specializes in automation and control, providing a variety of technological solutions for a variety of industrial sectors, including chemicals, oil and gas, energy, and other industries. UniSim Design is part of their software and engineering solutions for modeling and optimizing manufacturing processes.
*COMOS Process: COMOS Process, developed by Siemens, provides an integrated solution for the simulation and design of industrial processes, including petroleum refining. It provides simulation of thermal, hydraulic, and chemical processes. The COMOS Process is manufactured by Siemens AG, which is headquartered in Germany. Siemens is a large international conglomerate providing a variety of technology products and services in a variety of industries, including energy, healthcare, transportation, and industry.
COMOS Process is part of Siemens software designed for the engineering and life-cycle management of industrial facilities.

*ProMax: ProMax, provided by Bryan Research & Engineering, is designed for process simulation and optimization in the chemical and petroleum refining industries. It allows you to simulate various operations such as distillation, absorption, and reactions. ProMax software is produced and provided by Bryan Research & Engineering (BR&E). BR&E is an American company headquartered in the United States. They specialize in the development of software products for the modeling and simulation of chemical processes, including those in the chemical, oil and gas, and other industries. ProMax is one of their products designed for engineering simulation and process optimization in the chemical industry.
*KBC Petro-SIM: Petro-SIM, provided by KBC Advanced Technologies, provides a comprehensive process modeling solution for the petroleum refining industry. It includes tools for analysis, optimization, and control of production processes.
KBC Petro-SIM is manufactured by KBC Advanced Technologies. KBC is an international consulting and engineering company specializing in the energy and chemical industries. KBC headquarters are in the UK.
Petro-SIM is software for the simulation and optimization of processes in the oil, gas, and chemical industries. This is an innovative solution that allows you to simulate complex technological processes, predict their operation, and optimize parameters to achieve maximum efficiency.
These tools enable engineers to create virtual models of refinery equipment, conduct tests, analyze production parameters, and optimize processes.

3. Prototype testing: If there are physical prototypes of the equipment, conduct experiments using real samples to verify and confirm the results of virtual models. Testing physical prototypes of equipment in the oil refining industry may involve creating mock-ups and prototypes to conduct real-life experiments and verify results obtained from virtual simulations. Some companies specialize in creating prototypes and conducting physical tests in this area. Here are some examples:
*TNO (Netherlands Organization for Applied Scientific Research): TNO is an organization for applied scientific research in the Netherlands. They provide testing and prototype development services to a variety of industries, including petroleum refining.
*Fluor Corporation: Fluor is a global engineering and construction contractor. The company provides prototyping and testing services to the chemical, oil, and gas industries. Fluor Corporation is headquartered in Irvine, Texas, USA.
*Emerson Process Management: Emerson provides technology solutions and services, including prototyping and testing, for industrial applications. Emerson Process Management has been renamed Emerson Automation Solutions. Emerson Automation Solutions is a division of Emerson Electric Co. and specializes in providing automated solutions for a variety of industries, including oil and gas, chemical, and other industries
Emerson Electric Co. has a global presence, and they have offices and representative offices in various countries around the world. Emerson Electric Co. Headquarters is located in St. Louis, Missouri, USA.
*Wood Group: Wood Group provides engineering services, including prototyping and testing, to the oil and gas industry. The Wood Group merged with Amec Foster Wheeler to create the new Wood Group. The new company adopted the name Wood. Wood's headquarters are in the UK. Wood's main office is in Aberdeen, Scotland.

*Schlumberger: Schlumberger is a leading global technology company for the oil and gas industry. They provide hardware testing and prototype development services. Schlumberger is a large international company with offices around the world. Schlumberger headquarters is in France, in the city of Paris. However, Schlumberger has offices and representative offices in various countries and cities around the world, including the USA, Russia, Saudi Arabia, and Brazil. Azerbaijan, and many others. These companies offer engineering services, including creating physical prototypes and conducting testing to validate the results obtained from the virtual simulation process.

4.Tests on pilot plants: In the case of pilot plants for oil refining, carry out experiments and measurements on these plants to collect data for the analysis of production parameters. Pilot plants in the petroleum refining industry are small functional models that are used to conduct experiments, test new technologies, or optimize processes. Pilot plant tests provide valuable data to analyze production parameters and evaluate efficiency before scaling up production to full-scale plants. Here's how to imagine a pilot plant and some general testing rules:

Pilot installation:
*Scaling: Pilot plants can be scaled-down versions of full production equipment, allowing scientists and engineers to study processes under realistic conditions.
*Miniature Processes: Pilot plants simulate major petroleum refining processes such as distillation, cracking, hydrotreating, and others using reduced volumes of feedstock.
* Equipment Simulation: Pilot plants contain scale models of equipment such as reactors, distillation columns, and heat exchangers to simulate operating conditions.

Test rules:
*Defining Goals: Defining test goals could be process optimization, evaluating the effectiveness of a new technology, or adapting to changes in raw materials.
*Monitoring Systems: Installation of monitoring systems to record real-time data such as temperature, pressure, flows, and chemical composition.
*Control Measurements: Conducting regular measurements of parameters related to product quality, energy consumption, and other key indicators.
*Modifications and Experimentation: Make changes to process parameters or experimental conditions to evaluate the effect on results.
*Safety: compliance with safety standards during pilot plant operation.
*Data Analysis: Collect and analyze data to identify trends, determine optimal conditions, and make decisions based on the results.
*Scaling: In the case of successful trials, developing a strategy for scaling successful results to full-fledged production. Pilot plants provide valuable knowledge and experience that can reduce risks and improve the efficiency of introducing new technologies and processes into the oil refining industry.

5. Evaluating the effectiveness of changes: Experimental implementation of digital technologies in real production conditions, followed by evaluation of changes in production efficiency, product quality, and reduction in design time. Measuring the effectiveness of changes introduced using

digital technologies into production processes is a key step to confirm the positive impact and make decisions about scaling. Here's an example of what it might look like:

An example of the implementation of digital technologies in oil refining:
Goal: Improving the efficiency of the production process for the destruction of heavy oil fractions using digital technologies.
Steps:
*Digitalization of the Process: Development of a virtual model of the destruction process using digital twins and digital design tools.
* Integration of Sensors and IoT: Installation of sensors and IoT devices to monitor real parameters in real time (temperature, pressure, raw material consumption).
* Optimization with Artificial Intelligence: Implementation of an artificial intelligence system to analyze data and optimize process parameters in real time.
*Experimental Implementation: Stage-by-stage implementation of digital technologies in real production condition with evaluation of effectiveness at each stage.
*Monitoring and Evaluation: systematic monitoring of production parameters in real time, comparison with previous data, and analysis of results.
*Product Quality Analysis: Assessing the impact of changes on the quality of the final product, including analysis of chemical composition and compliance with standards.
*Economic Analysis: Calculates the economic benefits of digital technology, including reduced design time, reduced energy costs, and increased productivity.
Results: After the successful experimental implementation of digital technologies, the following results were achieved:
*Increased Efficiency: Reduce energy costs by 15% and increase productivity by 10% by optimizing process parameters.
*Product Quality: Improving the quality of the final product based on analysis of the chemical composition and compliance with standards.
*Reduced Design Time: Reduce design time for new technologies and processes by 20% through the use of digital twins.
*Economic Benefit: calculation of positive economic benefits, including saved energy costs and reduced design time.
This example demonstrates how digital technologies can be successfully integrated into manufacturing processes and then evaluated for improved efficiency, quality, and cost benefits.

6. Measurement of economic parameters: Collecting data on the costs of introducing digital technologies, measuring the return on investment, and other economic indicators. Measuring the economics of digital adoption includes collecting cost data, measuring the return on investment (ROI), and other key economic indicators. Here is an example of assessing economic parameters for a project to introduce digital technologies into the production process:
An example of assessing economic parameters:
Project: Implementation of a digital monitoring and control system in an oil refining plant.
Project goal: improve operational efficiency, reduce costs, and increase productivity using digital technologies.

Project Stages:

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*Investment: Purchase and installation of digital sensors, monitoring systems, and software for digital control. Training.
*Costs: Costs for purchasing technological equipment, updating software, training personnel, and integrating the system into the current infrastructure.
*Production Time Loss: Estimate the time required to implement and integrate new technologies and productivity losses during the transition period.
*Operating Costs: Forecasting operating costs such as energy costs, maintenance, and technology upgrades.

Performance Measurement:
*Improved Productivity: Measures productivity improvements due to the introduction of digital technologies (for example, reduction in equipment downtime).
* Energy Saving: Measure energy savings and determine the impact on operating costs.
*Product Quality: Evaluation of product quality improvements, if any.

ROI assessment:
*Cost calculation: calculation of the total investment and operating costs associated with the project.
* Benefit Calculation: Estimating economic benefits such as cost reduction, increased output, and increased efficiency.
*ROI Calculation: Calculate ROI as the ratio of benefits to costs, expressed as a percentage.

Approximate Result:
*After the introduction of digital technologies, the project demonstrated a cost reduction of 15% due to optimization of production processes. Increase productivity by 10%. The payback period for investments is less than 2 years. This example highlights the importance of systematically measuring and evaluating economic parameters when introducing digital technologies in order to assess their impact on business processes and enterprise performance.
7. Data Analysis: Application of statistical methods to analyze data obtained from experiments in order to identify statistically significant differences and dependencies. Data analysis in the context of the oil refining industry may include processing information about production parameters, product quality, equipment efficiency, and other key indicators. Here is an example of data analysis to optimize processes in an oil refinery plant:

Data Analysis Example:
Goal: Optimization of the cracking production process to improve the efficiency and quality of the final product.

Data Analysis Steps:
*Data Collection: Record data on temperature, pressure, raw material and product flows, chemical composition analysis, and equipment operation.
*Identification of Key Performance Indicators (KPI): Determination of KPIs such as raw material utilization rate, cracking efficiency, and percentage of target product yield.
*Trend Identification: Using data visualization to identify time trends and patterns in the operation of production processes.

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*Correlation Analysis: The study of relationships between various process parameters, such as how changes in temperature affect efficiency.
*Anomaly Analysis: identification and analysis of anomalies or abnormal situations that may affect production. Optimization of Parameters: Modeling of various optimization scenarios, changing process parameters, and analyzing their impact on KPIs.
*Optimization Effect Monitoring: Implementation of optimal parameters and monitoring their impact on production in real time.

Example Result:
*Trend Identification: Analysis showed that increasing the temperature in the reactor leads to an increase in cracking efficiency.
*Optimization of Parameters: Changes in temperature parameters resulted in an 8% increase in raw material utilization without an increase in unwanted products.
*Production Impact: Implementation of optimal parameters has resulted in increased overall process efficiency and reduced downtime.
*Economic Impact Assessment: Calculation of economic benefits from increased productivity and reduced energy costs. Data analysis allows you to identify patterns, optimize production process parameters, and make informed decisions to improve efficiency and economic productivity. In general, a combination of virtual and real experiments will allow us to fully evaluate the effectiveness of digital design of oil refining equipment and determine its potential benefits from the point of view of economics and production processes.

Results of digital design and technology and their discussions.
The results of digital design and technology implementation in the oil refining industry can have a significant impact on production efficiency, product quality, resource savings, and other key aspects. The discussion of these results is an important part of the decision-making and management strategy of the enterprise. Here are a few areas that can be considered when discussing the results of digital design and technology implementation:
1. Improving Efficiency: Discusses specific improvements in manufacturing processes achieved through digital design. This may include optimizing parameters, reducing equipment downtime, and improving overall efficiency.
2. Product Quality: Consideration of the impact of digital technologies on the quality of the final product. Discuss improvements in quality control, predictive maintenance, and other factors that contribute to quality improvement.
3. Economic Benefit: Analysis of economic indicators such as cost reduction, productivity improvement, and ROI. Discuss the financial benefits of digital innovation.
4. Integration with Management Processes: Discussion of the integration of digital data into the management processes of an enterprise. Information is used to make strategic decisions and plans.
5. Reducing Design and Startup Time: Consider the results of reducing the time to design new processes and start up new equipment. How digital technologies affect the speed of implementation of new solutions.
6. Development of Digital Culture: Discussion of how the introduction of digital technologies affected the corporate culture and competencies of employees. What efforts have been made to train and develop staff

7. Risk and Safety Analysis: Assessing results in the context of risk management and safety. How digital solutions help reduce risks and improve security.
8. Plans: Discussion of plans for the further development and implementation of digital technologies. What technologies or strategies are planned for future phases.
Discussing the results of digital design and technology is important to create a common understanding of the results achieved, identify learning points, and identify future directions for development.

Conclusion

As a result of the study, it can be concluded that the digital design of oil refining equipment has great potential for increasing the efficiency and competitiveness of the oil refining industry. The use of modern tools and technologies such as computer simulation, virtual prototyping, and data analysis can speed up and improve the design process, reduce testing costs, and ensure greater accuracy and quality of products. In particular, when using software packages such as SolidWorks, it is possible to develop equipment for additional purification of oil from mechanical impurities with high accuracy and speed. This significantly improves the design process and reduces product development time. However, it should be noted that digital design cannot completely replace physical testing and inspection. It is important to conduct comprehensive testing of equipment in practice to ensure its functionality and effectiveness. Thus, the digital design of oil refining equipment is an important tool for improving production efficiency and reducing the cost of developing new products in the oil refining industry.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

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REFERENCES

1. B. Prasad, K. Ramakrishnan, V. Narasimhan, and R. Rajkumar, "Digital Design of Petroleum Refining Equipment," International Journal of Engineering Research and Technology, vol. 5, no. 2, pp. 168-174, 2016.
2. M. S. Bakhtiar, A. H. F. M. Amin, M. S. Zainuddin, and S. S. M. Sani, "Digital Design and Manufacturing of Oil and Gas Processing Equipment," Procedia Engineering, vol. 68, pp. 161-167, 2013.
3. N. J. Park, Y. J. Kim, and H. Y. Kim, "Digital Design and Analysis of a Crude Oil Distillation Column," Energy Procedia, vol. 114, pp. 4231-4238, 2017.

4. S. Yu, Q. Xie, and B. Wang, "Digital Design and Optimization of a Petroleum Refinery Atmospheric and Vacuum Distillation Unit," Energy Procedia, vol. 142, pp. 278-283, 2017.
5. S. Sarkar, A. Jana, and S. Pal, "Digital Design of Oil and Gas Process Equipment: A Review," Journal of Energy Resources Technology, vol. 142, no. 1, pp. 1-13, 2020.
6. Al-Khalifa, "Digital Design and Simulation of Petroleum Refining Processes," Journal of Process Control, vol. 50, pp. 101-108, 2017.
7. L. Zhang, Y. Wang, and C. Wang, "Digital Design of Heat Exchangers in Petroleum Refineries," Chemical Engineering and Processing - Process Intensification, vol. 136, pp. 1-9, 2019.
8. D. D. Patel and D. P. Vakharia, "Digital Design of Oil and Gas Processing Plants: A Review," Journal of Process Control and Automation, vol. 3, no. 1, pp. 1-11, 2016.
9. H. J. Kim and K. T. Kim, "Digital Design and Simulation of a Crude Oil Desalter," Chemical Engineering Science, vol. 156, pp. 374-382, 2016.
10. J. Li and Y. Wang, "Digital Design of Petroleum Refining and Petrochemical Processes," Chemical Engineering Research and Design, vol. 168, pp. 182-191, 2022.
11. Ganesh Thakur. "Digital Transformation in the Oil & Gas Industry".: CRC Press, 2019
12. Mark M. Mills. "Digitalization and the American Refinery". Manhattan Institute, 2019
13. Lionel Filteau. "Digital Oil and Gas: A Digital Transformation Guide for the Oil and Gas Industry". Independently published, 2019
14. Havard Devold. "Oil and Gas Production Handbook: An Introduction to Oil and Gas Production". lulu.com, 2009.
15. Barry D. Lewis. "Smart Manufacturing: The Technologies and Applications of the Next Industrial Revolution". Wiley, 2016
16. Alasdair Gilchrist. "Industry 4.0: The Industrial Internet of Things". Springer, 2016
17. Klaus Schwab. "The Fourth Industrial Revolution". Crown Business, 2016

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DISTRIBUTED ALGORITHMS AND THEIR APPLICATION IN BIG DATA ANALYTICS

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ABSTRACT

Finding nonlinear features from raw data is a challenge to perform discriminative tasks in big data analytics. Deep learning algorithms can be used in this scenario to extract complex non-linear features from huge datasets, and then simple linear models are used to perform discriminative tasks taking the extracted features as input. The main advantages of this approach include adding non-linearity to the data analysis and computationally efficient implementation of linear models that are easier to implement than extracted features, which are automatically a major advantage in big data analytics. Thus, a large amount of input data is used to develop non-linear features, which is a great advantage for data analysts, as the knowledge present in the data can be effectively used. In this way, data analytics can be greatly benefited by applying deep learning techniques. Also, the paper considered such methods as Big Data, Semantic Indexing, Deep Learning, Frequent Pattern (FP) Tree and set of Frequent Elements, Machine learning algorithms, Supervised Learning, etc. These methods were represented in analysis of sick people at diagnostics of diseases.
Keywords: Big Data, analysis, Tree Projection, Machine Learning.

Introduction

Managing large volumes of different types of data is a major challenge faced by all organizations. The right analytics platform is essential to manage this data. In addition to analytics, incident correlation, metrics calculation, and statistics development are included and may vary depending on the scenario.

Machine learning is ideal for exploiting tacit knowledge in these large, disparate databases with very little manpower. It learns from available inputs and/or outputs, is strictly data-driven, and operates at machine scale, able to handle the large number of variables as well as the complexity of data essential in today's big data world. Machine learning consists of various data analysis disciplines ranging from predictive analytics and data mining to pattern recognition, and various algorithms are used for these purposes.

In the era of big data, innovative tools and techniques are required to extract, process and store large amounts of data and to find structured insights from the database. These techniques must be scalable enough to support on-demand demand and also distributed to allow for parallel processing. Several such algorithms are briefly described in the following section. Frequently used pattern search in large databases is a very important and expensive task in the world of data mining in the last few years. The FP Growth algorithm is an efficient and effective way to handle huge datasets that are scalable in nature. It was found that this algorithm performs better than

other similar algorithms like Apriori algorithm and Tree Projection. The main reason for the improved performance is in the methodology of finding frequent item sets without using candidate generation. The main feature of this method is the presence of a special data structure, a Frequent Pattern Tree (FP tree), which is responsible for storing information related to a set of elements. A brief description of the methodology is described below [15,16].

• FP tree is constructed using 2 passes, compressing input databases to represent Frequent Patterns.

• As a next step, the compressed dataset is divided into conditional datasets, where each number represents a frequent sample.

• Finally, each conditional database is extracted separately. As a result, the frequent item set can be extracted directly from the FP tree.

Problem statement

The main methodology of this algorithm is divided into two stages: Frequent Pattern (FP) Tree and Set of Frequent Elements.

Deep learning is a new field of machine learning, and its main goal is to bring machine learning closer to one of its main goals - artificial intelligence. One of the important features of deep learning is the ability to analyze unsupervised datasets, which is highly demanded in big data analytics because the data here is unlabeled and uncategorized. Fewer-known applications include extracting complex patterns from huge databases, faster data retrieval, data labeling, and more concentrates. Its main advantages are its robustness, generalizability and scalability. In this learning methodology, no pre-design of features is required, features are automatically learned to be optimal for a specific task. Because the learning is automatic, it is also robust to the natural variability of the data. It is also generic as it can be used for several applications and data. Scalability is another very important feature of this methodology, as the performance here improves with increasing data and can be massively parallelized. Another great advantage is that it can extract representations from unsupervised data without manual intervention, which is extremely effective in big data because the volume of data is large.

Below are some common applications of deep learning in big data analytics [18].

Information retrieval is one of the main tasks of big data analytics, and it is highly dependent on efficient storage and retrieval process. Here, the problem increases as the volume of data is large. In this case, semantic indexing is extremely useful, presenting information more efficiently, automatically aiding in the process of knowledge discovery and understanding. Deep learning enters the picture because it can generate high-level abstract data representations that can be used for semantic indexing. Since data representation plays an important role in data indexing, deep learning is used to provide semantic and relational understanding of complex data along with vector representation of data patterns, leading to faster search and information retrieval. In the world of big data, large and heterogeneous datasets are two major challenges for traditional approaches such as trial and error to extract meaningful information from these datasets. Also, very few tools allow processing this huge, complex dataset in a short amount of time. Machine Learning, a new and rapidly expanding field of research, provides an effective and efficient solution to the above issues by applying relevant machine learning techniques that differ from traditional approaches [19].

The solution of the problem

There are several learning styles or learning models that a machine learning algorithm can adapt to achieve the desired result. Common learning styles include Supervised Learning, Unsupervised Learning, Reinforcement Learning, Transduction, and Learning to learn. A brief description of these learning styles is described below [20, 21].

For neural networks, it is used to find the error of the network and make necessary adjustments to the network to minimize it. Figure 3.2 illustrates the basic methodology in supervised learning.

The main goal in supervised learning is to build a model that can make predictions based on evidence under conditions of uncertainty. To do this, it first takes known input data and, based on it, trains a model to be able to generate a prediction with a new set of inputs [23, 24]. Support Vector Machine (SVM). A Support Vector Machine (SVM) is a supervised machine learning algorithm that can be used for both classification and regression problems, although it is mainly used in classification problems. Here, we describe each data item as a point in an n-dimensional space, where n denotes the feature number. The value of the specific coordinate is basically the value of the feature. The following example explains it better.

Suppose we have a sample set that is 50% male and 50% female. Following the characteristics of this sample set, we need to create some rules so that it is possible to correctly determine the gender of a new person based on this set of rules. This is basically a classification domain problem that can be effectively solved by a Support Vector Machine. Example characteristics for observation here are height and hair length. First, we plot the data based on these two features that clearly classify the set into two segments. Here, the circles represent the female population and the squares represent the male population.

The support vector is the coordinate of an individual observation. Here (45, 150) is the support vector representing the female. A Support Vector Machine is a boundary that can optimally separate two groups. Since many frontiers may exist in the market problem, there are various strategies that are quite efficient to find the optimal frontier. The simplest way to understand the objective function in SVM is to find the smallest minimum distance of the boundary from the closest support vector that can belong to any class. After finding all distances for all boundaries, we simply select the boundary with the maximum distance from the nearest support vector.

A support vector machine finds the best way to classify data based on the position relative to the boundary between the positive class and the negative class. This boundary is known as the hyper-plane, which maximizes the distance between data points of different classes. Like decision tree and random forest, support vector machine can be used in both classification and regression, SVC (support vector classification) is for classification problem.

```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier()
knn.fit(X_train, y_train)
y_pred = knn.predict(X_test)
```

Reinforcement Learning is a very popular technique in today's machine learning world, where an agent learns to perform a task based on its learning experiences from its environment. The basic idea is that reinforcement is positive if a goal is achieved and negative if an obstacle is encountered. Video games and robotics are areas where this learning methodology is widely applied. In general, there is an agent, a game character or a robot, that moves through the

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environment. An agent is allowed to perform a task while moving. If he encounters obstacles while moving, the result is negative, if he reaches the goal, it is positive.

Results

This learning technique is also used to optimize anemia management in hemodialysis patients. This is a very well-known problem in nephrology, the suitability of this methodology is the solution to the problem of achieving long-term stability in patients' hemoglobin levels. If the patient is in a certain position, this technique suggests a sequence of actions that guides the patient to the best possible position [32].

Another real-life application of this learning is marketing campaign optimization. A basic approach is to use information from a marketing campaign to suggest company policies to achieve long-term organizational goals achieved through the implementation of such learning [32].

During the differentiation of "lung" diseases, when analyzing complaints and anamnesis, the most common symptoms require special attention:

- shortness of breath,
- speed of development,
- shortness of breath,
- temperature,
- humidity (external factors) etc.

The importance of big data in obtaining real results on the basis of block scheme with the help of "data" obtained below is emphasized.

Basic information:

Table 1.

Disease types			
Covid-19 (A)	Asthma(B)	Pneumonia(C)	AXOX*(D)
Physical examination (F.m)			
Temperature	Regular cough	Temperature	Pathological sputum
Cough Wheezing,	Difficult breathing	Musculoskeletal pain	Chronic cough
Difficulty breathing	Choking fits	Cough	Tobacco addiction
Loss of taste and smell	Respiratory inflammation	Sore throat	(d_3) Occupational factors (exposure to chemicals, dust)
Sore throat		Chest pain	(d_4) Shortness of breath (dyspnea)

Table 2

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	X-ray (Lung) and Computed Tomography (CT) **1-R 1 2, 3, 4, 5, 6,7,8, 9- R2**
1	Normal
2	Damaged: 1 segment of 1 share
3	1 segment to 1 share
4	1-sided damage
5	Bilateral damage - both sides
6	Total and subtotal damage
7	3 or less foci of induration less than 3 cm
8	"Frozen glass" type solidification in more than 3 foci less than 5 cm
9	"frozen glass" diffuse hardening and consolidation of lung tissue with reticular changes

Table 3

Temperature (T)	Degree	Stethoskope (S)	PZR test (PZR)
Subnormal	36°C aşağı	Number of breaths:	Pozitive
Normal	36,4°-36,8°C	a. Up to 25 per minute	Neqative
Subfebril	37,1°-38°C	b.min. 25+	
Febril	38,1°C	c.min. 30-40	
Letal max	43°C	d.min. 40+	

Table 4

	Blood test (Q) **1-Q1** **2, 3, 4, 5, 6-Q2**
1	Normal
2	Moderate leukocytosis
3	Leukocytosis
4	Leukocytosis, anemia
5	The number of leukocytes, neutrophils, platelets is normal
6	Marked leukopenia, lymphopenia, eosinophilia, thrombocytopenia

The importance of big data in obtaining real results on the basis of block scheme with the help of "data" obtained below is emphasized.

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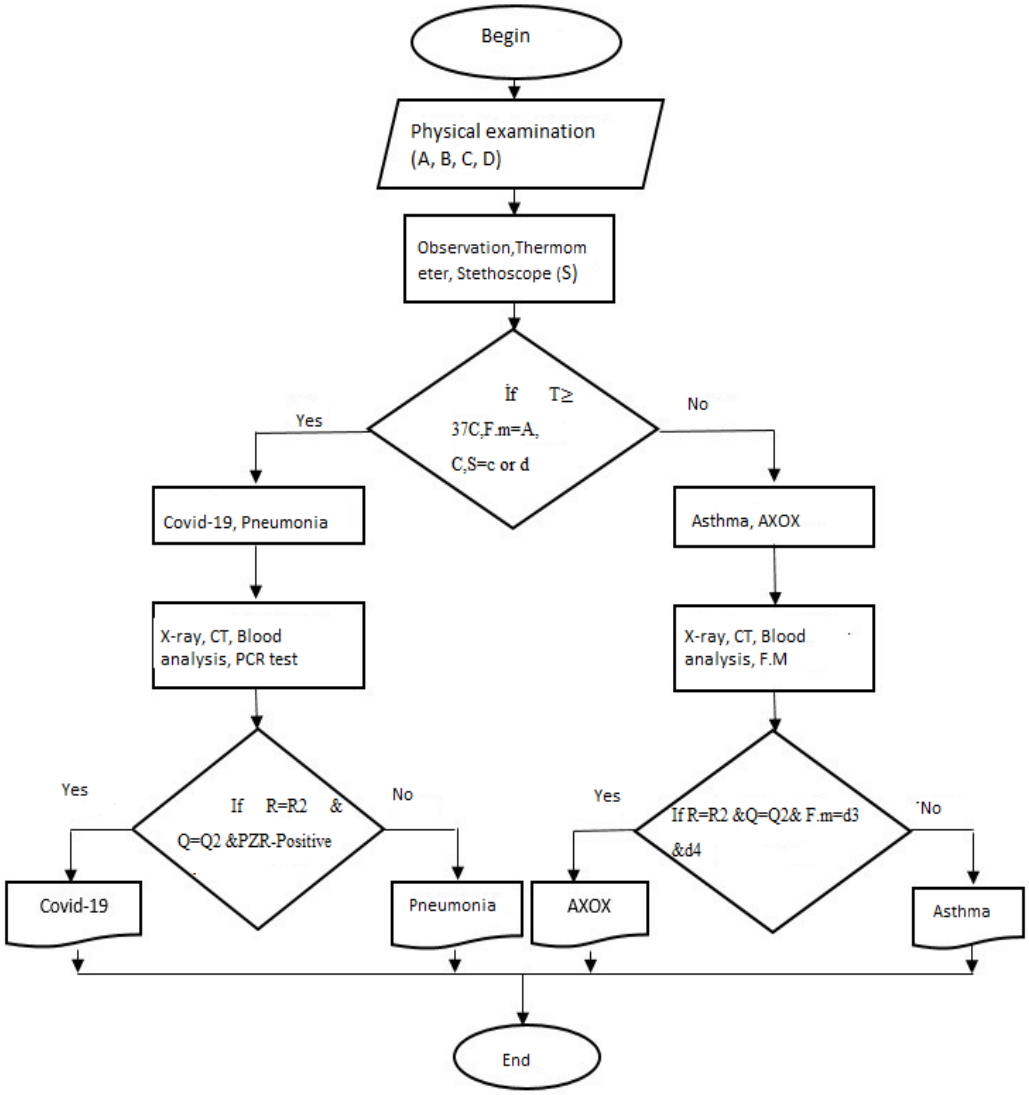

Conclusion

In today's era of big data, by applying unstructured traditional algorithms/methods, environmental studies, biomedical science, engineering, etc. It has become a real challenge to get meaningful insights with complex datasets in fields such as So, various innovative tools, technologies and frameworks have been developed to solve these problems. The following considerations were reflected in the issue:

- Storage and processing of large data sets is analyzed using Hadoop distributed file system and Map Reduce programming paradigm;
- framework, various NoSQL data warehouses with flexible schema example, several machine learning algorithms such as supervised, unsupervised and reinforcement learning are considered;
- various tools, technologies, machine learning algorithms and their application in the field of analytics are described in detail;
- the application methodology of machine learning algorithms is explained

Declarations
The manuscript has not been submitted to any other journal or conference.

Study Limitations
There are no limitations that could affect the results of the study.

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REFERENCES

1. Clifton D.A., Niehaus K.E., Charlton P., Colopy G.W. Health informatics via machine learning for the clinical management of patients. – Yearbook Med. Inform. – 2015, 10(1). – P.38.
2. Moazeni M. Parallel Algorithms for Medical Informatics on Data-Parallel Many-Core Processors. – 2013.
3. Acharjee S., Ray R., Chakraborty S., Nath S., Dey N. Watermarking in motion vector for security enhancement of medical videos. // In 2014 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT). – July 2014. – Pp.532–537.
4. Bose S., Acharjee S., Chowdhury S. R., Chakrabort, S., Dey N. Effect of watermarking in vector quantization based image compression. // In 2014 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT). – 2014, July. – Pp.503-508.
5. Rathi S.C., Inamdar V.S. Analysis of watermarking techniques for medical images preserving ROI. In: Computer Science & Information Technology (CS & IT 05)-open access-Computer Science Conference Proceedings (CSCP). – 2012. – Pp. 297–308.
6. Coatrieux G., Lecornu L., Sankur B., Roux C. A review of image watermarking applications in healthcare. In: Engineering in Medicine and Biology Society // EMBS'06. 28th Annual International Conference of the IEEE. – 2006, August. – Pp.4691–4694.
7. Abd-Eldayem M.M. A proposed security technique based on watermarking and encryption for digital imaging and communications in medicine. // Egypt. Inform. J. – 2013, 14(1). – Pp.1–13.
8. Suri J., Dey, N., Bose, S., Das, A., Chaudhuri, S.S., Saba, L., Nicolaides, A. 2084743 diagnostic preservation of atherosclerotic ultrasound video for stroke telemedicine in watermarking framework // Ultrasound Med. Biol. – 2015, 41(4). – S.133.
9. Pal, A.K., Dey, N., Samanta, S., Das, A., Chaudhuri, S.S. A hybrid reversible watermarking technique for color biomedical images. // In: 2013 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC). – 2013, December. – Pp.1–6.
10. Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., Byers, A. H. Big Data: The Next Frontier for Innovation, Competition, and Productivity. – 2011.

11. Kamal, S., Ripon, S.H., Dey, N., Ashour, A.S., Santhi, V. A MapReduce approach to diminish imbalance parameters for big deoxyribonucleic acid dataset. Comput. Methods Programs Biomed. – 2016131. – Pp.191–206.
12. A presentation on MapReduce. http://www.slideshare.net/nishantgandhi99/ map-reduceprogramming-model-to-solve-graph-problems.
13. A tutorial on "Introduction to Hadoop". http://www.tutorialspoint. com/hadoop/hadoop_introduction.htm.
14. A whitepaper on "Graph Database". http://lambdazen.blogspot.com/2014/01/from-entityrelationship-to-property.html.
15. Sidhu S., Meena, U.K., Nawani, A., Gupta, H., Thakur, N.: FP Growth algorithm implementation. Int.// J. Comput. Appl. –2014, 93(8).
16. A whitepaper on "Data Mining Algorithms In R/Frequent Pattern Mining / The FP-Growth Algorithm". https://en.wikibooks.org/wiki/ Data_Mining_Algorithms_In_R/Frequent_Pattern_Mining/The_FP-Growth_ Algorithm 196 A. Desarkar and A. Das.
17. Verhein, F. Frequent Pattern Growth (FP-Growth) Algorithm. School of Information Studies // The University of Sydney. – Australia, 2008.
18. Najafabadi, M.M., Villanustre, F., Khoshgoftaar, T.M., Seliya, N., Wald, R., Muharemagic, E. Deep learning applications and challenges in big data analytics. // J. Big Data. – 2015, 2(1), 1.
19. Brownlee, J. A Tour of Machine Learning Algorithms. A post available at http:// machinelearningmastery.com/a-tour-of-machine-learning-algorithms/
20. Qiu, J., Wu, Q., Ding, G., Xu, Y., Feng, S. A survey of machine learning for big data processing. // EURASIP J. Adv. Signal Process. – 2016, (1). – Pp.1–16.
21. Oberlin, S. Machine learning, cognition, and big data. // CA Technology Exchange, 2012, 44.
22. A learning material on "Machine Learning 101: General Concepts". http://www.astroml.org/ sklearn_tutorial/general_concepts.html
23. Machine Learning-What it is & Why it Matters. http://www.sas.com/en_id/insights/ analytics/machine-learning.html.
24. Machine Learning, Part I: Supervised and Unsupervised Learning. http://www.aihorizon.com/essays/generalai/su-pervised_unsupervised_machine_learning.htm.
25. Supervised Learning Workflow and Algorithms. http://in.mathworks.com/help/stats/supervised-learning-machine-learning-workflow-and-lgorithms.html?requestedDomain=www.mathworks.com
26. A blog on "Understanding Support Vector Machine Algorithm from Examples". http://www.analyticsvidhya.com/blog/2014/10/support-vector-machine-simplified/
27. A lecture note on "Machine Learning: Decision Trees". http://pages.cs.wisc.edu/*jerryz-hu/cs540/handouts/dt.pdf
28. Ray, S. Essentials of Machine Learning Algorithms (with Python and R Codes). A post at AnalyticsVidhya available at http://www.analyticsvidhya.com/blog/2015/08/commonmachine-learning-algorithms/
29. Cios, K.J., Swiniarski, R.W., Pedrycz, W., Kurgan, L.A. Unsupervised learning: clustering. // In Data Mining. Springer US – 2007. – Pp.257-288.

30. Yau, K.L.A., Komisarczuk, P., Teal, P.D. Reinforcement learning for context awareness and intelligence in wireless networks: review, new features and open issues. // J. Netw. Comput. Appl. – 2012, 35(1). – Pp.253–267.
31. Wang, L. Support Vector Machines: Theory and Applications // Springer Science & Business Media. – 2005. - Vol.177.
32. Martín-Guerrero, J.D., Soria-Olivas, E., Martínez-Sober, M., Serrrano-López, A.J., Magdalena-Benedito, R., Gómez-Sanchis // J.: Use of reinforcement learning in two real applications. In: European Workshop on Reinforcement Learning. Springer Berlin Heidelberg. – 2008. - Pp.191–204.

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FAMENNIAN STAGE OF THE UPPER DEVONIAN OF NAKHICHEVAN AR

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ABSTRACT

Brachiopods are a widespread and rapidly evolving group of organisms that are extremely important for the development of the biostratigraphy of Devonian deposits. Devon was their heyday. Their special significance for the stratigraphy of Devonian deposits is also determined by the fact that the first subdivision of the Devonian in the type sections of Western Europe was made mainly based on brachiopods. At present, in almost all regions, Devonian deposits are divided into local or regional zones based on brachiopods. Brachiopod zones of zoo geographic provinces are compared with each other by stepwise correlation, through intermediate sections based on linking with zones identified by other groups.

The article provides a correlation of local stratigraphic units and biostratigraphic zones, identified only in the Upper Devonian deposits of Transcaucasia, with synchronous units of Western Europe and other regions of Eurasia.

Keywords: section, deposits, formation, zone, stage, fauna, horizon, biostratigraphic zones, sub-formation.

Introduction

Devonian deposits in the Southern Transcaucasia are distributed over a limited area - in the western part of the Nakhchivan Autonomous Republic, but here they are widespread and are represented by all three well-characterized faunal departments. Moreover, if the Lower and Middle Devonian deposits are distributed only in the western part of the territory of the Nakhchivan Autonomous Republic, then the Upper Devonian deposits are also developed in the adjacent areas. Currently, a scheme has been developed for the zonal division of Devonian deposits developed in these areas, identifying 16 local stratigraphic units (formations) and 20 biostratigraphic zones.

Biostratigraphic zones, formations and sub-formations identified in the Devonian deposits of the Nakhchivan Autonomous Republic and adjacent areas, based on the study of the entire complex of organic remains, mainly brachiopods and conodonts, can be compared with synchronous deposits of typical sections of Western Europe (Ardennes and Eifel Mountains) and many regions of Eurasia, etc. Despite the great distance of most of these regions from Transcaucasia, thanks to the general and characteristic species of brachiopods and representatives of other faunal groups, almost all local divisions of the Devonian, including the Upper Devonian of Transcaucasia, are correlated with synchronous deposits established in these regions.

Problem statement

The Famennian stage in the Devonian sections of Transcaucasia is represented by six local formations: Noravank, Ertich, Kadlin, Shamamidzor, Gortun and Arshakiakhbyur; Each substage, with a three-member division of the stage, corresponds to two formations.

The Noravank Formation, which belongs to the lower Famennian substage in continuous sections of the Upper Devonian of Transcaucasia, is recognized within the Mesoplica meisteri brachiopod zone. The stratotype is located within the Amagu-Gnishik anticline in the Gnishik River gorge, under the Noravank monastery (Armenia). The lower limit is drawn by the appearance in the section of the index species, Cyrtospirifer asiaticus Brice (=C. archiaci Murch., sensu Verneuil, 1845) and other accompanying species.

In addition to the stratotype section, deposits of the Noravank Formation are exposed in the Ertichsky and Yaydzhinsky (parastratotype) sections and in the lower reaches of Bagarsykh-Deresi. They are represented by thick, light, often sugar-like quartzites and black, brownish-black clayey shales, which include layers and interlayers of dark gray, sandy limestones and light bluish siltstones. The thickness of the formation ranges from 60-151.5 m; it reaches its maximum in the Yaydzhinsky section, and its minimum in the Bagarsykh-Deresi region.

Limestones often contain organic remains: brachiopods, foraminifera, conodonts, algae, etc.

In the sediments of the Noravank Formation, 10 species and subspecies of brachiopods were found (see table): Mesoplica meisteri (Peetz), M.tasadyrica (Nal.), M.kayseri Khalfin, Ripidiorhynchus griasica Nal., Cyrtospirifer asiaticus Brice, Tenticospirifer cf.tenticulum (Vern., sensu Tien, 1938), etc.; of these, 8 species appear in the Noravank Formation itself [1].

Of these brachiopods, Mesoplica meisteri is the guiding form for the Meisterian layers of the lower Famennian of Kazakhstan. M.tasadyrica was described by D.V. Nalivkin (1937) from the upper Meisterevian layers of Kazakhstan. Ripidiorhynchus griasica is a common and leading form for the Yelets layers (lower Famennian) of the Leningrad and Voronezh regions of the Russian Platform. Cyrtospirifer asiaticus is one of the characteristic, guiding forms for the lower Famennian stage. Tenticospirifer tenticulum comes from the Bureg layers of the Urals, etc.[3].

Thus, almost all brachiopod species found in the Noravank Formation of Transcaucasia date its age as Early Famennian.

In the sediments of the Noravank Formation, 13 species and subspecies of conodonts were identified (identified by V.G. Khalymbadzhi): Icriodus cornudus Sannem., I.alternatus (Br.et Mehl,), I.subterminus Joung., Polygnathus aff.desorosus Stauffer, Pol. sagittalis Khalym.sp.nov., Pol.szulcewskii Matysa, Pol.procetus Br.et Mehl. and etc.

Analyzing the above conodont complex, V.G. Khalymbadzha (1979/5) concludes that with the exception of Pol.streeli, all other species are most often distributed in the lower Famennian stage. In general, V.G. Khalymbadzha believes that the Noravank Formation may correspond to the Palmatolepis triangularis conodont zone [2].

Thus, the Noravank formation corresponds to: the Zadonsky horizon of the Russian platform, the lower part of the Izhemsky formation of Southern Timan, the Ionishsky formation of Lithuania, the Makarovsky horizon of the western slope of the Southern and Middle Urals, the Koglysaysky horizon of the Middle Tien Shan, the Meisterevsky layers of North-Eastern Kazakhstan and their analogues in others regions.

In Belgium, the lower part of the Senzeil beds (Fa1a) probably corresponds to the Noravank Formation. In the Rhineland, the lower part of the Nekhden Formation should be compared with the Noravank Formation of Transcaucasia. In Afghanistan, the lower part of the so-called 9th zone with Cyrtospirifer asiaticus can be correlated with the Noravank Formation (according to D. Brice, 1977).

The Ertichi Formation is accepted within the scope of the Cyrtiopsis orbelianus - Cyrtiopsis davidsoni famenniana brachiopod zone. The stratotype of the formation is located in the basin of

the Eastern Arpachay River, along its left bank, near the ruins of the village of Ertich. The lower boundary is established by the appearance in the section of index species of the corresponding zone and representatives of the accompanying brachiopod complex: Ptychomaletoechia omaliusi (Goss.), Centrorhynchus baitalensis Reed, etc. Sediments of the Ertich Formation are exposed in the basin of the East Arpachay River - in the Ertich (stratotype) and Yaydzhinsky (parastratotype)) sections, as well as in the middle part of the Shamamidzor gorge.

Lithologically, the deposits of the Ertic Formation are represented by limestones, quartzites and black, brownish-black clayey shales. The thickness of the formation in the stratotypical Ertichsky section is 82.5 m, and its greatest thickness is in the Yaydzhinsky section - 256 m.

Limestone strata and interlayers, especially sandy ones, contain a very rich fauna, the predominant of which are brachiopods. The formation includes several layers and interlayers consisting entirely of calcareous algae.

The Ertic Formation includes 57 species and subspecies of brachiopods (see diagram): Schuchertella chemungensis Conrad, Productella chitralensis Reed, Pr.lachrymosa Hall, Mesoplica tasadyryrica (Nal.), Praewaagenoconcha speciosa (Hall), Pareliana Möell., Ripidiorhynchus ferguensis (Goss.), Ptychomalotoechia omaliusi (Goss.), P.depradi (Mansuy), P.turanica (Roman.), P.charakensis Brice, Centrorhynchus letiensis (Goss.), C.baitalensis (Reed), Eoparophorhynchus triaqualis (Goss.), Paryphorhynchus cf.fatima Hal., Pugnoides nana Martynova, Yunnanella synplicata Grabau, Camarotoechia ex gr.sobrina Stainb., Cyrtospirifer verneuili yunnanensis (Mansuy), C.whitneyi (Hall), Cyrtiopsis orbelianus (Abich.), C.davidsoni famenniana Paeck. , Athyris gurdoni (Reed), etc. From this complex, 42 species and subspecies appear in the Ertich Formation itself.

The vast majority of species from this complex are known from the Famennian stage of Eurasia and North America, and they are mainly distributed in the lower Famennian and the above brachiopod complex determines the Early Famennian age of the Ertich Formation of Transcaucasia. For example, Schuchertella chemungensis in North America comes from the Upper Devonian Chemung Beds. In Kazakhstan, this species is common in the Meisterian layers of the lower Famennian, etc.

Thus, the Ertic Formation, based on the richest complex of fauna, primarily brachiopod fauna, can be correlated with: the Yeletsk horizon (with small upper layers of the Zadonsk horizon) of the central regions of the Russian Platform, with the upper parts of the Meisterian layers of North-Eastern Kazakhstan, the Makarovsk horizon of the Urals and their stratigraphic analogues in other regions. In the Franco-Belgian basin, the section interval of the Ertic Formation of Transcaucasia apparently corresponds to the Mariembourg layers (Fa1b) with characteristic forms of Ptychomaletoechia omaliusi (Goss.). In the Rhineland, the considered section interval of the Ertic Formation corresponds to the middle most part of the Nechden Formation. In Afghanistan, this interval apparently corresponds to the upper part of the so-called 9th zone with Cyrtospirifer asiaticus Brice (=C. archiaci Vern., 1845; non Murchison, 1840), C. quadratus Nalivkin, etc.

The Kadrli Formation is accepted within the scope of the Dmitria seminoi Zone. It conformably overlies the Ertich Formation. The lower limit is established, first of all, by the appearance of the index species in the section - D.seminoi (Viq.).

The deposits of the Kadli suite are most developed on the territory of Armenia - in the Shamamidzor gorge (stratotype); within the Amagu-Gnishik anticline - in the gorge of the Chrakhana River (left tributary of the Gnishik River), southwest of the village of Gnishik; in the Ararat region, on the banks of the Araks River, near the village of Shikhlar, on one of the isolated

hills. And on the territory of the Nakhchivan Autonomous Republic - in the vicinity of the village of Nizhny Yayji (parastratotype); on a large territory located between the Bagarsykh-Deresi river in the east and the Dzhaanam-Deresi river in the west, in a strip closer to the watershed part of the Bagarsykh ridge.

Lithologically, the formation is represented by alternating units of limestone, quartzite, mudstone and sandstone; Quartzites and mudstones are predominant. The thickness of the formation in the stratotype Shamamidzor section is 106 m, and in the parastratotype Yaydzha section - 105 m.

The formation contains brachiopods, corals (rugosas), conodonts and foraminifera. Of the brachiopods, 24 species and subspecies were found in the Kadlin Formation: Schizophoria ex gr. impressa (Hall), Schellwienella cf.percha Stainb., Productella cf.herminae Frech., Pr.lachrymosa Hall, Whidbornella caperatiformis (Abr.), Mesoplica ex gr.simplicior Whidb., Ptychomaletoechia omaliusi (Goss.), P.charakensis Brice , Centrorhynchus letiensis (Goss.), Cyrtospirifer verneuili yunnanensis (Mansuy), C. sinensis mut. alfa (Grabau), Dmitria seminoi (Viq.), Athyris pseudoglobularis (Reed.), etc. Of those species that appeared in the section of the Qadli Formation: Dmitria seminoi was established in the Upper Devonian of Iran. In Afghanistan, this species is found in the "archiaci" zone and the Ptychomaletoechia(?) turanica zone of the Upper Famennian, with its two-member division. Schizophoria impressa Hall in North America is found in the Chemung layers, in Kazakhstan - in sulciferic layers. Schellwienella percha in North America, in the area of New Mexico, comes from the Percha Formation, and in Afghanistan - from Upper Famennian deposits, etc. Many species originate from the Lower Famennian, i.e. appeared in the underlying sediments. At the same time, a number of species appeared in the section from the base of the formation under consideration, and they, as well as most of the indicated transit species, are generally distributed in the upper Famennian of different geological provinces of the world, in a two-member division of the stage. Consequently, the presence in the complex of many Lower Famennian elements and the appearance in the community of many new species, common in younger formations than the Lower Famennian ones, give grounds to establish the age of the Kadlin Formation as the basis of the Middle Famennian substage, with its three-member division.

Thus, the Kadlinsky formation can be correlated with the Lebedyansky horizon and the lower part of the Dankovsky horizon of the Russian Platform (Mtsensk layers). In the Southern Urals, an analogue of the Kadlin Formation may be the lower part of the Murzakaevo Horizon, which also corresponds to the rhomboidea and marginifera conodont zones. The Kadrlin Formation of Transcaucasia can be correlated with the lowermost part of the sulciferous layers of Kazakhstan. In the Franco-Belgian basin, perhaps, the formation under consideration corresponds to: Esnier layers (Fa1c), Souvenir-Pré layers (Fa2a) with Centrorhynchus letiensis (Goss.), etc., which also correspond to the rhomboidea and marginifera conodont zones. In Germany, the upper part of the Nekhden Formation (Fa1c-Fa2a) and the lower part of the Hemberg Formation (Fa2b) are synchronous with the Kadlin Formation of Transcaucasia. In Afghanistan, the so-called 10th zone with Dmitria seminoi is synchronous with the formation under consideration (according to D. Brice, 1970; 1977).

The Shamamidzor Formation is accepted within the scope of the Cyrtospirifer pamiricus - Enchondrospirifer ghorensis zone. The stratotype is located in the Shamamidzor gorge, within the Kadli anticline. The lower limit is established by the appearance in the section of index species of a given zone and many other characteristic species (representatives of the genera: Sentasia, Araratella, Syntectirostrum, etc.). They are common in all structures where the underlying

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sediments of the Kadlin Formation are exposed and lie conformably on them. In addition, there are beautiful outcrops of the Shamamidzor formation: in the area of the village of Danzik, not far from the ruins of the village of Mamadasan; in the lower reaches of Bagarsykh-Deresi, near the village of Mahmud-Kend; There are also small outcrops at the southwestern foot of Tezhgar [9,10].

The formation is represented by limestones, mudstones, siltstones and quartzites, interspersed with each other. The limestones are highly sandy and replete with organic remains, mainly brachiopods. The thickness of the formation is 33-60 m, with a maximum thickness in the vicinity of the village of Nizhny Yaydzhi, and a minimum in the Shamamidzor gorge. In other cuts, they are not completely exposed.

The Shamamidzor Formation is very richly represented paleontologically, especially by brachiopods. 49 species and subspecies of brachiopods were found here: Aulacella cf.interlineata (Sow.), Schizophoria ex gr. impressa (Hall), Schuchertella chemungensis Conrad, Productella herminae Frech, Mesoplica tasadyrica (Nal.), M.simplicior Whidb., Planoproductus hillsboroensis (Kindle), Sentosia retiformis (Kr.et Karp.), Ptychomaletoechia ex gr.dumonti (Goss.), Centrorhynchus baitalensis (Reed), Eoparophorhynchus triaqualis (Goss.), Araratella dichotomians Abr., Camarotoechia sobrina Stainb., C.tenisica Martynova, Cyrtospirifer verneuili cyringothyriformis Paeck., C.tarbagataicus (Vas.), C.choui (Grabau) , C. pamiricus Reed, C. procumbens Simorin, Enchondrospirifer ghorensis Brice, Athyris sulcifera Nal. and etc.

Of these, only 15 species are characteristic of the formation under consideration. Of these: Aulacella interlineata in England occurs in the Pilton Beds; it is quite often found in Famennian deposits of the Urals and Kazakhstan (in the Meisterian and sulcifer layers). Planoproductus hillsboroensis in North America, in the New Mexico area, occurs in the Percha formation. Productella baitalensis in Afghanistan - at the Ak-Baital Pass (Pamir) - in the lower Famennian and at the base of the upper Famennian, with a two-part division of the stage. Sentosia retiformis comes from the Kynov horizon of the Urals and the lower Tournaisian of Berchogur. Cyrtospirifer tarbagataicus is distributed in the Famennian deposits of Tarbagatai (Kazakhstan - lower Neo-Devonian). C. pamiricus comes from the Famennian stage of the Ak-Baital region in the Pamirs. Enchondrospirifer ghorensis is found in the upper Famennian of Central Afghanistan, with a two-member division of this stage, etc.

In the conodont complex, Pelekysgnathus inclinatus is distributed from the velifer zone to the lower costatus; Polygnathus streeli and Pol. collinsoni - from the styriacus zone to the costatus zone. The complex contains species that usually do not rise above the velifer zone and species that arise in the lower styriacus.

Thus, the Shamamidzor Formation, which we attribute to the upper middle Famennian, apparently corresponds to the middle part of the Dankovsky horizon of the Central regions of the Russian Platform and the upper most part of the Murzakaevsky horizon of the Urals. It should be compared with the Sairam horizon of the Middle Tien Shan, with the middle part of the sulciferic horizon of northeastern Kazakhstan and their stratigraphic analogues. This can be confirmed by the following species found here, in addition to the index species: Planoproductus hillsboroensis (Kindle), Camarotoechia tenisica Mart., Cyrtospirifer procumbens Sim. etc. In the Dinant basin, the Monfort layers (Fa2b) and the lower Evieux layers (Fa2c) should be compared with the Shamamidzor formation. In Afghanistan, the Shamamidzor Formation should be compared with deposits of the so-called 11th zone with representatives of Araratella, Enchondrospirifer, Dichospirifer, etc., including index species.

The Gortun Formation, accepted in the volume of the brachiopod zone of Paurogastroderhynchus nalivkini, to the lower part of the Upper Famennian, with its three-member division. The stratotype of the formation is exposed in the gorge of the Aratso River, south of the village of Gortun. The lower boundary is determined by the appearance in the section of the index species of the zone and, in general, by a sharp reduction in the faunal complex and a change in the lithological composition. Its deposits, in addition to the stratotype section, are distributed in the southern part of the Eastern Arpachay river basin: in the area of the village of Nizhny Yaidzhi, - at the northern foot of the city of Gerankalasy (parastratotype); on the eastern, northeastern ridge with the peak of Munkh-Bala ogly; in the lower reaches of Bagarsykh-Deresi, - south of the city of Kabakhdag; at the western and southwestern foot of Tezhgar; on the spurs of the city of Birali-Kuzey, along a narrow strip stretching west to the southern foot of the Urtsky ridge and into the Shamamidzor gorge.

Solution of the problem

It is composed of terrigenous rocks (variegated clayey shales and siltstones) with interlayers and packs of ferruginous clayey (partly sandy), highly micaceous limestones, usually brownish-gray and brownish. The thickness of the deposits ranges from 28 m in the stratotype to 112 m in the parastratotype Yaydzhinsky section.

Limestones of the Gortun Formation often contain numerous shells of brachiopod fauna, mainly isolated valves of P.nalivkini. In general, the formation contains 31 species and subspecies of brachiopods, of which: Bagrasia chonetiformis (Kr.et Karp.) is common in the upper reaches of the Upper Famennian and in the Etrenian layers of the Southern and Northern Urals. B.scabricula (Martin) is found in the upper Devonian and lower Carboniferous of England, the Ardennes and in several areas of Asia and Eastern Europe, as well as in Afghanistan. Paurogastroderhynchus nalivkini was established in the deposits of the Gortun Formation of the Upper Famennian of Transcaucasia and is the leading form for this formation; It was found at approximately the same stratigraphic level in Afghanistan (D. Brice, 1977). Cyrtospirifer insulcifer lectus Mart. comes from the upper part of the sulciferic layers of Central Kazakhstan. Species Cyrtospirifer krestovnikovi Nal., Spirifer distans Sow. and S.pseudosuavis Kr.et Karp. known from Etren shell rocks of the Southern Urals. Athyris squamigra Kon. and Actinoconchus struniensis (Dehee) originate from the Etren zone of the Dinant Basin stratotype region. In the deposits of the Gortun Formation, many species that appeared in the Middle Famennian section continue to exist; these comprise 17 species. At the same time, those that reappeared in the Gortun Formation (12 species in total) in many regions of the world are characteristic of the upper Famennian layers and the transitional layers of the Devonian and Carboniferous [6,7,8].

Thus, the Gortun Formation, attributed to the bottom of the Upper Famennian, with its three-member division, should be compared with the top of the Dankovo horizon, i.e. with the Kudeyarov layers of the Russian Platform; Upper Zelenets subhorizon of the Timan-Pechora province; Ust-Karaganda layers and the lower part of the Simorinsky horizon of Kazakhstan; Kushelga horizon of the Urals and their analogues in other regions. In the Franco-Belgian basin, the Gortun Formation should be compared with the ammonoid zones: Gonioclimenia speciosa, Kalloclimenia subarmata and Wocklumeria sphaeroides. That is, in the Franco-Belgian basin with the Gortun Formation of Transcaucasia, one can compare the upper part of the Evieux layers (Fa2c), the Combline-Pont layers (Fa2d), at least the lower half of this unit. In the Eifel Mountains, the Dasberg Formation (Fa2c) and the lower part of the so-called Waclumer layers

(Fa2d) are synchronous with the formation under consideration. In Afghanistan, the Gortun Formation of Transcaucasia corresponds to the so-called 12th zone according to D. Brice (D. Brice, 1977) with Paurogastroderhynchus nalivkini (Abr.), Buxtonia scabricula (Sow.), etc. In North America, the Percha Formation corresponds to the Gortun Formation (Percha formation) with Schellwienella percha Stainb., Camarotoechia sobrina Stainb., Cyrtospirifer kindlei St. etc., at least its lower half. From here a large complex of conodonts has been identified [4,5].

The Arshakiakhbyur Formation, accepted within the scope of the brachiopod zone Spinocarinifera niger - Hamlingella goergesi - Sphenospira julii, now - after at the joint plenum of the ISC commissions on the Devonian and Carboniferous systems (Minsk, April 1986), the decision was made to indicate the interval of analogues of the zone Etren in the former USSR should be transferred from the base of the Carboniferous to the tops of the Famennian stage, and on the basis of this decision, the Devonian commission of the MSK recommended adopting a three-part division of the Famennian stage in the former USSR - refers to the tops of the Upper Famennian substage. The stratotype of the formation is located in the gorge of the Arshakiakhbyur River within the Kadlin anticline, on its southwestern wing. The lower boundary of the formation is quite clear, it corresponds to the beginning of the transgressive sedimentation cycle and is marked by the appearance of sandy-clayey, somewhat lumpy, usually reddish-brown limestones, with an abundant brachiopod fauna: Spinocarinifera niger (Goss.), Mesoplica praelonga (Sow.), Sphenospira julii (Dehee) and other species characteristic of this formation. The upper boundary is drawn at the base of a unit of mudstones with thin platy layers of sandy and sandy-clayey limestones with Rhipidomella michellini (L'Ev.), Undispirifer of the U.tornacensis group (Kon.), U.ussiensis Tolm., Camarotoechia panderi (Sem.et Moell .), Syringothyris cf.hannibalensis Winch. and other characteristic species for the lower parts of the Carboniferous system.

The deposits of the Arshakiakhbyur Formation are exposed in those sections where the deposits of the Gortun Formation of the Upper Famennian are developed and lie conformably on them. Lithologically, the formation is represented mainly by alternating units of yellowish-gray sandy limestones and black shales, which also include layers and interlayers of sandstones and quartzites. Thickness - 60-100 m.

Results and discussion

Among the organic remains, numerous brachiopods, corals, bivalves, crinoids, foraminifera, calcareous algae, conodonts, etc. are found, and for almost all groups of fauna its Etrenian age is clearly determined. Thus, the faunal complex of the Arshakiakhbyur Formation is close to that of the Etroeungt layer (Tn1a) and, possibly, the lowermost Hastier layers (Tn1b) of the Franco-Belgian Basin. In Germany, the formation under consideration is adequate to the upper half of the so-called Waclumer layers (Tn1a). The Lytvinsky horizon of the Southern Urals, the ore-bearing layers of the Liman formation of the Dnieper-Donets depression, the “C a” deposits of Donbass, the upper most part of the Simorinsky horizon of Kazakhstan are synchronous with the Arshakiakhbyur formation (now all these stratigraphic units, according to the decision of the MSK, have been transferred to the tops of the Upper Famennian). In the western and central parts of the Russian Platform, the Arshakiakhbyur Formation corresponds to the Trans-Volgian horizon. In the Kuznetsk Basin, the Abyshevo Horizon can be compared with the Arshakiakhbyur Formation. The Arshakiakhbyur Formation can be compared with sediments at the level of the Etren zone in Iran and Afghanistan; in Afghanistan, these deposits are part of the so-called 12th zone (D. Brice, 1977). In North America, the upper part of the Percha formation, New Mexico, as

well as the lower layers of the Kinderhook series (Bushberg and Hannibal layers) of the Missouri River basin can be compared with the Arshakiahbyur Formation (Scheme 1)

Scheme 1. Biostratigrapic division of the Upper Devonian of the South Transcaucasus (Nakhichevan Autonomous Republic and adjacent regions).

System	Departments	Tiers	Subtiers	Suites (according to A.B. Mamedov, 1980; A.B.Mamedov, M.A.Rzonsnitzkaja, 1985)	Brachiopod zones (according to A.B. Mamedov, 1962, 1980)	Zones according to rhynchonellids (according to L.T. Teymurzade, 2003)	Conodont zones (according to N.S. Ovnatanova; V.A. Aristov, 1984 and V.G.Halymbadzhe)	Ural folded region (Western slope: Unified regional stratigraphic scheme) (M.A. Rzhonsnitskaya, 1964, 1968, 1973, 1988	
Carbon	Lower	Turnaean	Lower	Gerankalasinskaya	Rhipidomella micheilini – Unispirifer ussiensis		Duplicate Culcata	Lytvinsky	Nigeroplica niger, Bagrasia retiformis, Fusella aff. tornasensis, Sphenospira julii, Syringothyris uralensis, Composito struniensis
Devonian	Upper	Famensian	Upper	Arshakiakhbyur	Spinocarinifera niger – Hamlingella goergesi – Sphenospira julii	Araratella araratica - Paryph. striaticostatum	Costata	Kushelchinsky	Mesoplica praelonga, Sphenospira aff. julii, Spirifer strunianus
								Murzakaevsky	Zigania ursa, Planovatirostrum planum
				Gortunskaya	Paurogastroderhynchus nalivkini	Paurogastroderhynchus nalivkin		Makarovsky	Cyrtospirifer asiaticus

						i	Styriacus	Askynsky	Theodossia anossofi, Cyrtospirifer markovskii, Hypothyridina cuboides, Gypidula biplicatiformis and etc.
			Middle	Shamamidzor	Cyrtospirifer pamiricus – Enchondrospirifer ghorensis	Ptychomaletoechia dumanti	Velifer	Mendymsky	Calvinaria megistana, C.biplicata, Atrypa aschensis
				Kadrli	Dmitria seminoi	Ptychomaletoechia raricostata	Marginifera Rhomboidea	Domanikovyj	Calvinaria megistana, C. domanicen-sis, C.cf.taimyrica and etc.
			Lower	Ertichi	Cyrtiopsis orbelianus – Cyrtiopsis davidsoni famenniana	Ripidiorhynchus kotalensis	Crepida	Sargaevsky	Ladogia meyendorfi, Hypothyridina calva, Anatrypa timanica, Mucrospi-rifer novosibiricus,M.muralis and etc.
				Noravank	Mesoplica meisteri	Ripidiorhynchus griasica	Pol. Triangularis	Kynovsky	Schizophoria ivanovi, "Atrypa" velikaya, Uchtospirifer murchisonianus, Hypothyridina semilukiana and etc..
		Francian	Upper	Yaydzhinskaya			Gigas An. Triangularis Upper		

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								Middle			
				Bagarsykhckaya	Cyphoterorhynchus koraghensis – Cyrtospirifer subarchiaci	Cyphoterorhynchus koraghensis		Lower	Pashiysky	Schizophoria ivanovi, Spinatrypina douvillei, "Atrypa" velikaya, Uchtospirifer murchisonianus and etc.	
			Lower	Chrakhaninskaya	Cyrtospirifer disjunctus elegans	Hypothyridina calva	Disparilis hermanni – cristatus				
	D_2	Givetian	Upper	Arpachai		Undispirifer undiferus – Emanuella pseudovolhynica					Varcus

Conclusion

The practical value of the work is determined by the development of the most detailed stratigraphic scheme of the Devonian of Transcaucasia, which can serve as the basis for a legend for the State Geological Map at a scale of 1:50000 and larger scales and linking it with the ISC. The great importance of brachiopods is determined by the fact that they are one of the most effective groups of fauna not only for dating the age of sediments in natural outcrops, but also give good results when conducting broad interregional correlations.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

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REFERENCES

1. Tagarieva R.Ch., Misens A.G. Sections of the western slope of the Southern Urals, promising for selecting a point of the regional stratotype of the lower boundary of the Famennian Stage. //Lithosphere, (3), 2015, pp. 33-56.
2. Tagarieva R.Ch. (2013) Conodont biodiversity of the Frasnian-Famennian boundary interval (Upper Devonian) in the Southern Urals.// Bul. Geos. 88(2), pp.297-314.
3. Tagarieva R.Ch. Famennian conodont zonation in the Barma and Makarovo deposits at the Kuk-Karauk-I section (South Urals) / International Field Symposium"The Devonian and Lower Carboniferous of northern Gondwana" in memory of Dr. Volker Ebbighausen, 22–29 March 2013: Abstracts book, 2013. P. 120–122.
4. Tagarieva R.Ch., Mizens A.G. Razrezy zapadnogo sklona Yuzhnogo Urala, perspektivnye dlya vybora tochki regional'nogo stratotipa nizhnei granitsy famenskogo yarusa [Sections in the western slope of the south urals perspective for the choice of the famennian regional boundary stratotype point] // Lithosfera, 2015, No. 3. P. 33–56.
5. Tagarieva R.Ch. Stratigraphic hiatuses at the Frasnian/ Famennian boundary in South Ural's sections / The 6th International Siberian Early Career GeoScientists Conference: Proceedings of the Conference (9–23 June 2012, Novosibirsk, Russia). – Novosibirsk, 2012. – P. 189–190.
6. Gatovsky Y.A. Famennian – Tournaisian boundary on the western slope of the South Urals, Russia: new look / B. Mottequin et al. (eds.) // STRATA: IGCP596–SDS Symposium (Brussels, September 2015). – 2015. – Série 1, Vol. 16. – P. 51–52.
7. Misens A.G. (2012) Brachiopods and biostratigraphy of the Upper Devonian of the Middle and Southern Urals. -Ekaterinburg: Ural Branch of the Russian Academy of Sciences, 324 p.
8. Misens A.G., Misens L.I. Stratigraphic significance of Devonian brachiopods of the Urals. //Lithosphere, 2017;17(4):62-72.
9. Teymurzade L.T. Biostratigraphic division according to rhynchonellids in the Nakhchivan Autonomous Republic/ Abstracts of I International Scientific and Practical Conference. Toronto, Canada, 1-3 October 2020, 582-588.
10. Teymurzade L.T. Biostratigraphic division of the Upper Devonian (Frasnian stage) of Southern Transcaucasia (Nakhchivan Autonomous Republic and adjacent areas). /Abstracts of I International Scientific and Practical Conference Buenos Aires, Argentina, 6-8 December 2020, 198-208.

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IMPROVED IRRIGATION SYSTEM BASED ON Z-INFORMATION

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ABSTRACT

In this paper an automatic intelligent irrigation system is considered. Irrigation regimes for agricultural crops provide the determination of scientifically based norms of irrigation, depending on the soil, physiological, climatic and technical characteristics of the irrigated array. In modern irrigation systems, the parameters of irrigation regimes are calculated similarly to traditional methods. But to solve the problem of efficient irrigation, it is necessary to take into account the weak formalizability, which makes it difficult to use accurate mathematical models to describe the control system. The solution of this problem would be partially possible if there were many qualified experts who, taking into account the linguistic nature of the variables, are able, using their experience without constructing any dependencies, to determine the optimal irrigation rates. In the absence of such reference experts in intelligent irrigation planning systems, mathematical models based on Soft Computing should come forward. Our model is based on Z-information, as an important qualitative attribute of information on which decisions are based is its reliability. The concept of Z-number relates to the issue of reliability of information, especially in the realms of decision analysis. Z-number valuations, take into account the uncertainty of the experts` opinion in estimation of the options.
Keywords: Z-numbers, uncertainty, reliability, fuzzy logic, linear interpolation, similarity

Introduction

In the last century, water infrastructure has been developed considering the growing demand for agricultural products in the Azerbaijan Republic. International experience shows that the priorities for achieving efficiency in irrigation agriculture depend on the level of economic development of the country, the degree of development of science, the existing potential of highly qualified personnel. Methodical approaches and problem-solving methods for systematic evaluation of irrigation and melioration systems should be adapted to the current situation. The main characteristics of the measurement quality are accuracy and reliability. Increasing the accuracy of the measurement due to the reduction of its error is technically difficult, expensive and laborious. Therefore, the level of accuracy to which one should strive is determined by the criterion of expediency, which depends on specific conditions and the purpose of measurements.

Various methods, including using of fuzzy logic, have been developed to make an automatic irrigation design. For example, a fuzzy logic controller was suggested for a drip irrigation system in Qatar. The following parameters were used in fuzzy rules for decision-making in the Mamdani model: soil moisture, water consumed, solar radiation, and temperature [9]. Fuzzy Logic is used in [6] for the evapotranspiration, that takes into consideration recent rainfall, humidity, radiation, and a crop coefficient. Authors in [7] used fuzzy logic for the automatic control of water pumps.

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In this work, we consider the automatic irrigation system based on Z-information. Prof. Zadeh introduced the concept of Z-numbers to describe the uncertain information, which are more generalized notions. A Z-number is an ordered pair of fuzzy numbers $(\tilde{A},\tilde{B})$. Here $\tilde{A}$ is a value of some variable and $\tilde{B}$ represents an idea of certainty or other closely related concepts, such as sureness, confidence, reliability, strength of truth, or probability [10]. It should be noted that in everyday decision-making most decisions are in the form of Z-numbers, for example:

(Probability of the state of nature, big, not sure)

(Outcome of the state of nature, medium, very likely)

Zadeh suggests some operations for computation with Z-numbers, using the extension principle. This theme was extended in [10]. It was shown how to use these Z-numbers to provide information about an uncertain variable in the form of Z-valuations, assuming that this uncertain variable is random. In [10] the author offers an illustration of a Z-valuation, showing how to make decisions and answer questions. Also, an alternative formulation is used for the information contained in the Z-valuations in terms of a Dumpster-Shafer belief structure that makes use of type-2 fuzzy sets. A simplified version of Z-valuation of decision relevant information is considered in [5]. Z-number theory was applied to a lot of problems, for example, a linear programming problem [1], the approximate reasoning problem [4], where the approximate reasoning with Z-rules was considered, etc. The paper is organized as follows. In Section II we present required preliminaries, formulate a statement of the problem and present a method used to solve it. In Section III, we cover the application of the suggested method to a real-life irrigation problem. Concluding comments are included in Section IV.

Statement of the problem

Definition. A Z-number [2,3]. A Z-number is an ordered pair of fuzzy numbers, $(\tilde{A},\tilde{B})$. $\tilde{A}$-is a fuzzy restriction on the values which a real-valued uncertain variable is allowed to take. $\tilde{B}$ is a measure of reliability of the first component.

Our problem is to find the Z value of consequence Y_i for the Z-values of the current inputs X_j given the Z-rules [4]:

Rule 1: If X_1 is $Z_{X_1,1}=(A_{X_1,1},B_{X_1,1})$ and…and X_m is $Z_{X_m,1}=(A_{X_m,1},B_{X_m,1})$

Then Y is $Z_{Y,1}=(A_{Y,1},B_{Y,1})$ …

Rule n: If X_1 is $Z_{X_1,n}=(A_{X_1,n},B_{X_1,n})$ and…and X_m is $Z_{X_m,n}=(A_{X_m,n},B_{X_m,n})$

Then Y is $Z_{Y,n}=(A_{Y,n},B_{Y,n})$

Let the Z-values of the current inputs are the following:

X_1' is $Z'_{X_1}=(A'_{X_1},B'_{X_1})$ and…and X'_m is $Z'_{X_m}=(A'_{X_m},B'_{X_m})$.

We suppose that the antecedents of the given and current inputs don't overlap. For this purpose, we use the interpolation approach for Z-rules suggested in [4]. For a new Z-valued antecedent, a corresponding Z-valued consequence should be determined as an interpolation of Z-valued consequences.

Solution of the problem

The Z-value of the current output is determined by the following equation [4]:

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$$Z'_Y = \sum_{i=1}^{n} Z_{Y,i} w_i$$

where w_i are the coefficients of linear interpolation and are determined as follows ,

$$w_i = \frac{s_i(Z'_{X_{ij}}, Z_{X_{ij}})}{\sum_{k=1}^{i} s_k(Z'_{X_{ij}}, Z_{X_{ij}})}$$

k=1,…, n are coefficients of linear interpolation, s represents a similarity between given input and current Z-valued antecedent.

Let $A_1 = \{a_{11}, a_{12}, a_{13}, a_{14}\}$ and $A_2 = \{a_{21}, a_{22}, a_{23}, a_{24}\}$ be A-subparts of Z-numbers.
The distance between two A-subparts as trapezoidal fuzzy numbers is determined as

$$d(A_1, A_2) = \left(\sum_{r=1}^{4} (|a_r - b_r|)^p \right)^{1/p}$$

Where U is a universe of discourse and $u = \max(U) - \min(U)$.
The similarity between A subpart will be as follows:

$$s(A_1, A_2) = 1 - \frac{1}{4 \times u^p} \times d(A_1, A_2)^p$$

In order to characterize the relationship between two subparts of Z numbers, we have to determine the similarity measure of probability distributions p_{ij}, using the method described in [8].
The restrictions will be as follows:

$$\sum_{j=1}^{n} p_{ij} = 1; \ \sum_{j=1}^{n} p_{ij} \mu_{A_{ij}} \to B_j$$

Where $\mu_{A_{ij}}$ be the membership function of A-subpart .
Thus, we can represent the similarity measure for probability distributions as

$$s(p_{A_1}, p_{A_2}) = 1 - \max\left(\sum_{j=1}^{n} \left| p_{A_{1j}} - p_{A_{2j}} \right| \right)$$

The general similarity measure between two A-subparts of Z-numbers can be determined as a half of a sum of A-parts similarity and a similarity between probability distributions.

$$Gs(A_1, A_2) = 0.5(s(A_1, A_2) + s(p_{A_1}, p_{A_2}))$$
$$s(Z_1, Z_2) = \omega \times s(B_1, B_2) + (1 - \omega) \times Gs(A_1, A_2)]$$

Where ω, $0 < \omega < 1$, is a weight value depending on experts` opinion.

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Application of an approach in an irrigation system

Let the input and output variables for the evaporation model be represented as Z-numbers. We will denote input variables: soil moisture as Z_{sm}, solar irradiance as Z_{si}, air temperature as Z_{at}, air humidity Z_{ah} and the output variable – pump voltage as Z_{pv}. We use this model because pump voltage impacts directly on the rate of flow of water [3]. An increase in pump voltage will decrease the rate of flow of water. We use three linguistic terms for each of the inputs: low, normal and high for soil moisture ($Z_{sm,low}$, $Z_{sm,normal}$, $Z_{sm,high}$); dim, normal and bright for solar irradiance ($Z_{si,\dim}$, $Z_{si,normal}$, $Z_{si,bright}$); cold, normal and hot for air temperature ($Z_{at,cold}$, $Z_{at,normal}$, $Z_{at,hot}$); low, normal, high for air humidity ($Z_{ah,low}$, $Z_{ah,normal}$, $Z_{ah,high}$) and five linguistic terms for output variable –pump voltage: very low ($Z_{pv,very\ low}$), low ($Z_{pv,low}$), normal ($Z_{pv,normal}$), high ($Z_{pv,high}$), very high ($Z_{pv,very\ high}$).

The parts for antecedents and consequence are the membership functions with the following parameters [7]:

1. Soil Moisture (the percentage). It ranges from 0 to 100.
Low—[0 0 35], Normal—[20 40 50 60], High—[45 100 100];
2. Solar Irradiance (watts per square meter). It ranges from 0 to 1000.
Dim—[0 0 500], Normal—[350 400 500 675], Bright—[500 1000 1000];
3. Air Temperature (degrees Celsius). It ranges from 0 to 50.
Cold—[0 0 0 22.5], Normal—[17.5 21 23 27.5], Hot—[22.5 50 50];
4. Air Humidity (the percentage). It ranges from 0 to 100.
Low—[0 0 0 50], Normal—[35 45 60 70], High—[52.5 100 100 100];
Pump Voltage (volts). It ranges from 0 to 13.
Very low—[0 0 0 3.3], Low—[2 3 4 5], Normal—[3.3 5 6 7], High—[5 7 8 10],
Very high—[7 13 13 13].

The linguistic terms for inputs and output are shown in Fig. 1 (a, b, c, d and f).

We will use the linguistic term “Usually” =(0.1, 1, 1) for all antecedents and consequence. The codebooks for reliabilities are given in Fig.2.

The total number of Z- rules is equal to the product of the number of linguistic rules for antecedents. i.e. 81. The mathematical model of this system is the following [7]:

Pump voltage is inversely proportional to the rate of flow of water and is proportional to (Solar Irradiance x Air Temperature) / (Soil Moisture x Air Humidity).

We construct our linguistic rules based on this mathematical model. For example, we can consider the following two linguistic rules:

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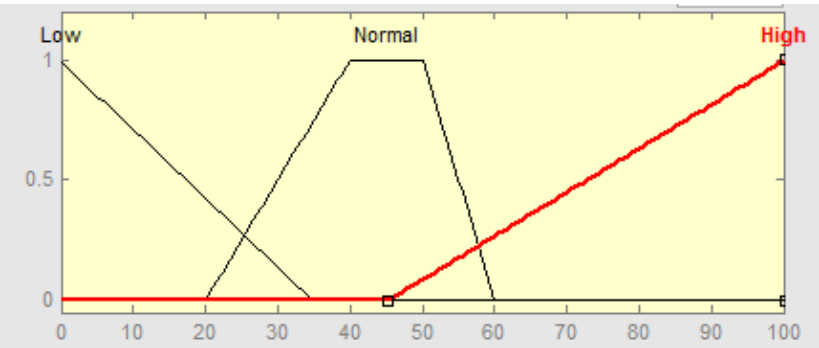

Figure 1 (a). Linguistic terms for Soil Moisture

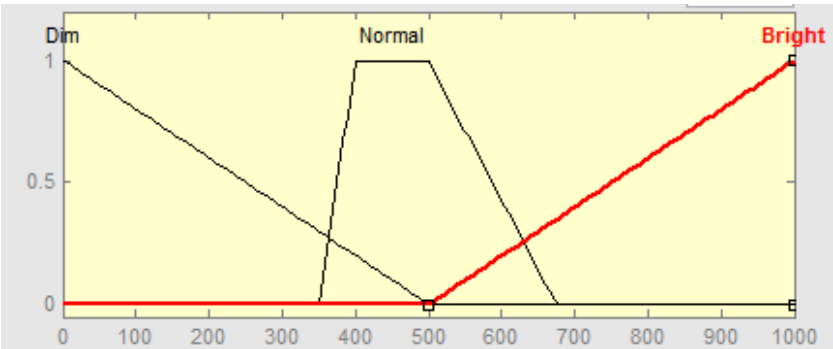

Figure 1 (b). Linguistic terms for Solar Irradiance

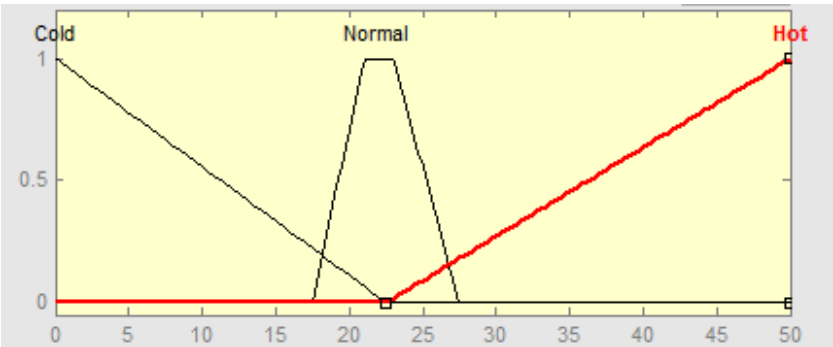

Figure 1 (c). Linguistic terms for Air Temperature

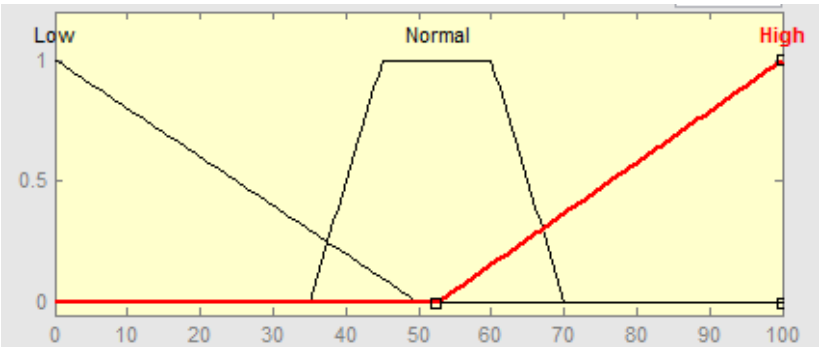

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Figure 1 (d). Linguistic terms for Air Humidity

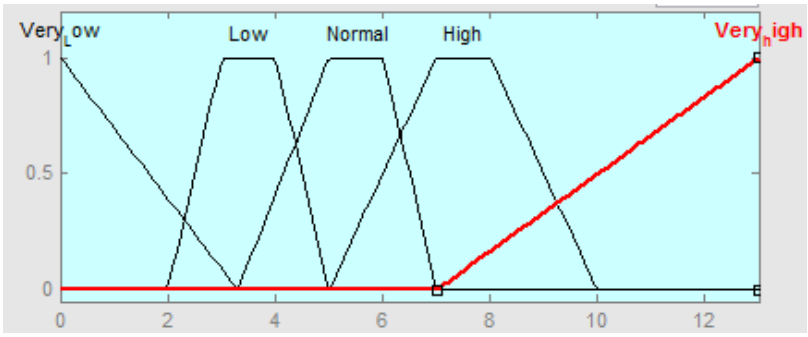

Figure 1 (f). Linguistic terms for Pump Voltage

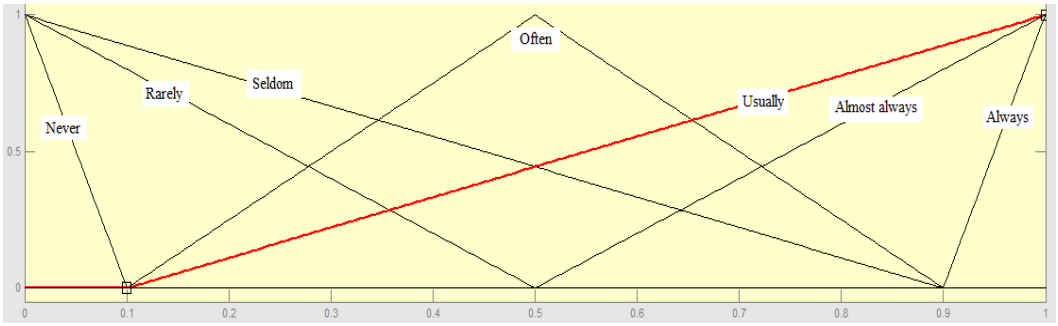

Figure 2. Linguistic terms for reliability.

Rule 1: If Solar irradiance is (Normal, Usually) and Air temperature is (Cold, Usually) and Soil Moisture is (Low, Usually) and Air humidity is (Normal, usually) Then Pump voltage is (High, Usually).

Rule 2: If Solar irradiance is (Bright, Usually) and Air temperature is (Cold, Usually) and Soil Moisture is (High, Usually) and Air humidity is (Low, usually) Then Pump voltage is (Normal, Usually).

Let the current Z-values for antecedents be the following:

$Z'_{sm} = (A'_{sm}, B'_{sm}) = ((10\ 20\ 25\ 40), (0.1\ 0.2\ 0.3)),$

$Z'_{si} = (A'_{si}, B'_{si}) = ((300\ 350\ 400\ 500), (0.1\ 0.3\ 0.5)),$

$Z'_{at} = (A'_{at}, B'_{at}) = ((15\ 20\ 25\ 35), (0.5\ 0.6\ 0.7)),$

$Z'_{ah} = (A'_{ah}, B'_{ah}) = ((40\ 50\ 60\ 70), (0.6\ 0.7\ 0.8)).$

Firstly, we determine the similarity between A- parts of given inputs and current antecedents, for example, for the first rule, assigning p=2.

$$d(A'_{sm}, A_{sm,low}) = (|0-10|^2 + |0-20|^2 + |0-25|^2 + |35-40|^2)^{1/2} = 33.91$$

$$d(A'_{si}, A_{si,normal}) = (|350-300|^2 + |400-350|^2 + |500-400|^2 + |675-500|^2)^{1/2} = 213.6$$

$$d(A'_{at}, A_{at,cold}) = (|0-15|^2 + |0-20|^2 + |0-25|^2 + |22.5-35|^2)^{1/2} = 37.5$$

$$d(A'_{ah}, A_{ah,low}) = (|0-40|^2 + |0-50|^2 + |0-60|^2 + |3.3-70|^2)^{1/2} = 95.03$$

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$u_{sm} = 40 - 0 = 40;\ u_{si} = 40 - 0 = 40;\ u_{at} = 40 - 0 = 40;\ u_{ah} = 40 - 0 = 40$

$$s(A'_{sm}, A_{sm,low}) = 1 - \frac{1}{4 \times 40^2} \times 33.91^2 = 0.82$$

$$s(A'_{si}, A_{si,normal}) = 1 - \frac{1}{4 \times 375^2} \times 213.6^2 = 0.918$$

$$s(A'_{at}, A_{at,cold}) = 1 - \frac{1}{4 \times 35^2} \times 37.5^2 = 0.713$$

$$s(A'_{ah}, A_{ah,low}) = 1 - \frac{1}{4 \times 70^2} \times 95.038^2 = 0.539$$

As the probability distributions for A-subparts are the random numbers that add up to one then we can suppose that we have the following distributions, for example for soil moisture:

$$p^1_{A_{sm,low}} = 0.16/0 + 0.19/3.5 + 0.06/7 + 0.22/10.5 + 0.04/14 +$$
$$+0.04/17.5 + 0.01/21 + 0.01/24.5 + 0.08/28 + 0.04/31.5 + 0.13/35$$

$$p^2_{A_{sm,low}} = 0.17/0 + 0.18/3.5 + 0.06/7 + 0.21/10.5 + 0.04/14 +$$
$$+0.04/17.5 + 0.01/21 + 0.01/24.5 + 0.08/28 + 0.04/31.5 + 0.12/35$$

$$p^3_{A_{sm,low}} = 0.16/0 + 0.17/3.5 + 0.05/7 + 0.20/10.5 + 0.04/14 +$$
$$+0.08/17.5 + 0.01/21 + 0.01/24.5 + 0.07/28 + 0.04/31.5 + 0.12/35$$

$$p'^1_{A_{sm}} = 0.29/10 + 0.16/13.33 + 0.05/16.66 + 0.18/19.99 + 0.04/23.32 +$$
$$+0.08/23.32 + 0.01/26.65 + 0.01/29.98 + 0.07/33.31 + 0.04/36.64 + 0.03/40$$

$$p'^1_{A_{sm}} = 0.25/10 + 0.14/13.33 + 0.11/16.66 + 0.16/19.99 + 0.03/23.32 +$$
$$+0.08/23.32 + 0.01/26.65 + 0.03/29.98 + 0.07/33.31 + 0.03/36.64 + 0.03/40$$

$$p'^1_{A_{sm}} = 0.21/10 + 0.13/13.33 + 0.07/16.66 + 0.15/19.99 + 0.03/23.32 +$$
$$+0.07/23.32 + 0.01/26.65 + 0.03/29.98 + 0.07/33.31 + 0.15/36.64 + 0.03/40$$

Using the equation of similarity for probability distributions, we determine

$$s(p'_{A_{sm}}, p_{A_{sm,low}}) = 1 - \max\left(\sum_{j=1}^{n} \left| p'_{A_{sm,j}} - p_{A_{sm,low,j}} \right|\right) = 0,72$$

For simplicity, we will take the same membership functions values for other probability distributions and consequently the value of similarity measure will be the same.

Thus, the general similarity measures will be as follows:

$Gs(A'_{sm}, A_{sm,low}) = 0,72;\ Gs(A'_{si}, A_{si,normal}) = 0,819;$

$Gs(A'_{at}, A_{at,cold}) = 0,7165;\ Gs(A'_{ah}, A_{ah,low}) = 0,6295.$

Similarity of reliability measures can be determined by the same method as for A-subparts.

Then the similarity measures for reliability parts will be as

$s(B'_{sm}, B_{sm,low}) = 0,45;\ s(B'_{si}, B_{si,normal}) = 0,62;$

$s(B'_{at}, B_{at,cold}) = 0,82;\ s(B'_{ah}, B_{ah,low}) = 0,85.$

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Let the value of weight be $\omega = 0.5$. It means that we estimate the importance of restriction and reliability subparts of Z-numbers equally.
Then the weighted value of the similarity measure will be as follows

$$s(Z'_{sm}, Z_{sm,low}) = 0.5 \times s(B'_{sm}, B_{sm,low}) + (1-0.5) \times Gs(A'_{sm}, A_{sm,low})] = 0.585$$

$$s(Z'_{si}, Z_{si,normal}) = 0.5 \times s(B'_{si}, B_{si,normal}) + (1-0.5) \times Gs(A'_{si}, A_{si,normal})] = 0.7195$$

$$s(Z'_{at}, Z_{at,cold}) = 0.5 \times s(B'_{at}, B_{at,cold}) + (1-0.5) \times Gs(A'_{at}, A_{at,cold})] = 0.768$$

$$s(Z'_{ah}, Z_{ah,low}) = 0.5 \times s(B'_{ah}, B_{ah,low}) + (1-0.5) \times Gs(A'_{ah}, A_{ah,low})] = 0.739$$

Analogously, we have calculated the similarity measures for the second rule` inputs. We choose the minimum value between the similarity measures for the first rule, and it is equal to 0.585.
Analogously, we have determined the minimum similarity measure for the second rule. And it is equal to 0.46.
According to (1) the coefficients of linear interpolation are determined as follows:

$w_1 = 0.585/(0.585+0.46) = 0.146$

$w_2 = 0.031/(0.0053+0.031) = 0.853$

The Z-values for consequences for the first and the second rules are as follows:

$$Z_{Y,1} = ((5, 7, 10) ; (0.1, 1, 1)), \quad Z_{Y,2} = ((3.3, 5, 7);(0.1, 1, 1)).$$

Using a methodology of direct calculation over Z- numbers [6] we can determine

$$Z'_Y = w_1 Z_{Y,1} + w_2 Z_{Y,2} = ((4.245, 6.113, 8.67);(0.044, 0.4634, 0.9233)).$$

Based on the distance between the determined Z-value of consequence and the given values of linguistic terms for consequences, we can determine that the current value of consequence for the case of two rules is defined as

$$Z'_Y = ((\text{Normal}); (\text{Usually})).$$

Conclusion

In this paper, we constructed the irrigation control system based on Z-information. An important qualitative attribute of information on which decisions are based is its reliability, as it allows taking into account a degree of experts' qualification. This solution provides us a better precision.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

Acknowledgment

The author would like to express gratitude to the care support workers and elderly individuals who participated in this study, sharing their invaluable insights and experiences. Their

cooperation and openness have significantly contributed to the depth and richness of the research findings.

REFERENCES

1. 1.Aliev, R.A., Alizadeh, A.V., Huseynov, O.H., Jabbarova, K.I. Z-number based Linear Programming. //Int J Intell Syst 30, pp.563-589, 2015.
2. Aliev, R. A., Alizadeh, A. V., Huseynov, O. H. The arithmetic of discrete Z-numbers.// Inf. Sci., **290**, 134–155, 2015. doi.org/10.1016/j.ins.2014.08.024
3. Aliev, R. A., Huseynov, O. H., Zeinalova L. M. The arithmetic of continuous Z-numbers.// Inf. Sci., 373, 441–460, 2016. doi.org/10.1016/j.ins.2016.08.078
4. Aliev R.A., Pedrycz W., Huseynov O.H., Eyupoglu S.Z. Approximate reasoning on a basis of z-number-valued if-then rules.// IEEE Transactions on Fuzzy Systems, 25 (6), pp. 1589–1600, 2017
5. Kang B., Daijun Wei, Ya Li, Yong Deng. "A method of converting Z-number to classical fuzzy number,"// Journal of Information & Computational Science, 9(3): 703-709, 2012.
6. Khatri, V. Application of Fuzzy logic in water irrigation system.// Int. Res. J. Eng. Technol., 2018, 5, 3372.
7. Singh, Arunesh Kumar, Tariq, Tabish, oth. Intelligent Control of Irrigation Systems Using Fuzzy Logic Controller.// Energies (19961073), Vol. 15 Issue 19, 19 p., October 2022
8. Souvik Das, Ashish Garg, Sankar K. Pal, Jhareswar Maiti . A Weighted Similarity Measure Between Z -Numbers and Bow-Tie Quantification.//IEEE Transactions on Fuzzy Systems , pp(99):1-1, July 2019
9. Touati, F., Al-Hitmi, M., Benhmed, K. and Tabish, R. A fuzzy logic based irrigation system enhanced with wireless data logging applied to the state of Qatar. /Computers and electronics in agriculture 98, pp. 233-241, 2013.
10. Yager R. R. "On Z-valuations using Zadeh`s Z-numbers,"//International Journal of Intelligent Systems, 27: 259-278, 2012.

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PLANNING MOBILE ROBOT BEHAVIOR IN AN UNCERTAIN MULTI-AGENT ENVIRONMENT

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ABSTRACT

The paper proposes an approach for safe navigation when changing lanes in a road scenario. The aim of this approach is to create the baseline value of the decision making module for the lane changing task with multiple agents to avoid collisions. The paper describes three models of the project. Model-1 is a working method for implementing modeling. Model-2 is a way to build a decision-making module using safe zones. Model-3 is the proposed way to build a decision-making module using value functions.
The paper presents a multi-agent approach to adjust traffic lights depending on traffic situations to reduce average delay time. The traffic lights of each intersection are controlled by a mobile agent. This approach creates a classical non-stationary environment, as each agent's decision affects neighboring agents. Therefore, each agent must not only learn from past experience, but also take into account the decisions of its neighbors to rule out dynamic changes in the traffic network. Fuzzy Q-learning and game theory are used to develop new policies based on previous experiences and decisions of neighboring agents. The results obtained from the simulation show the advantage of the proposed method over fixed time management, fuzzy Q-learning and fuzzy Q-learning methods.
Keywords: intelligent agent, behavior planning, goal planning, action planning, agent simulation, simulation simulation, neural network, fuzzy Q learning

Introduction

Planning safe navigation for mobile vehicles depends on many factors. From this point of view, the topic of navigation planning can be classified into action planning, goal planning, behavior planning. Motion planning establishes the movement path of any vehicle, taking into account its dynamic parameters. The goal is to optimize the path to reach different control points taking into account the planning time, distance or the various maneuvers required. Behavior planning allows tactical management decisions to be made regarding the maintenance of distance, lane change and interaction with neighboring vehicles [1].
The aim of the work is to build a decision-making module based on value functions [2, 3]. The paper looks at planning the behavior of a multi-agent mobile vehicle under uncertainty conditions.
Agent modeling is a relatively new method. Initially it was mostly the subject of theoretical considerations in academic circles, but since the 2000s researchers have started to use it in practice [4].
The task of simulation modeling in the agent approach is to describe the characteristics of the state of agents and the environment, to study the behavior of agents in various interaction situations and changing states of the environment. It is known that the simulation modeling

method is widely used to investigate complex dynamic systems. Research shows that this method is used when it is difficult to formulate a solved problem, when it is not possible to study the system, object, processes studied by analytical and numerical methods in sufficient detail. From this point of view, it becomes important to use new methods that make it possible to solve the problems of management of complex objects. One such method is the method of agent modeling. The essence of agent simulation is that the local behavior of agents operating according to their own rules shapes the overall behavior of the system as a whole (bottom-up design concept).
Existing agent architectures can be classified as follows:

1. Agent architectures based on the principles and methods of an intelligent system (IP) (advisor agent architectures).
2. Reactive architectures based on behavior and response to external environment events (reactive agent architectures).
3. Layered architectures based on behavior and methods IS (Hybrid Agent Architecture)

The organization of agent architecture based on the principles of artificial intelligence has advantages in terms of the availability of methods and tools of symbolic representation of knowledge developed within the framework of artificial intelligence, but at the same time, the creation of an accurate and complete model of the environment poses serious difficulties in representing the processes and mechanisms of justification. These types of architectures include
- Production system-based architecture
- Classification-based architecture
- Architecture with a hierarchical knowledge base etc.

The main advantage of the architectural agents listed above is the presence of a developed mental subsystem that forms the intellectual component of the agent.
Agent-centered modeling (AVM) is a modeling technique used to study and predict the formation of complex group behavior patterns by modeling the activity and interaction of many autonomous agents in specific scenarios [5-7].
Agent-oriented simulations are widely used in academia such as game theory, complex problem-solving, and information processing systems. Traditional motion planning and control methods such as PID regulation, linear feedback, or predictive modeling are designed to predict the future motion trajectories of other participants to avoid collisions, but real-world motion scenarios assume complex interactions between different participants (schwarting, Planning and Decision-Autonomous Vehicles, MIT, 2018). To solve this problem, they resort to action planning taking into account new trends - learning-based approaches and behaviors.
Agent-oriented modeling is a powerful method for modeling dynamic complex systems and observing their emergent behavior. Using this method, it is possible to model the movement scenarios of airplanes on the runway and the movements of robots in a manufacturing plant. Agent models are known to extend the application possibilities of simulation modeling to solve a number of problems that cannot be solved by system dynamics or event-driven modeling methods.
This approach differs from the traditional "top-down" approach to designing a simulation model, in which the behavior of system elements is determined by global laws. The behavior of the agent is determined by a set of rules. As a result of modeling, the final results of the activity of the entire socio-economic system can be predicted. This can be called a "bottom-up" approach: based on the behavior of individual elements of the system (individual agents) it is possible to infer the functioning of the whole.

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From a practical point of view, agent modeling is a method that investigates the behavior of the modeled agents and how it affects the behavior of the whole system.
The reason for the high interest in this model is the wide range of possibilities and agility of the models.
In the context of agent technologies, a systematic analysis and a methodological concept of the management of weakly formalized multicomponent systems is prepared.

Statement of problem

System modeling. Suppose it is necessary to plan the collision-free movement of given moving objects (n-objects). The structure of the management system is given in figure 1. Multi-agent systems use agent-cars and agent-regulators that interact with each other to minimize the stopping time of cars at intersections.

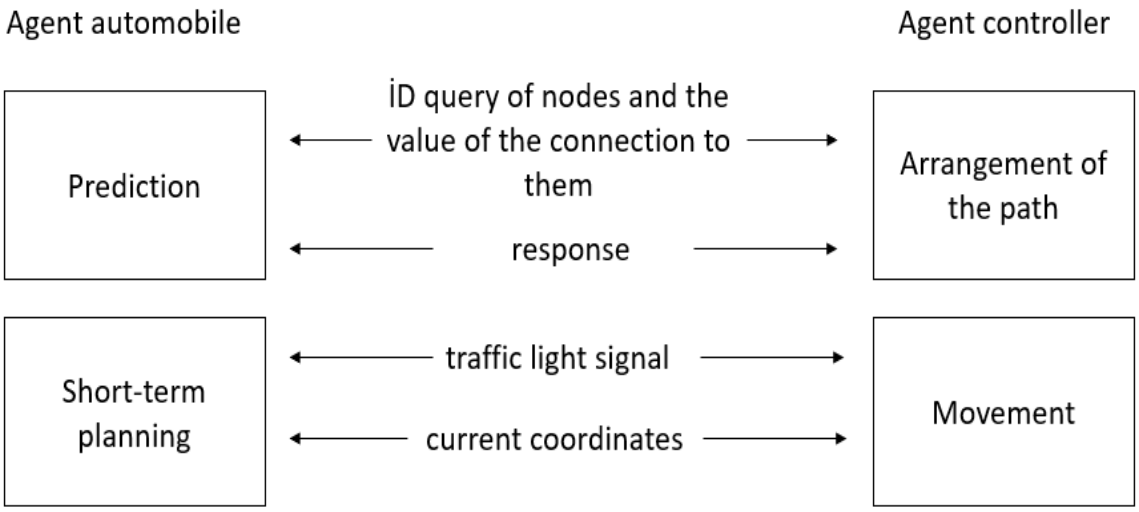

Figure 1. Agent-car and agents-regulator interactions in multiagent systems

When cars start moving, each automobile agent calculates the optimal path obtained from the regulator in the exchange of information about the projected road situation. Regulatory agents provide this information on the basis of the results of their own forecasting system, which collects and analyzes the information coming to it during the agent's working time. The vehicle agent sends information to the regulatory agent about its position in the driving process, at which point it sends it to the intersection. Based on the overall assessment of the speed and position of all machines approaching it, the regulator decides to change the signal of the traffic light. In addition, regulators can exchange messages with neighbors to work together and create the optimal automotive flow.
In order to perform the task of planning vehicle behavior in an uncertain, multi-agent environment, a road model with intersections with a fuzzy controller is built in MATLAB package. A complete road map consists of several intersections [12, 13]. The full route of the vehicle consists of a set of roads/intersections on which it moves. Photo 2 shows the intersection of two roads. Four cars arrive at the intersection. During T, vehicles a (car 1 - blue), b (car 2 - green), c (car 3 - purple), d (car 4 - yellow) aim to cross the intersection in a straight line.

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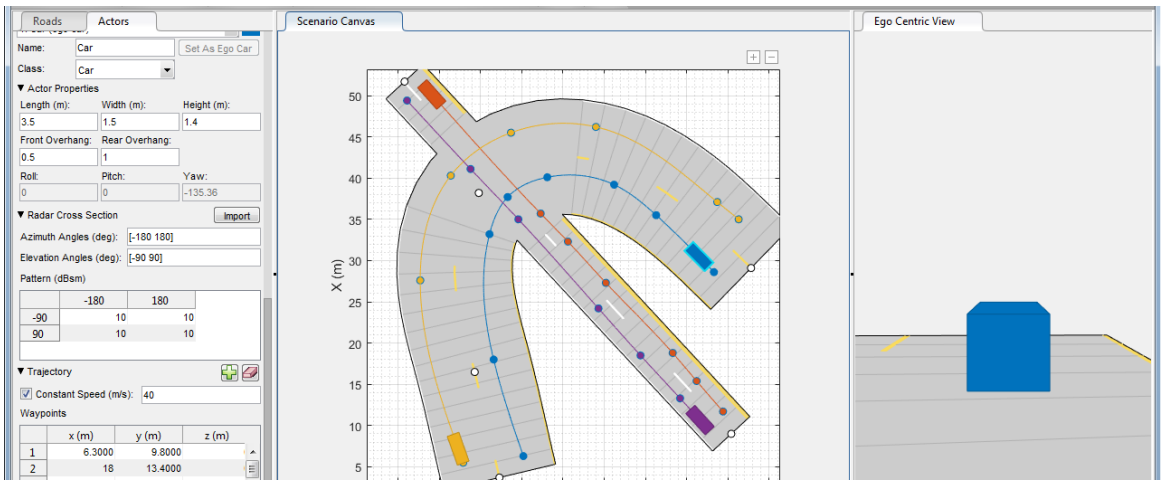
Figure 2. Initial situation. Showing the intersection of two roads.



As you can see from the figure, the movement in each of the possible directions is organized in a separate lane. This circuit was chosen because the inputs vary.

The parameters, i.e. the number of cars approaching the intersection for each lane, can change the configuration: by setting the number of cars to zero, a certain lane can be excluded from the model. This creates a cross-sectional pattern of arbitrary configuration. In the model created, in order to simplify the calculations, the traffic is chosen in such a way that the number of cars waiting to move in each lane increases with a certain probability at each specified time interval. At the same time, for each interval of the signal, the number of cars waiting at the stop line in the respective lane decreases. Let's look at Figure 3.

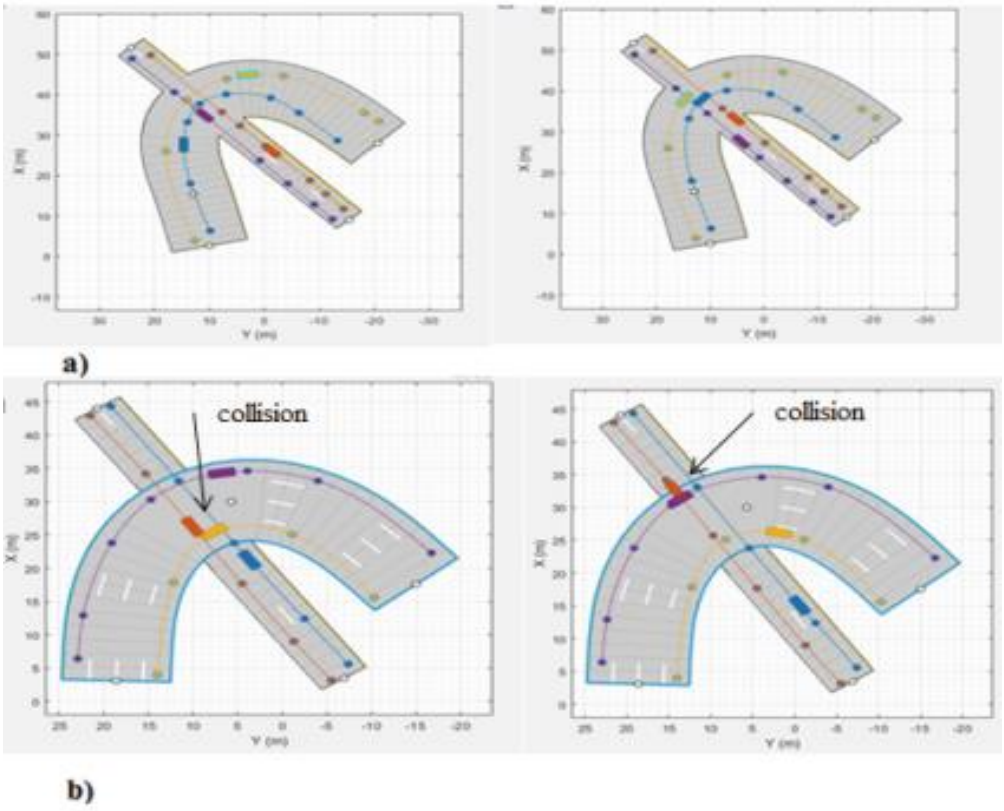


Figure 3. Vehicle traffic at the intersection. a) Normal movement of cars at an intersection. b) a collision event.

Cars approaching from below and from the right (Figure 2).3 (a)) move up, left and right respectively. In this case, the exit procedure is strictly determined - only the purple car on the left does not intervene, so the intersection passes first. The orange car does not move because the green car intervenes on the right. The yellow car cannot turn left and get ahead of the purple car moving from the opposite side. The blue car is likewise waiting for the interference on the right to disappear.

Conclusıon

This paper addresses the reactive control of an autonomous mobile robot that needs to safely navigate in a crowded and unknown environment to reach the desired goal. A successful way to structure the navigation task to solve the problem is to use behavioral approaches to navigation. In this study, questions related to the design of individual behavior will be solved using a fuzzy logic approach. Simulation results show that the fuzzy controller can effectively control every movement of the robot from its current position to its final movement.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

Acknowledgment
The author would like to express gratitude to the care support workers and elderly individuals who participated in this study, sharing their invaluable insights and experiences. Their cooperation and openness have significantly contributed to the depth and richness of the research findings.

REFERENCES

1. Aliev, R.A., Fazlollahi, B., Aliev, R.R. Soft Computing and its Applications in Business and Economics. //Springer, Heidelberg, 2004. https://doi.org/10.1007/978-3-540-44429-9
2. Naranjo, J.E., González, C., García, R., de Pedro, T. Lane-change fuzzy control in autonomous vehicles for the overtaking maneuver. //IEEE Trans. Intell. Transp. Syst. 9,438–450, 2008.
3. Bentalba, S., El Hajjaji A., Rachid A. Fuzzy parking and point stabilization: application car dynamics model./ In: 5th IEEE Mediterranean Conference on Control and Systems, 1997
4. Frese, C.; Beyerer, J.: A comparison of motion planning algorithms for cooperative collision avoidance of multiple cognitive automobiles./ In: Proceedings of the 2011 IEEE Intelligent Vehicles Symposium, Baden-Baden, Germany, pp. 1156–1162, 2011
5. Wei, J., Snider, J.M., Kim, J., Dolan, J.M., Rajkumar, R., Litkouhi, B.: Towards a viable autonomous driving research platform./ In: IEEE Intelligent Vehicles Symposium (IV), pp. 763–770, 2013
6. Kuwata, Y., Karaman, S., Teo, J., Frazzoli, E., How, J.P., Fiore, G. Real-time motion planning with applications to autonomous urban driving. //IEEE Trans. Control Syst. Technol. 17, 1105– 1118, 2009
7. Sultanova Axira Baxman . Fuzzy Logic-Based Planning of the Behavior of Autonomous Vehicles . March 2023 DOI: 10.1007/978-3-031-25252-5_75. / In book: 15th International Conference on Applications of Fuzzy Systems, Soft Computing and Artificial Intelligence Tools – ICAFS-2022
8. Aliev R.A., Aliev R.R, Soft Computing and its Application, World Scientific.- New Jersey, London, Singapure, Hong Kong, 2001, pp.465

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PRELIMINARY RESULTS OF THE TECHNOLOGY OF OBTAINING ORGANIC FERTILIZERS BASED ON SOLID WASTE AND NATURAL RESOURCES

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ABSTRACT

The article is devoted to the obtaining of organic-mineral fertilizers based on solid household waste. During the obtaining process of fertilizers, solid domestic waste, which is generated in large quantities in our republic, and minerals with large reserves containing 40–60% gypsum were used as raw materials. During the experiment, the ratio of solid household waste to drywall was taken as 95:5 and 90:10. In the article, the chemical analysis data of both raw materials used during the purchase of fertilizer are given, and the obtained results are explained in detail. During the experiment, the temperature of the process was 50°C and the speed of mixing was 120 revolutions per minute. Under these conditions, the amount of decomposition of the mixture of solid household waste with drywall depends on time and the transition of the main components to the solution within 5–50 minutes. In the variant with a ratio of solid household waste to drywall of 95:5, the degree of decomposition of the mixture is 83%, the amount of nutrients passing into the solution is P_2O_5–70%, total N was -77%, and organic compounds were -70%. In another option, that is, when the ratio of solid household waste to drywall is 90:10, the above-mentioned temperature of the mixture and the degree of decomposition over time are 65%, the amount of nutrients passing into the solution is P_2O_5 (65%), K_2O (70%), total N (75%), and the amount of organic compounds is 80%. In both options, increasing the duration of the process by an additional 25 minutes did not significantly affect the degree of decomposition or the amount of nutrients transferred to the solution.
During the technological process, the residue with a solid organic content formed in the form of waste is used for salinized soils. A trial to study the effect of improvement was carried out, and it was determined that the degree of salinization of soils can be reduced from 2.094% to 0.386% during washing with the application of a meliorate, and salinity can be completely eliminated.
Keywords: Solid household waste, mineral fertilizer, late, salinization, morphological composition, washing, density, granulometric composition, ameliorant.

Introduction

High-speed development of the country's industry, establishment of new industries, agricultural processing enterprises, exploitation of natural mineral deposits and their enrichment processes have led to an increase in the amount of waste generated in the country. According to its origin, waste generated in the country can be divided into three groups:

1. Waste of industrial enterprises;

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2. Waste obtained in the process of processing and enrichment of natural resources;
3. Waste in the form of cuttings from oil and wastewater treatment [1, 2].

Currently, a very important and necessary work is being carried out in the country to save raw materials, rational use of natural resources and protect the environment in the field of waste disposal, their reuse, as well as the use of low-waste or non-waste technologies. In the field of waste management, advanced methods are used, and extensive research is being carried out in this direction. The construction of new residential areas, the development of suburban areas has led to a sharp increase in the amount of household waste [10, 11]. Due to the fact that the main part of its contents are organic matter and water, solid household waste (SHW) begins to rot in a very short time and creates favorable conditions for the growth of insects and microorganisms that cause many diseases. If this type of waste is not disposed of quickly, it can seriously damage the health of people living in the area and cause an ecological imbalance in the environment. At the same time, it should not be forgotten that solid household waste is an inexhaustible source of raw materials and energy that intensifies various technological processes and plays an important role in the modernization of technologies. The dry part of this waste is used as fuel, and some of it is used as additional raw material in various industries [3].

Statement of the problem

It is the development of chemical ameliorants and the development of washing technologies with their use on the basis of solid household waste, which increases the efficiency of washing of soils with heavy granulometric composition, exposed to various degrees of salinization and salinization, reduces the washing time and rate. These substances are prepared based on domestic and industrial waste in order to increase their economic efficiency without reducing their ameliorative effect.

As a result of many years of research (since the beginning of the last century) to improve soil fertility, it was determined that elimination of salinity, ecological restoration of saline soils is impossible without the intervention of chemical elements, i.e. in the absorbing complex of such soils, sodium ions must be replaced by calcium ions, which can be done in two ways:

- Adding calcium-containing substances to the soil [6, 7];
- This is the decomposition of calcium carbonate in the soil and its transformation into calcium salts, readily soluble in water [12-14].

Azerbaijan State Oil and Industry University is conducting research to solve this problem. The employees of the department have developed a technology for the preparation of many ameliorants and applied them in production. One of these ameliorants is an organic-mineral complex ameliorative substance produced on the basis of solid domestic waste and drywall.

Materials used and research methodology. It was determined that, on average, 0.41-0.48 tons of household waste is generated per person per year. One of the main indicators of the SHW is its physical properties, which also depend on the morphological and fractional composition of waste, moisture. The morphological composition varies in different proportions according to the seasons. Thus, there is an increase in the composition of wastes, especially fruit and vegetable residues, and a decrease in the percentage of metal and glass products, due to the low use of canned products in spring and summer [4].

Table 1. About SHW statistics formed per capita per day in Azerbaijan.

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Years	1990	1995	2000	2005	2010	2014	2017
SHW statistics formed per day, with gram	105-120	125-130	150-170	180-200	300-350	410-470	420-480

The main indicators of the chemical properties of the SHW are the content of organic matter, minerals and hydrocarbons, its richness in nutrients (N, P, K) and organic matter makes it a valuable raw material for the preparation of organic and mineral ameliorative substances necessary for the normal development of plants.

Table 2. Chemical composition of solid household waste, with %.

Cities	Organic ompounds	NO_2	P_2O_5	K_2O	H_2O	pH
Ganja	40,0-52,0	1,3-1,36	0,77-0,87	0,5-0,9	35,0-40,0	6,1-7,9
Sumgayıt	39,0-50,0	1,2-1,45	0,65-0,75	0,4-0,6	30,0-35,0	6,3-7,7

Drywall is one of the largest natural resources in the country, widely used in agriculture [5]. The amount of gypsum in the composition ranges from 40-60%. The rest is mainly calcium carbonate.

Table 3. The chemical composition of the drywall, with %.

SiO2	Al2O3	Fe2O3	CaO	MgO	N2O	Na2O	P2O5	SO3	H2O
15,7-21,4	3,1-1,9	2,15-3,05	26,9-23,8	1,17-1,08	0,89-0,45	0,60-0,40	11,35	35,70-29,25	0,38-1,03
19,5-17,5	4,95-4,5	0,55-2,30	22,88-25,78	0,25-2,10	–	1,26-2,09	–	38,23-34,27	1,50-0,65

As a result of the analysis, it was found that the density of its framework is 1.3-1.4 g / cm3, the density of the solid phase is 2.0-2.4 g / cm3, and the porosity is 42-45%. In strength, it resembles loose rocks. Maximum moisture capacity 37-40%, capillary moisture capacity 32.5-34.6%, dehydration -5.5-5.6 mm / sec, irrigation 1.0 cm / min. Its water absorption capacity is quite high - 14.0 mm / sec.

Solid household waste, cleaned of all impurities and added with a delay, is fed into a 500 ml reactor containing a 25% sulfuric acid solution, and the mixer is started. During the process, the temperature in the reactor is kept at 500°C and the mixer speed is kept at 120 rpm. During the experiment, SHW is mixed with drywall in two ratios - 95: 5 and 90:10, i.e. the amount of SHW is 95 and 90 parts by weight, and the amount of drywall is 5 and 10 parts by weight.

Solid household waste, cleaned of all impurities and added with a delay, is fed into a 500 ml reactor containing a 25% sulfuric acid solution, and the mixer is started. During the process, the temperature in the reactor is kept at 500°C and the mixer speed is kept at 120 rpm. During the experiment, BT is mixed with gypsum in two ratios - 95: 5 and 90:10, i.e. the amount of UN is 95 and 90 parts by weight, and the amount of gypsum is 5 and 10 parts by weight.

The amount of the mixture is adjusted so that the ratio of liquid to solid in the reactor. The process takes 75 minutes. Every 5 minutes, a sample is taken from the reactor and analyzed to determine

the degree of SHW decomposition and dissolution of the main components. At the end of the technological process, the solid part is separated from the liquid part by filtration.

All chemical analyses performed during the investigation were performed according to standards. Determination of the amount of total nitrogen in fertilizer (GOST 26715-85); determination of the amount of ammonia nitrogen (GOST 20851.1–75); determination of the amount of absorbable P_2O_5 (GOST 20851.2–75); determination of the amount of potassium in a flame photometer (FP 6431, Flame Photometer) (GOST 12533–76); weight method of moisture content designation (GOST 26713–85); determination of the amount of organic substances (GOST 27980 Determination of the amount of nitrate form of nitrogen that can be assimilated in the soil (GOST 27894.4); determination of the amount of ammonia nitrogen (GOST 27894.3); determination of absorbable P_2O_5 (GOST 54650-2011); flame photometer (FP 6431, Flame Photometer) (GOST 26726-85); determination of the amount of humus (GOST 26213-84).

The study of the effect of the obtained meliorate on soil salinization is carried out in experimental conditions according to the following methodology: the agricultural tests of the meliorates were carried out in laboratory conditions in special containers with a height of 30 cm, a diameter of 5 cm, and a mesh bottom. Air-dried, pre-salting, and desalting graded soil samples are crushed and sieved. The soil sample determined by the investigation is mixed with a chemical meliorant, poured into special containers, and lightly beaten until the density of the soil is 1.4 g/cm^3. A calculated amount of washing water is supplied to the soil from the top of the containers. After the washing rate of 5,000 m^3/ha, the filtration rate is measured, and samples of the filtered water are taken for chemical analysis. 3–4 days after the full washing rate is given, the soil is emptied from the washed containers, dried for 5–10 days, depending on the weather, and prepared for the chemical analysis [8, 9, 15-17].

Solution of the problem

The purpose of the experimental experiment is to study the genetics of a mixture of SHW with drywall under the influence of an acid solution, the decomposition of the main components over time, and the transition of nutrients into solution in 5–75 minutes. The results of the study are presented in table 4. As can be seen from the data in the table, the rate of decomposition of SHW in 5–50 minutes is 83% of the rate of decomposition of the mixture in a ratio of 95: 5, the amount of nutrients in the P2O5 solution is 70%; K2O -70%; Ntotal-77% and organic compounds -70%. Alternatively, i.e. the ratio of the mixture in the ratio 90:10 during the specified period is -65%, and the amount of nutrients in the P2O5 solution is -65%; K2O was -70%, total -75% and organic compounds -80%. In both cases, an additional increase in the duration of the process by 25 minutes did not have a significant effect on the rate of decomposition or the transfer of nutrients into the solution (table 4).

As a result of our first research, it was found that, the filtered liquid-organic mineral complex, rich in nitrogen, phosphorus, potassium and organic compounds, can be widely used in agriculture as a liquid fertilizer. The solid part, consisting of organic compounds and gypsum, is completely suitable for use as an ameliorative agent in the ameliorative of saline soils. At the same time, it is possible to increase or decrease the amount of gypsum in the ameliorant by changing the ratio of SHW to drywall.

The ameliorative effect of the obtained ameliorant on saline soils was studied in comparison with other ameliorants. The experimental experience was carried out at a leaching rate of 1500 m3/ ha, which gives 10 tons of ameliorant per hectare. During the experiment, a soil sample with a heavy

particle size distribution (92% of physical clay), a high carbonate content (21.41%), and a weak gypsum (0.227%) with an initial salinity of 2.31% was used. The experiment was carried out 5 times in special containers:

Table 4. Decomposition of drywall mixture with solid household waste over time and the transition of the main components to the solution, with % (process temperature 50^0C, Movement speed of the mixer 120 cycle/ minute).

The main components of the mixture	Time, minute														
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
95:5															
P2O5	8,0/7,3	19/16	22/19	28/23	37/34	43/36	50/40	63/51	77/64	83/70	84/71	85/74	84/76	84/76	84/77
K2O	7,0/5,0	16/14	18/16	23/19	35/30	40/36	49/40	60/53	70/64	80/70	83/74	83/77	83/76	83/76	83/76
Ntotal	8,5/7,3	17/15	19/16	19/16	37/35	44/39	50/44	61/56	71/64	82/77	84/79	85/80	85/81	85/82	85/82
Organic compounds	9/7	18/17	19/16	19/16	36/30	41/33	48/40	59/50	69/61	81/70	85/77	85/78	85/80	85/80	85/82
90:10															
P2O5	10/8,0	19/17	23/20	28/24	37/35	44/37	49/35	50/41	64/52	77/65	84/72	84/70	85/72	85/75	85/75
K2O	9,0/8,0	16/15	19/16	24/19	36/32	42/37	50/40	61/54	72/68	80/70	84/76	85/76	85/76	85/76	85/76
Ntotal	7,0/6,0	17/16	19/16	25/22	38/36	44/40	52/44	62/56	71/69	82/77	85/80	85/82	85/82	85/82	85/82
Organic compounds	9,0/8,0	18/17	19/16	32/24	37/32	48/40	60/50	70/80	82/80	85/80	85/80	85/82	85/80	85/80	85/82

An air-dried soil sample is crushed and passed through a 1 mm sieve. The required amount of calculated soil (with a density of 1.4 g / cm3) is weighed, pre-mixed with an ameliorant, poured into special containers (h = 35 cm; d = 5 cm) and washed. During the washing period, the water level is always maintained at a height of 5 cm above the soil layer. After every 5000 m3/ha washing norm, the filtration rate and the amount of filtered water are measured to determine the mineral content.

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Table 5. Changes in soil salinity after washing with various chemical ameliorants, with %.

Options	HCO3	Cl	SO4	Ca	Mg	Na	Total of salts	Dry residue
Before the experiment	0,022 0,36	0,022 0,36	0,022 0,36	0,022 0,36	0,0220, 36	0,022 0,36	2,31	2,32
Washing with water (controlled)	0,024 0,39	0,024 0,39	0,024 0,39	0,024 0,39	0,024 0,39	0,024 0,39	1,18	1,21
Washing by giving drywall	0,024 0,39	0,024 0,39	0,024 0,39	0,024 0,39	0,024 0,39	0,024 0,39	0,73	0,74
Washing with prepared ameliorant	0,024 0,39	0,032 0,90	0,021 6,70	0,042 2,10	0,020 1,70	0,096 4,19	0,54	0,55

Analyzing the results of the experiment, it was found that the initial salinity as a result of flushing decreased to 1.18% on dry matter in the case of washing with water. At the same time, the content of the chlorine ion decreased to 0.106%, and the sulfate ion to 0.676% of the washed components. The weakest washed salt was Na2SO4. So, as a result of washing in this variant, the amount of Na2SO4 salt decreased by 0.046% to 0.770%, and NaCl decreased by 0.961% to 0.174%.
When the results obtained with leaching with chemical improvers were compared with conventional water leaching, it was determined that the soil salinity decreased to 0.73% in the late leaching, however, in this case, 75.79 % of the total residual salts were harmful salts (NaCl - 0.078%; Na2SO4 - 0.361; MgSO4 - 0.112%).

Table 6. The hypothetical composition of residual salts after washing with the use of various chemical ameliorants, with %.

Options	$Ca(HCO_3)_2$	$CaSO_4$	$MgSO_4$	Na_2SO_4	NaCl	Total of salts	Including	
							Harmful salts	Amount in % of the total
Before the expriement	0,029	0,184	0,143	0,816	1,135	2,307	2,094	90,76
Washing with water (controlled)	0,032	0,071	0,132	0,770	0,174	1,179	1,076	91,26
Washing by giving drywall	0,032	0,144	0,112	0,361	0,078	0,727	0,551	75,79
Washing with prepared ameliorant	0,032	0,116	0,102	0,234	0,050	0,535	0,386	72,73

Using a recently purchased ameliorant, soil salinity was reduced to 0.54% as a result of leaching in the leach option. Compared with the late leaching option, the amount of Na2SO4 from harmful salts in the soil decreased by 0.127%, the amount of MgSO4 decreased by -0.010%, and the amount of NaCl decreased by 0.028–0.234%; 0,102% respectively(table 6).
Re-chemical analysis of the absorbed bases after washing showed that the influence of ameliorants on soil salinity is different. Although there was a slight decrease in salinity in the

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water wash option, these values were significantly higher in the case of chemical ameliorants. The resulting organo-mineral complex was used to reduce the amount of absorbed sodium in the soil-absorption complex from 14.2% to 3.5% when washing saline soils by introducing an ameliorant, as a result of which a complete elimination of salinity was achieved. As a result of the research, a technology was developed for obtaining an organo-mineral complex liquid fertilizer and ameliorative substance containing organo-mineral raw materials, and a technological scheme was developed (Figure 1).

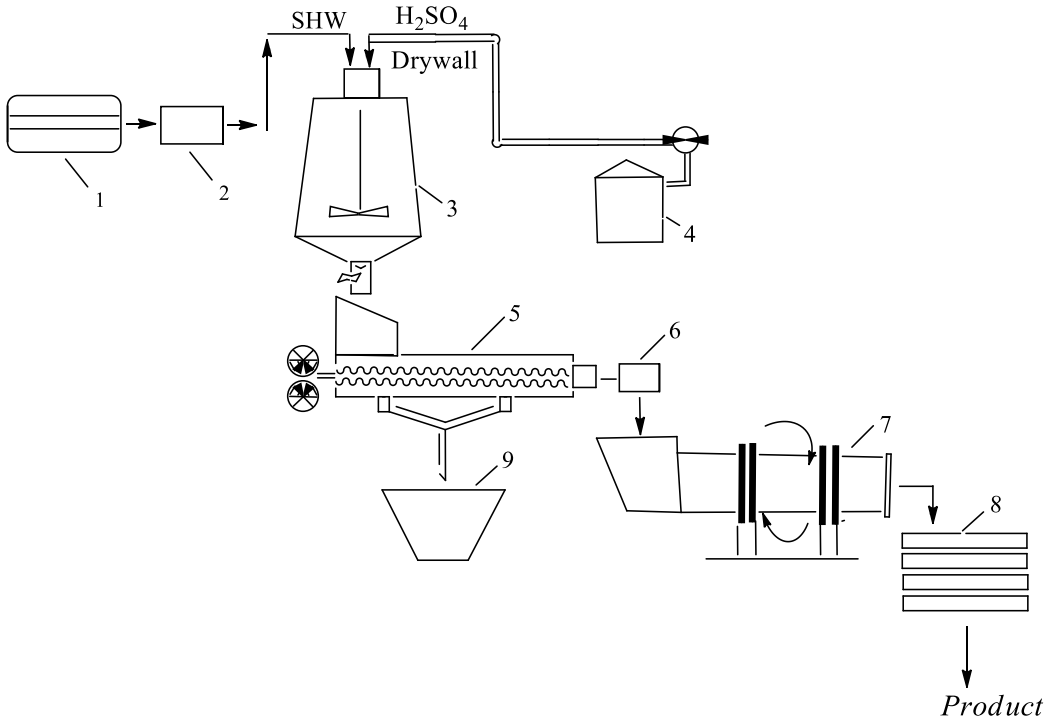

Figure 1. Technological scheme for obtaining liquid organo-mineral fertilizers and organo-mineral ameliorants from SHW with the drywall additive.
1. Sorting section; 2. Chopper; 3. Reactor; 4. Sulfuric acid tank; 5. Screw vise;
6. Neutralizing; 7. Dryer drum; 8. Sieves 9. Organo-mineral fertilizer in liquid form

Explanation of the scheme. The pre-sorted (1) and crushed (2) SHW and also the gec (5) are fed to the reactor (3) with a pre-poured 25% sulfuric acid solution. SHW and drywall are preliminarily fed into the reactor (3), where 25% sulfuric acid solution is poured. The mixer starts up. After the mixture is mixed in the required amount, the resulting wash enters the screw (5), where the solid part is separated from the liquid part. The solid part passes through the neutralizer (6) and is fed to the dryer (7). The meliorant coming out of the dryer is passed through sieves (8) and sent to packaging. The liquid part (9) is packaged for use as an organic mineral complex liquid fertilizer.

Conclusion

Organic-mineral complex ameliorative substance and organic-mineral liquid fertilizer obtained from SHW with the drywall additive are irreplaceable substances for ecological restoration of

saline-saline soils and increase of their fertility, increasing the productivity of agricultural crops. Since they are produced on a waste basis, their application to production is quite economical.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

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REFERENCES

1. Oliveira, L.S.; Oliveira, D.S.; Bezerra, B.S.; Pereira, B.S.; Battistelle, R.A.G. Environmental analysis of organic waste treatment focusing on composting scenarios. J. Clean. Prod. 2017, 155, 229–237.
2. Muhammad Kh.I. / Composing of Municipal Solid Waste and Its Use as Fertilizer. 2018. p 35-55. DOI: 10.5772/intechopen.81729
3. Muscolo, A.; Papalia, T.; Settineri, G.; Mallamaci, C.; Jeske-Kaczanowska, A. Are raw materials or composting conditions and time that most influence the maturity and/or quality of composts? Comparison of obtained composts on soil properties. J. Clean. Prod. 2018, 195, 93–101.
4. Ibrahimov S.K. - Increasing the fertility of brakish and saline soils is a guarantee of food security. New infrastructure of the agricultural sector in Azerbaijan: agro-parks, the need for their creation and their role in innovative development. Materials of the republican scientific and practical conference. Ganja, (06-07 May 2015).
5. Amelioration of heavy clayey saline soils in the Shurabad massive of the Caspian plain by the "Gypsum" method. Ecology and water management. Scientific and Technical and Production Journal. January 2009.
6. Shirinov I.N., Iskandarov M.Y. - Advanced technology of leaching during preliminary chemicalization of soils saline with neutral salts, using chemicals. Azerbaijan Agrarian Scientific-Theoretical Journal. No. 6-7.2007.
7. Teymurov K.G., Eminov S.A., Shirinov I.N., Ibrahimov S.K.- The effect of chemicalization on the composition of microaggregates in highly saline soils. Data sheet "On agriculture" No. -76. AzETETMİ. Baku 1987.
8. Arinushkina E.V. / Guide to chemical analysis of soils. Moscow. Ed. MSU. 1970. 487 c. https://7universum.com/ru/tech/archive/item/11752
9. Vea E.B., Romeo D., Thomsen M. //Biowaste Valorisation in a Future Circular Bioeconomy. 25th CIRP Conference on Life Cycle Engineering, , CIRP LCE 2018; Technical University of Denmark Copenhagen; Denmark; Vol. 69, P. 591-596.

10. Soltani A., Hewage K., Reza B., Sadiq R. // Multiple stakeholders in multi-criteria decision-making in the context of Municipal Solid Waste Management: A review. Waste Management, Volume 35, 2015, pp. 318-328. https://doi.org/10.1016/j.wasman.2014.09.010
11. Soobhany, N. Insight into the recovery of nutrients from organic solid waste through biochemical conversion processes for fertilizer production: A review. J. Clean. Prod. 2019, 241, 118413
12. Sindhu R.,Gnansounou, E., Rebello, S., Binod, P., itc. //Conversion of food and kitchen waste to value-added products, Journal of Environmental Management, 2019, Vol. 241, P. 619-630
13. Sayara, T.; Basheer-Salimia, R.; Hawamde, F.; Sánchez, A. Recycling of Organic Wastes through Composting: Process Performance and Compost Application in Agriculture. Agronomy 2020, 10 (11), p. 1838. https://doi.org/10.3390/agronomy10111838
14. Rai I., Ahirwar A., Rai A., Varjani S., Vinayak V. / Biowaste recycling strategies for regenerative life support system: An overview. Sustainable Energy Technologies and Assessments, Vol. 53, October 2022
15. Piresa A., Martinhoa G., Chang N. // Solid waste management in European countries: A review of systems analysis techniques. Journal of Environmental Management. 2011.Vol.92 (4), pp.1033-1050. https://doi.org/10.1016/j.jenvman.2010.11.024
16. Ibragimov S.K., Ramazanova Z.R. // Reclamation of solonetz soils included in crop rotation. Caspian lowland with sulfuric acid waste. Ecology and Construction scientific peer-reviewed international journal. 2019. C. 25
17. Jiao D., Chuncai Z., Yulin Z., Hexin S., Wentao W., Guijian L. // Physical–Chemical Properties of Municipal Solid Waste and the Implication for Urban Management on Greenhouse Gas Emissions. ACS Sustainable Chemistry & Engineering. 2022. vol. 10 (35). 11692-11701.

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RHEOLOGY OF VISCOPLASTIC FLUIDS

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ABSTRACT

It has been shown that Bingham viscoplastic fluids include oil disperse systems, polymeric fluids, many types of food materials, cement solutions, oil paints and others, which exhibit viscous, plastic and highly elastic properties.
However, some viscoplastic fluids exhibit properties that do not obey the Bingham equation. Such fluids are commonly described by other rheological equations of the Ostwald-de-Ville or Herschel-Balkley type, which are widely used to describe the flow of plastic greases, heavy oils and petroleum disperse systems.
This is due to the presence of various particles of the dispersed phase in the liquid, and as a result, such systems are prone to form coagulation structures up to the formation of aggregate clusters and frameworks. In addition, the coefficients included in the rheological equation will depend on concentration, particle size and properties, as well as temperature and many other parameters.
At therefore, here is no consensus on the mechanism of non-Newtonian flow in oil disperse systems and therefore the many flow or rheological viscosity equations used in practice are mostly empirical or semi-empirical. However, despite many works and a diversity of approaches to the rheology of structured disperse systems, including petroleum disperse systems, there is as yet no satisfactory quantitative theory linking the rheological properties of bodies to the parameters of their structure. It is possible that this is due to the formation of various disordered structures that affect the type of rheological model and the nature of the dependence of the effective viscosity of the dispersed system on the stress and shear rate.
The dependence of liquid viscosity on shear stress is obtained for viscoplastic, dilatant and Newtonian liquids.
Keywords: non-Newtonian oil, rheology, viscoplastic fluid, viscosity, shear rate.

Introduction

The main problem of the rheology of non-Newtonian oils is studying the regularities of their behavior under the action of external deforming stresses, taking into account their structure. Concurrently, are considered the processes associated with irreversible residual deformations and the flow of various viscous and plastic materials, as well as the phenomena of stress relaxation, elastic aftereffects, etc. The rheological parameters of non-Newtonian oil allow investigating of fundamental properties of oil disperse systems that are characterized by shear stress, and effective viscosity, corresponding to a certain disordered structure of the system. The effective viscosity of non-Newtonian oils depends on temperature and pressure, as well as shear strain rate, disordered structure properties, asphalt-resin content and dispersed phase concentration and determines the degree of oil transportability in its production and processing [1-5].

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The high content of asphaltene-resinous, paraffinic substances and solids of various grades and nature in non-Newtonian oils creates a special physical structure that gives them viscoplastic properties, which are described using the Bingham, Herschel-Balkley and Ostwald-de-Weel rheological models. These high-viscosity oil systems are formed by combining oil emulsions with water droplets, and oil suspensions with a solid phase in the crude oil and gas suspensions. The complex physical structure of non-Newtonian oil predetermines the potential for more complex coagulation structures that negatively affect rheology [6,7].

Statement of the problem

A non-Newtonian fluid with constant differential viscosity is called a perfect plastic fluid or a Bingham fluid.

Bingham viscous-plastic fluids include oil disperse systems, polymeric fluids, many types of food materials, cement solutions, oil paints and others that exhibit viscous, plastic and highly elastic properties. They differ from Newtonian fluids in that some finite stress has to be applied to initiate flow, which necessitates the development of appropriate rheological models.

Solution of the problem

The rheology of viscoplastic fluids is described by the Bingham equation

$$\tau = \tau_0 + \eta\dot{\gamma}, \quad \dot{\gamma} > 0 \qquad (1)$$

where τ and τ_0 – shear stress and yield stress respectively , η – viscosity, $\dot{\gamma}$ – shear rate.

And, if $\dot{\gamma} = 0$, то $\tau \le \tau_0$. In this equation, the shear rate $\dot{\gamma}$ can be represented as a gradient of the flow velocity:

$$\dot{\gamma} = \frac{d\left(dx/dy\right)}{dt} = \frac{d\left(dx/dt\right)}{dy} = \frac{dV_x}{dy} \qquad (2)$$

From expression (1), the viscosity of a viscoplastic oil can be defined as

$$\eta = \frac{\tau - \tau_0}{\dot{\gamma}}$$

Assume that the change in relative viscosity is proportional to linear strain in the form of

$$\frac{\Delta\eta}{\eta} \sim \mathrm{m}\left(\frac{\Delta x}{\Delta y}\right)^{\mathrm{p}} \qquad (3)$$

where Δx – increment of linear strain by changing Δy , m coefficient of proportionality, P – is a measure of the degree of nonlinearity.

In the limiting case $\Delta y \to 0$, passing to the differential form, we take a non-linear form of writing the expression (3)

$$\frac{\mathrm{d}\eta}{\eta} = \mathrm{m}\left(\frac{\mathrm{dx}}{\mathrm{dy}}\right)^{\mathrm{p}-1} \mathrm{d}\left(\frac{\mathrm{dx}}{\mathrm{dy}}\right) \qquad (4)$$

Considering that $dx/dy = \lambda dV_x/dy = \lambda\dot{\gamma}$, we have

$$\frac{\mathrm{d}\eta}{\eta} = \mathrm{m}(\lambda\dot{\gamma})^{\mathrm{p}-1}\mathrm{d}(\lambda\dot{\gamma}) \qquad (5)$$

With consideration of the initial and infinite viscosity, solution (5) can be written as

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$$\eta - C = (\eta_0 - C)\text{ext}\left(\frac{m}{p}(\lambda\dot{\gamma})^p\right) \qquad (6)$$

where C – liquid concentration, λ – relaxation time. And, if $\dot{\gamma} \to \infty$, so $C = \eta_\infty$. As a result, the dependence of fluid viscosity on shear stress at $m = 1 - n$, we obtain the dependencies of viscosity on shear rate for viscoplastic $(n > 1)$, dilatant $(n < 1)$ and Newtonian fluids $(n = 1)$ in the form:

$$\frac{\eta - \eta_\infty}{\eta_0 - \eta_\infty} = \exp\left(\frac{m_0}{p}(\lambda\dot{\gamma})^p\right), \quad n > 1, \quad m_0 > 0 \qquad \textbf{(7)}$$

$$\frac{\eta - \eta_\infty}{\eta_0 - \eta_\infty} = \exp\left(-\frac{m_0}{p}(\lambda\dot{\gamma})^p\right), \quad n < 1, \quad m_0 < 0 \qquad \textbf{(8)}$$

$$\eta = \eta_0, \quad n = 1, \quad m = 0 \qquad \textbf{(9)}$$

Present the last expression as

$$\frac{\eta - \eta_\infty}{\eta_0 - \eta_\infty} = \exp\left(-\frac{m_0}{p}(\lambda\dot{\gamma})^p\right) = \frac{1}{\left[\exp\left((\lambda\dot{\gamma})^p\right)\right]^{m_0/p}} \qquad (10)$$

Decomposing the exponent into a series $\exp\left((\lambda\dot{\gamma})^p\right) = 1 + (\lambda\dot{\gamma})^p + \frac{1}{2}(\lambda\dot{\gamma})^{2p} + \ldots\ldots$, obtain

$$\frac{\eta - \eta_\infty}{\eta_0 - \eta_\infty} = \frac{1}{\left[1 + (\lambda\dot{\gamma})^p + \frac{1}{2}(\lambda\dot{\gamma})^{2p}\right]^{m_0/p}} \qquad (11)$$

Most formulas for determining the viscosity of a viscoplastic fluid, taking into account the linear exponent decomposition, are based on (11). In particular, to describe the rheology of viscoplastic polymeric fluids, the most effective is the Carreau-Yasuda rheological model [8,9], represented as

$$\frac{\eta - \eta_\infty}{\eta_0 - \eta_\infty} = \left[1 + (\lambda\dot{\gamma})^p\right]^{(n-1)/p} \qquad \textbf{(12)}$$

here η_0, η_∞ is the value of the viscosity of liquid at the beginning and at infinity, P - is a dimensionless coefficient characterizing the transition from the region with initial viscosity to the region with finite viscosity. As noted in [8], equation (12) describes the rheology of polymer liquids at various concentrations and temperatures. In [8] a simpler form to describe viscoplastic fluids at $\eta_\infty = 0$

$$\eta = \frac{\eta_0}{1 + \lambda\dot{\gamma}} \qquad (13)$$

In [10] the following rheological models are proposed for viscoplastic Bingham and Herschel-Balkley fluids

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$$\frac{\eta-\eta_\infty}{\eta_0-\eta_\infty}=\frac{1}{1+\left(\frac{|\dot\gamma|}{\dot\gamma^m}\right)^m} \qquad (14)$$

$$\eta=\begin{cases}\tau_0+k_0|\dot\gamma|^m, & \tau>\tau_0\\ \infty & \tau\le\tau_0\end{cases} \qquad (15)$$

It is also important to note the relationship between viscosity and shear stress in the following empirical formula

$$(\eta-\eta_\infty)/(\eta_0-\eta_\infty)=\exp\left(-(\lambda\dot\gamma)^n\right) \qquad (16)$$

Figure 1 shows the viscosity versus shear rate for a viscoplastic fluid.
In [11], the viscosity of a non-Newtonian polymer fluid containing particles of different concentrations is defined as a function of shear stress as follows (Fig. 2)

$$\eta=\frac{\eta_0}{1+(m\tau)^n} \qquad (17)$$

It should be noted that the coefficients entering equation (17) η_0, m, n depend on concentration (volume fraction), particle material and temperature.

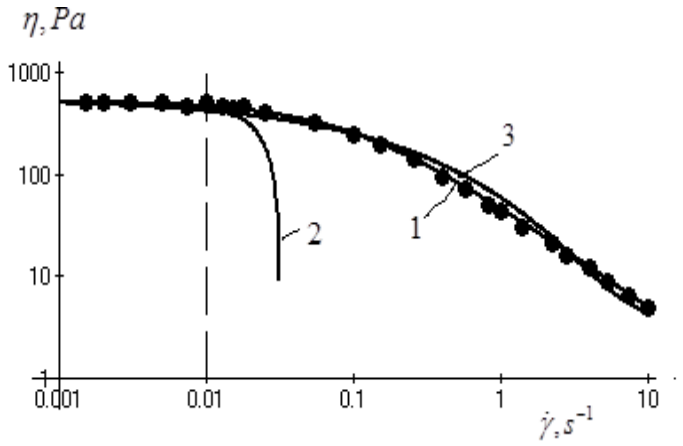

Figure 1. Dependence of fluid viscosity on shear rate for different equations:
1 – (6.17), $\eta_0=500Pas,\ \lambda=10s$ **; 2 –** $\eta=\eta_0-b\dot\gamma^2$ **[1]; 3 –** $(\eta-\eta_\infty)/(\eta_0-\eta_\infty)=\exp\left(-2.3\dot\gamma^{0.45}\right)$

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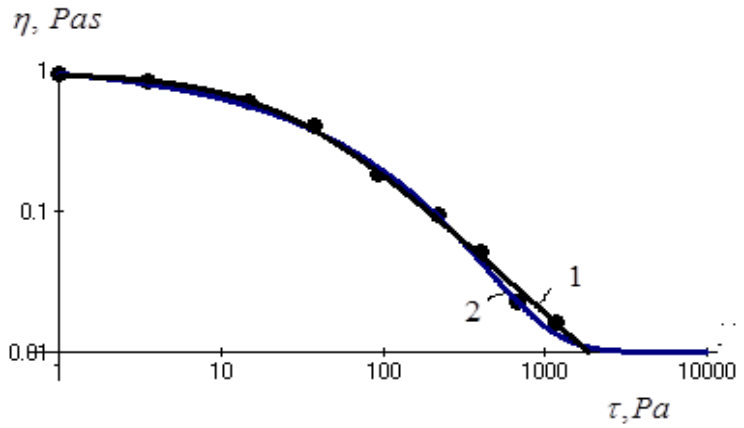

Figure 2. Dependence of viscosity on shear stress for different equations:

$1 - \ \eta = 0.95 / \left(1 + \left(0.046\tau\right)^{1.055}\right)$; $2 - \ \eta = 1.15\exp\left(-0.21\tau^{0.47}\right) + 0.01$

Figure 3 shows curves describing experimental values [184] of viscosity changes of polymer liquids by equations (8) and (9).

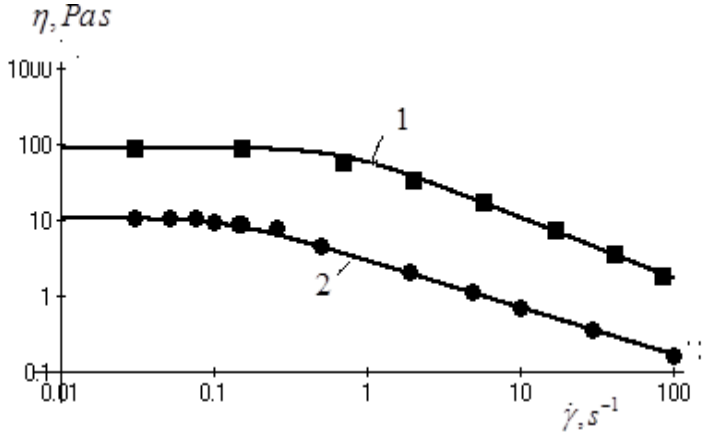

Figure 3. The viscosity of polymer liquids versus shear rate: 1 – 0.75% polyacrylamide in 95/5 mixture by weight of water and glycerin ($p = 2,\ \ m_0 / p = 0.4$); 2 – 7% aluminum soap in decalin and m-cresol ($p = 2,\ \ m_0 / p = 0.3$)

The given calculations and comparison with experimental data allow confirming the correctness of the accepted hypothesis about the proportionality of the relative deformation viscosity (3).
In principle, rheological models for various non-Newtonian fluid flows do not obey physical laws but are empirical and semiempirical approximations and formulas describing flow curves in a certain range of shear rates. Experimental measurements are approximated by some kind of approximated empirical or semiempirical equations, and the choice of the most convenient one is largely determined by the degree of maximum approximation of calculated and experimental measurements or by the simplicity of applied formulas in solving applied problems.

Conclusion

It is determined that the rheological equations of viscosity of oil disperse systems used in practical studies are empirical or semi-empirical. It is related to the formation of various disordered structures, which affects the structure of the rheological model and the nature of the dependence of the effective viscosity of the oil disperse system on the shear stress and shear rate. The dependence of fluid viscosity on shear stress for viscoplastic, dilatant and Newtonian fluids is obtained.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

Acknowledgment

The author would like to express gratitude to the care support workers and elderly individuals who participated in this study, sharing their invaluable insights and experiences. Their cooperation and openness have significantly contributed to the depth and richness of the research findings.

REFERENCES

1. Howard A. Barnes. A Review of the Rheology of Filled Viscoelastic Systems. //Rheology Reviews, 2003, pp.1-36.
2. Osman Turana, Nilanjan Chakrabortya, Robert J. Poolea Laminar natural convection of Bingham fluids in a square enclosure with differentially heated side walls. Non-Newtonian Fluid Mech., 165, pp.901-913, 2010.
3. Kelbaliev G.I., Tagiyev D.B., Rasulov S.R., Mustafaeva G.R., Kerimli V.I. Rheology of structural oil disperse systems. //Theoretical Foundations of Chemical Engineering, 51, 5, pp.729-735, 2017.
4. Kelbaliev G.I., Rasulov S.R., Rzaev A.G. and Mustafaeva G.R. Rheology of structured oils. //Journal of Engineering Physics and Thermophysics, 90, 4, pp. 996-1002, 2017
5. Zhaochuan Li, Lihui Zheng, Weian Huang. Rheological analysis of Newtonian and non-Newtonian fluids using Marsh funnel: Experimental study and computational fluid dynamics modeling. Energy Science and Engineering, 2020, https://doi.org/10.1002/ese3.647
6. Kelbaliev G.I., Rasulov S.R. Rheology of oil emulsions. Equipment and technologies for oil and gas complex, 5, pp. 64-69, 2019.
7. Khodakov G.S. Rheology of suspensions. Theory of phase flow and its experimental justification.// Ros. chim. journal., 2003, XLVII, 2, pp. 33-41, 2003
8. Giulia Finotello, Shauvik D., Jeroen C.R. Vrouwenvelder, Johan T. Padding, Kay A. Buist, Experimental investigation of non-Newtonian droplet collisions the role of extensional viscosity. //Experiments in Fluids, 59, 113, pp.112-128, 2018.
9. Byron Bird R., Robert C., Armstrong, Ole Hassager. Dynamics of Polymeric Liquids. 1987, 1, pp.75-82.

ISSN: 2298-0946 (Print), ISSN: 1987-6114 (Online)
THE CAUCASUS
ECONOMIC AND SOCIAL ANALYSIS JOURNAL OF SOUTHERN CAUCASUS

10. Kelbaliyev G.I., Rasulov S.R., Mustafayeva G.R., Suleymanov G.Z. Ecological aspects of extraction process of organic solution from sewage by recycling.- Herald of the Azerbaijan Engineering Academy, 2, pp.111-120, 2016.
11. Barnes H.A. Rheology Reviews, 1, pp.1-36, 2003

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THE PROBLEM OF FINDING ASSOCIATIVE RULES FOR CATALYTIC CRACKING

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ABSTRACT

Currently, the search for associative rules is one of the most relevant topics related to information technology. That is why the article pays considerable attention to the definition of associative rules. In particular, the article uses "Apriory" algorithm to solve the problem of finding associative rules, as well as speed up the process of detection of associative rules. Using the subtleties of the Apriori algorithm, this approach, as a concrete example, demonstrates the originality of the applied approach "Association Rule Mining".
In this article, the authors consider the problem of identifying hidden dependencies between data, and also explore and solve the problem of finding association rules using the method Association Rule Mining в среде XL Miner.
In recent years, the abbreviation «data mining» and its English synonym from the merging of two words is very often found in the special literature: Data Mining
This method - searches for associative rules in huge transactions through the information base of the installation of catalytic cracking. It identifies inputs that affect the output of the catalytic cracking unit, and also identifies hidden dependencies and useful knowledge. On the basis of this model there is a prediction of the quality of the output product (for example the relationship between output and output parameter). The difference between an association's classification and clustering tasks is that the search for patterns is not based on the properties of the object being analyzed, but between several events that occur simultaneously. As a rule, associative rules are as follows: if (condition), then (result), where the condition is not usually a logical expression (as in classification rules), but a set of objects from the set I to which the objects (associated) included in the result of the given rule are connected.
For example, the installation of catalytic. Cracking, based on the analysis of the information base, in order to predict the quality of the received product of the installation using one of the methods of Data Mining, namely the search for associative rules, determine the dependencies between input and output parameters, and also reveal hidden patterns. In this connection, ED-AVQ-6 (ELOU-AVT-6) considers the problem of detecting data dependency related to parameters of the rectification column.
Keywords: "Apriory" algorithm, associative rules, "Association Rule Mining", improvement, probability of accidentally, Data Mining.

Introduction

The rapid development of information technology, in particular, storage and advances in information processing techniques, has enabled many oil enterprises to collect large amounts of information that needs to be analyzed. Today, the direction related to the intellectualization of information processing and analysis methods is developing intensively. As a result, automatic

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data analysis is achieved. In this article, widely used method of a new technology called Data Mining. This method - searches for associative rules in huge transactions through the information base of the installation of catalytic cracking. It identifies inputs that affect the output of the catalytic cracking unit, and also identifies hidden dependencies and useful knowledge. [1]
In recent years, the abbreviation «data mining» and its English synonym from the merging of two words is very often found in the special literature: Data Mining.[5].
Speaking about the problem situation, it is necessary to note that, unlike statistical methods, the intellectual approach gives the opportunity to identify the inherent in the data uncertain patterns. In particular, associative rule searches reveal input and output factors as well as dependencies between them. In order to speed up the process of finding associative rules, the algorithm Priori.(7)

Problem statement

The one of local refinery has been constantly renewed and developed since its inception. This tradition continues to this day. In the last ten years, the N-22 (ED-AVG- 6) plant has been commissioned as a new kerosene and diesel fuel unit with high performance. At the moment, the capacity of the catalytic cracking unit is 3.0 million tones per year. To achieve this figure with UOP USA, in order to increase the productivity of the plant, with the firm FW (Foster Wheeler), the firm "Hamon Thermal Europe" of France were signed contracts.
Today, the local refinery has three certifications: real İSO-9001 in quality, İSO-14001 in ecology, TS-18001 in safety.
In order to predict the products listed above, to improve the quality of the output product, methods of Data Mining technology are widely used.
In literary sources, Data Mining (IAD) is defined by Data Mining technology and IAD practically refers to undefined and useful knowledge. In this context, knowledge acts as information stored in the data.
For example, the installation of catalytic. Cracking, based on the analysis of the information base, in order to predict the quality of the received product of the installation using one of the methods of Data Mining, namely the search for associative rules , determine the dependencies between input and output parameters, and also reveal hidden patterns.
In this connection, ED-AVQ-6 (ELOU-AVT-6) considers the problem of detecting data dependency related to parameters of the rectification column.
To identify a functional dependency:

1) Recovery column, ED-AVQ-6 refinery installation, is predicted based on data input factors analysis related to the settings in this installation.

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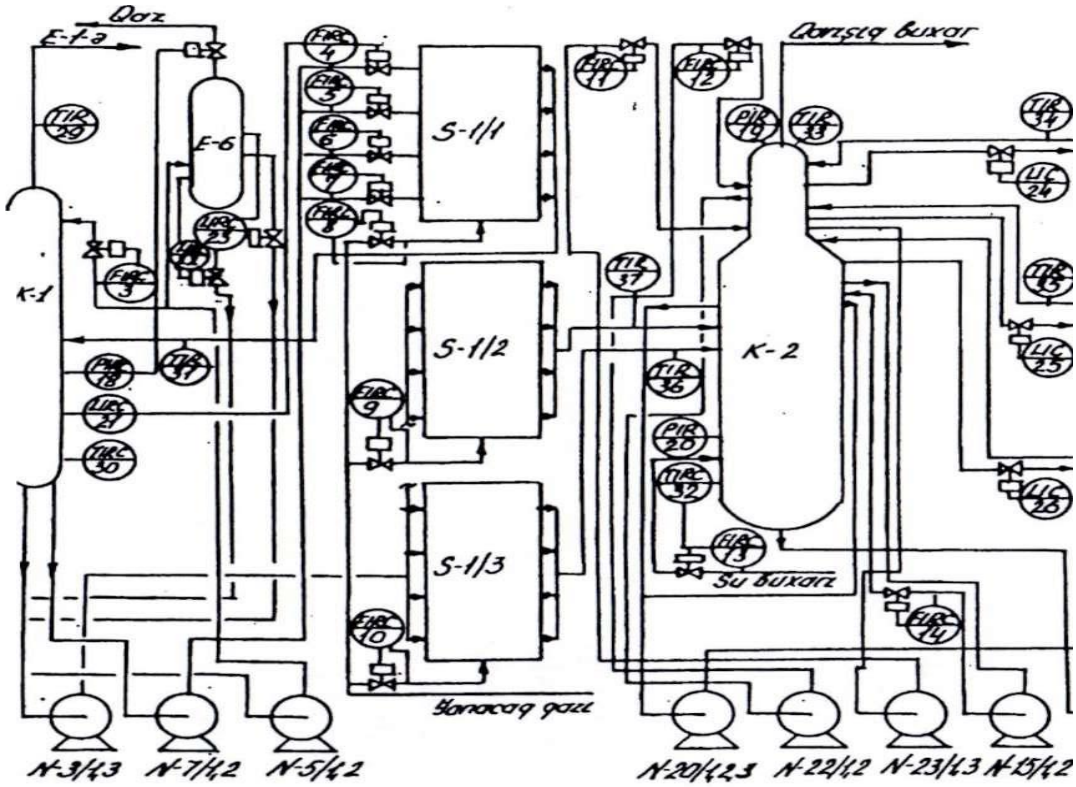

Figure 1. Cracking Mouth.
2) Based on the information base, we constructed the table below.

Table 1. Cracking Raw Materials and Products Characteristics.

Indicators	primary products		Cracking Products		
	Vacuum distillate	Recycled gas oil	Petrol	catalytic gas oil	
				light	heavy
Relative density:					
ρ_{277}^{293}	0,9100	0,9330	0,7600	0,9300	0,9400
ρ_{288}^{288}	0,9131	0,9340	0,7641	0,9330	0,9420
Boil-off limits, K	623-773	468-773	313-468	468-623	623-773
Molecular mass	360	248	105	200	340
Average molecular boiling point, K	683	582	384	548	676

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As a result of the analysis of Data Mining methods, the choice fell on the method of finding the association rules.

Solution of the problem

Data Mining (knowledge extraction) – the search process of various mathematical and statistical algorithms based on the analysis of clustering, regression and correlation, trends, relationships and patterns. The purpose of this search is to build a model of dependence. On the basis of this model there is a prediction of the quality of the output product (for example the relationship between output and output parameter). The difference between an association's classification and clustering tasks is that the search for patterns is not based on the properties of the object being analyzed, but between several events that occur simultaneously. As a rule, associative rules are as follows: if (condition), then (result), where the condition is not usually a logical expression (as in classification rules), but a set of objects from the set I to which the objects (associated) included in the result of the given rule are connected.

The number of associative rules can be very large and difficult-to-understand for a person. In addition, not all the built-up rules carry useful information. The following values are introduced to assess their usefulness:

Support - shows the percentage of transactions that support this rule.

Since the rule is built on the basis of a set, it means that the rule X=>Y has support equal to the support of the set F, which consists of X and Y:

$$SuppX => Y = SuppF = \frac{|D_{F=X\cup Y}|}{|D|} \qquad (1)$$

Obviously, rules based on the same set have the same support,
for example, support for Supp(if (Vacuum distillate, Gas Recirculating Oil), then (gasoline) = Supp(Vacuum distillate, Gas Recirculating Oil, Gasoline) = 0.5.

Confidence - shows the probability that the presence of a set X in the transaction follows the presence of a set Y in it.

The validity of a rule X=>Y is the ratio of the number of transactions containing X and Y to the number of transactions containing a set X:

$$ConfX => Y = \frac{|D_{F=X\cup Y}|}{|D_X|} = \frac{SuppX\cup Y}{Suppx} \qquad (2)$$

Conf(if (Vacuum distillate), (Gas Recirculating Oil)) = 2/3;
Conf(if (vacuum distillate), then (gasoline)) = 2/3;
Conf(if (Recirculating Gas Oil, Vacuum Distillate), then (Gasoline,)) = 1;
Conf(if (Gasoline), (Catalytic Gas Oil, Gas Oil Recycling)) = 2/3.

If the percentage of Y in a transaction, provided that it contains a set X, is less than the percentage of unconditional Y, i.e.:

$$ConfX => Y = \frac{SuppX\cup Y}{SuppX} < SuppY. \qquad (3)$$

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This means that the probability of accidentally guessing the presence of a set of Y in a transaction is greater than that of predicting it with the rule X=>Y.
To remedy this situation, an improvement measure is introduced.

Improvement - shows if the random guessing rule is more useful. Rule improvement is the ratio of the number of transactions containing sets X and Y to the product of the number of transactions containing a set X and the number of transactions, containing a set of Y:

$$imprX => Y = \frac{|DF=X \cup Y|}{|DX||DY|} = \frac{Supp X \cup Y}{Supp X * Y} \qquad (4)$$

At present, the problem of constructing associative rules in the light of the discovery of knowledge in data, in particular finding patterns between related events, is very topical. And the support and validity of these rules should be above certain thresholds, called respectively minimum support (min support) and minimum reliability (min confidence). For this purpose, the software implementation of the Priori algorithm is made in the XL Miner package.

Table 2. Object-feature transaction table.

TİD	Items
A.	Vacuum Distillate, Fuel Oil
B.	Gas recirculating oil
C.	Gasoline, Kerosene
D.	Catalytic gas oil (light, heavy)

Table 3. Normalized transaction table.

X1	X2	X3	X4
1	1	0	1
0	1	0	1
1	0	1	0
0	1	1	0
1	1	0	0
1	1	0	1
0	0	0	0
0	1	0	0
0	1	1	0
1	0	0	0
1	1	0	1
0	0	0	1
1	0	1	1

From the XL Miner menu, select the Association Rules Set the Minimum support values (#transactions and

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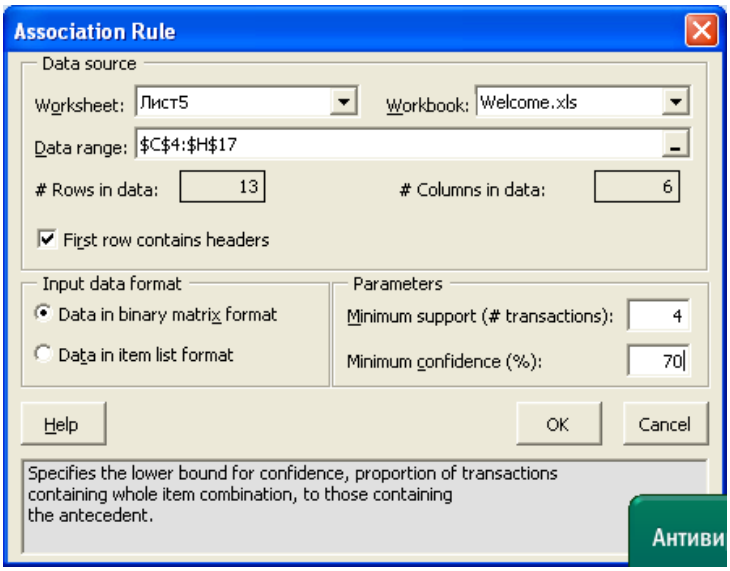
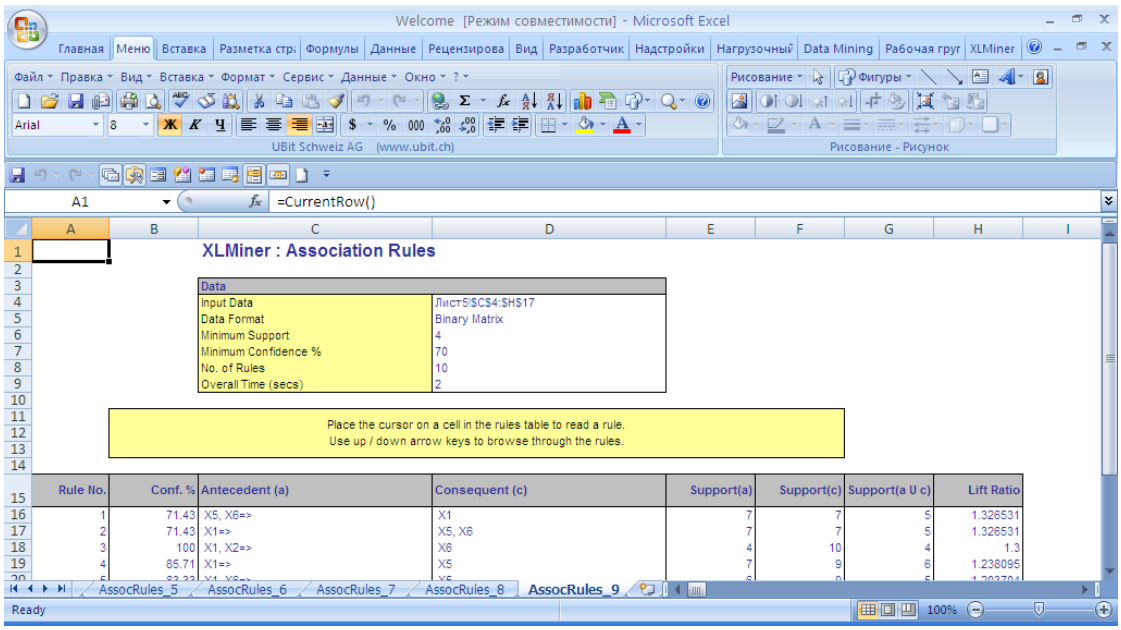


Minimum Confidence, then OK.
The results are presented in the software package XLMiner (Association rules).



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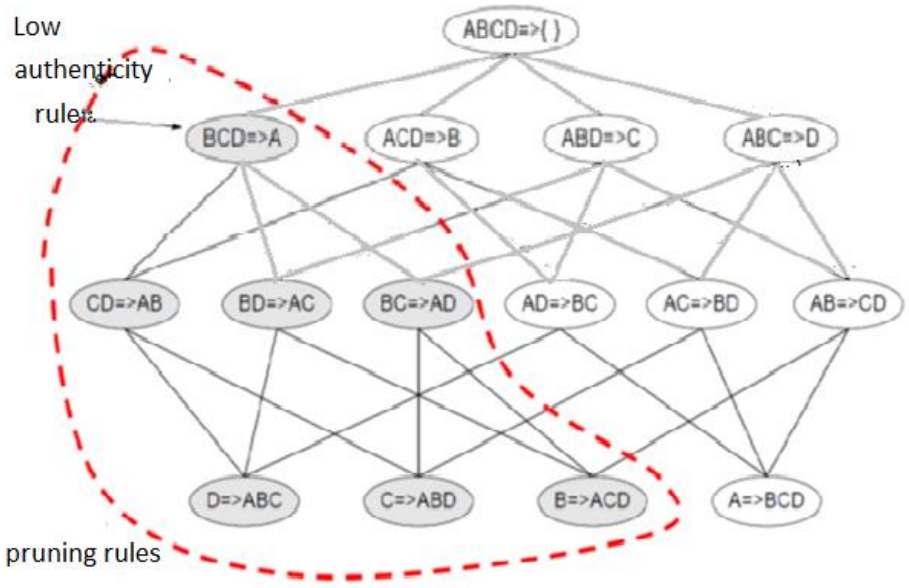

Figure 2. Model for representing association rules

Conclusion

In this article, the question of identification of generalized associative rules was considered. In order to speed up the process of finding associative rules, the Apriori algorithm is used.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

Acknowledgment

The author would like to express gratitude to the care support workers and elderly individuals who participated in this study, sharing their invaluable insights and experiences. Their cooperation and openness have significantly contributed to the depth and richness of the research findings.

REFERENCES

1. A. Marcus, J. I. Maletic, and K.-I. Lin. Ordinal association rules for error identification in data sets. /In Proc. of the 10th Intl. Conf. on Information and Knowledge Management, Atlanta, GA, October pages 589–591, 2001.
2. Shmueli G., Patel, N.R., Bruce, P.C. Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner // WileyInterscience, 2006.
3. G.Piatetsky-Shapiro: Association Rules and Frequent Item Analysis.

4. Datu ieguve. Pamati. / A. Sukovs, L. Aleksejeva, K. Makejeva ... [u.c.] – Rīga: SIADrukātava, 2007.
5. Mining Association Rules in Large Databases. Databases©Vladimir Estivill – Castro School of Computing and Information Technology With contributions from J. Han
6. A. Ozgur, P. N. Tan, and V. Kumar. RBA: An Integrated Framework for Regression based on Association Rules. /In Proc. of the SIAM Intl. Conf. on Data Mining, pages 210–221, Orlando, FL, April 2004.
7. Association Rule Learning and the Apriori Algorithm September 26, 2012, By Wesley.
8. Big data: definition, characteristics, life cycle, applications, and challenges
9. Hiba Basim Alwan1 and Ku Ruhana Ku-Mahamud. Published under licence by IOP Publishing Ltd IOP Conference Series: Materials Science and Engineering, Vol. 769, The 6th International Conference on Software Engineering & Computer Systems 25-27 September 2019, Pahang, Malaysia

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ВЛИЯНИЕ МАГНИТНОЙ БУРИ, СОЗДАВАЕМОЙ ВСПЫШКОЙ НА СОЛНЦЕ, НА ИЗМЕРЕНИЯ МАГНИТНОГО ПОЛЯ СИСТЕМЫ НА ЗЕМЛЕ

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РЕЗЮМЕ

В данной статье изучается влияние магнитной бури, создаваемой Солнцем, на измерения магнитного поля в зазоре сердечника электромагнита. Получено, что в период геомагнитной бури экспериментальные данные исследуемого объекта могут сильно отличаться от реального значения! Для окружающей среды такие изменения могут существенно влиять на развитие флоры, фауны и на самочувствие людей.
Ключевые слова: измерение магнитного поля, изменение магнитного поля Земли, техногенные поля, магнитные бури Солнца.

При проведении исследований, включающих измерение магнитного поля “открытой” (не изолированной магнитно непроницаемым экраном) системы, на исследуемое магнитное поле могут накладываться внешние поля (изменение магнитного поля Земли, техногенные поля, магнитные бури Солнца, и т. д.).
В данной статье изучается влияние магнитной бури, создаваемой Солнцем, на измерения магнитного поля в зазоре сердечника электромагнита, схема которого приведена на рисунке 1[1,2].

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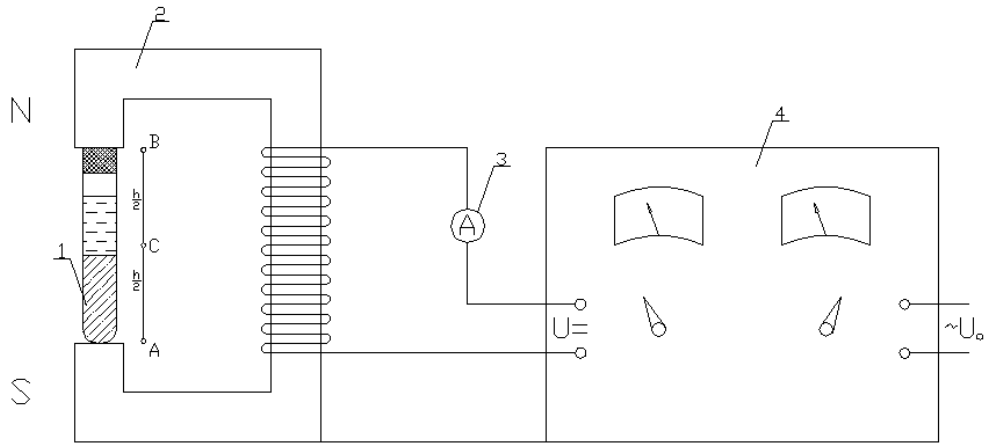

1 – исследуемый объект, 2 – сердечник электромагнитной катушки, 3 – амперметр, 4 – преобразователь переменного тока в постоянный.

Рис.1. Схема экспериментальной установки.

Измерения на установке для обработки исследуемого объекта 1 магнитным полем заключается в следующем. На выходе преобразователя переменного тока в постоянный ток 4 устанавливается напряжение постоянного электрического поля U. С помощью магнитометра определяется напряженность магнитного поля H в точке C, расположенной в середине сердечника электромагнитной катушки 2. Полученные значения заносятся в таблицу, на основе которой строится зависимость H от U, смотри рис.2.

Дата проведения эксперимента определялась из таблицы 1, которая указывает дни геомагнитных возмущений в Мае 2023 в городе Баку, опубликованной в интернете [3].

Исследования проводились в следующей последовательности.

На рисунке 2 приведены графики зависимости H от U до магнитной бури на Земле под действием вспышки на Солнце – кривая 1, в момент магнитной бури на Земле – 2, после магнитной бури на Земле – 3. Кривая 1 – была получена в процессе измерения в 11.00 часов 10.05.23 до магнитной бури на Земле (в таблице 1 значение 4!). Кривая 2 – была получена в процессе измерения в 14.42 часов 11.05.23 в момент сильной магнитной бури на Земле (в таблице 1 значение 6!). Кривая 3 – была получена в процессе измерения в 13.00 часов 12.05.23 в момент после магнитной бури на Земле. (в таблице 1 значение 3!)

Таблица 1.

Часы / Дни	0	3	6	9	12	15	18	21
1	3	2	1	1	2	3	3	3
2	3	3	2	2	4	4	4	3
3	3	2	1	1	2	2	2	2
4	2	2	2	1	2	2	1	1
5	0	1	1	1	1	2	3	2

6	2	3	3	3	3	3	3	3
7	3	3	4	4	5	5	6	6
8	5	5	4	4	4	4	3	4
9	3	2	2	2	1	1	1	2
10 до	2	1	1	4!	6	5	3	3
11 при	3	3	4	7	5	6!	4	5
12 после	4	4	3	3	3!	2	3	3
13	2	2	1	2	2	2	2	3
14	2	2	1	1	2	2	2	1
15	1	1	1	1	1	1	2	3
16	3	2	2	2	2	2	2	3
17	2	2	2	2	2	2	1	1
18	1	1	1	1	1	1	1	1
19	1	1	1	1	1	1	3	2
20	3	2	1	1	2	2	3	3
21	2	1	1	1	2	3	5	4
22	3	3	2	1	1	2	3	2
23	2	1	1	3	4	5	5	4
24	4	4	4	4	4	4	4	4
25	4	4	4	4	4	4	4	4
26	4	4	4	4	4	4	3	3
27	3	3	3	3	3	3	3	3
28	3	3	3	3	3	3	3	3
29	3	3	3	3	3	3	2	2
30	2	2	2	2	2	2	2	2
31	2	2	2	2	2	2	2	2

1 – нет заметных возмущений;
2 – небольшие возмущения;
3 – слабая геомагнитная буря;
4 – малая геомагнитная буря;
5 – умеренная геомагнитная буря;
6 – сильная геомагнитная буря;
7 – жесткий геомагнитный шторм;
8 – экстремальный шторм.

Из рисунка 2 следует, что до и после геомагнитной бури значения кривых, создаваемого электромагнитом искусственного магнитного поля, имеют гладкий характер («эталонная кривая») и, с учетом погрешности экспериментальных данных, практически совпадают.

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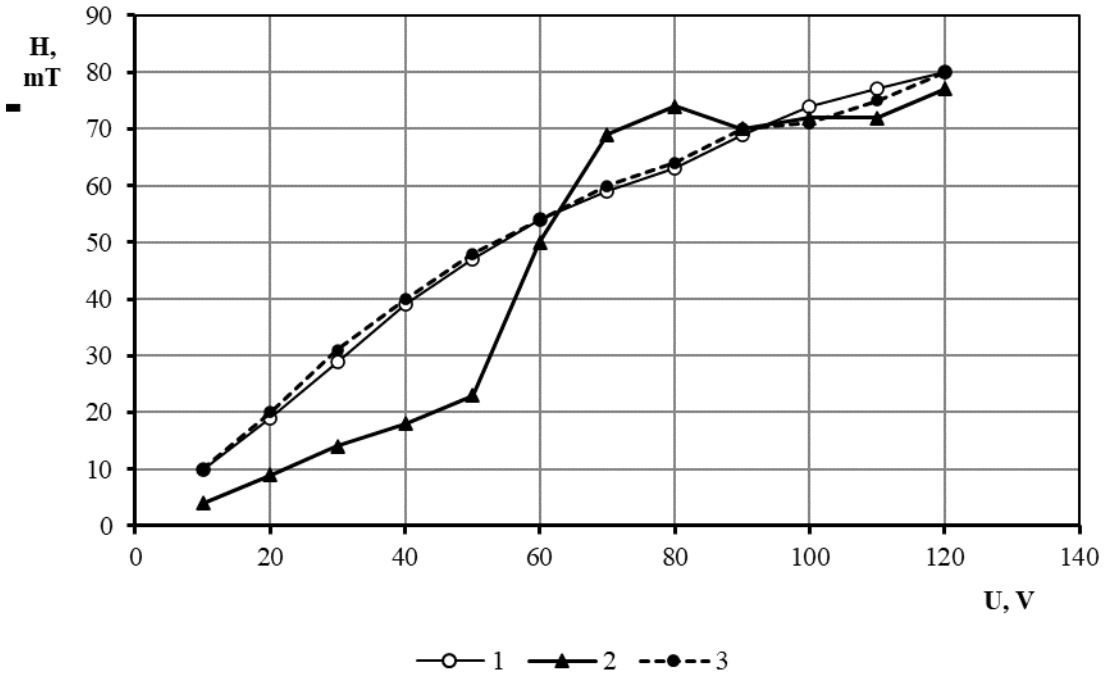

Рис. 2. Зависимость напряженности магнитного поля H от напряжения постоянного электрического поля U.

В процессе действия геомагнитной бури, при малых значениях создаваемого электромагнитом искусственного магнитного поля, кривая находится значительно ниже «эталонной кривой» до значения U = 60 вольт. Выше этих значений слегка увеличивается и при значении U = 90 вольт и выше практически совпадает с «эталонной кривой».

Выводы

1. Отсюда следует, что в период геомагнитной бури экспериментальные данные исследуемого объекта могут сильно отличаться от реального значения!
2. Для окружающей среды такие изменения могут существенно влиять на развитие флоры, фауны и на самочувствие людей.

Декларации

Рукопись не была представлена в какой-либо другой журнал или на конференцию.

Ограничения исследования

Ограничений, которые могли бы повлиять на результаты исследования, нет.

Подтверждение

Автор хотел бы выразить благодарность работникам службы поддержки и пожилым людям, которые приняли участие в этом исследовании, поделившись своими бесценными знаниями и опытом. Их сотрудничество и открытость в значительной степени способствовали глубине и богатству результатов исследований.

ЛИТЕРАТУРА

1. А.М. Мамед-заде. Нанотехнологии в нефтедобыче. Баку, 2010, 268 с.
2. Malikov H.Kh.,Aliyev E.N.,Mustafaeva R.E.,Malikov T.H. Calculation of the strength of the magnetic field of treatment of the pumped water into the formation to obtain the maximum oil production. News of Baku University series of Physic-Mathematical Sciences, №3, 2022, pp.49 – 54.
3. Интернет: time – in. run: Магнитные бури в Баку

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MODERNIZATION AND ECONOMIC ASPECTS OF INSTITUTIONS IN THE WORLD EXPERIENCE

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ABSTRACT

Application of technologies based on world experience in industrial enterprises is important for increasing efficiency and optimizing industrial processes. Among these technologies are technologies such as industry 4.0, cloud computing, IoT (internet of things), artificial intelligence (AI) and block chain. The application of these technologies enables enterprises to achieve a higher level of process automation, data analytics and data management. The world experience is developing more as a result of the rapid and effective functioning of industrial enterprises with the application of these technologies. This helps enterprises to strengthen their position in the field of competition by reacting to work faster. As a result, industrial enterprises continue to grow, which in turn promotes the future development of the economy as a whole. Application of new technologies based on world experience enables enterprises to gain competitive advantage and increase compliance with industry standards. As a result of the application of technologies in industrial enterprises, the reduction of labor demand and the faster execution of automated processes make it possible to clear employment. The results of technologies applied in industrial enterprises result in faster fulfillment of product demand, on-time delivery of the student and increased customer satisfaction.
In the article, the current situation of the field of robotics in the experience of Kazakhstan and Turkey and the steps taken for its development, forecasts are reflected. The importance of supporting this field by both integrators who know the local market well and by the state was also noted. In both experiments, the effect of robotization and automation on the industry is reflected in the article, which accelerates the development of the country's economy and strengthens its competitive position compared to the countries of the world.
In the experience of Turkey and Kazakhstan, the successes and indicators achieved in recent years in artificial intelligence, robotic technologies, biotechnologies, nanotechnology, metaverse, virtual reality, Big Data, energy technologies, super-fast computing, agricultural technologies, cyber security and other fields have been noted.
Keywords: Industrial enterprises, world experience, innovation, digitization, robotics, modernization, industry 4.0.

Introduction.

The word "technology" is derived from the Greek words "techne" (art, skill) and "logos" (word, description). The distinction between the concepts of technique and technology lies in the fact that technique refers to the implementation of tasks using specific machines and tools, whereas technology encompasses processes and methodologies used to innovate, enhance productivity, and ensure competitiveness.

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Every enterprise aims to address the challenges it faces in production activities with a specific line of development by learning new technologies. Several factors influence the spread of technological innovations at the national level and their acceptance by individuals. These factors include cultural changes, societal norms, communication technologies, the characteristics of innovations, technology culture and compatibility, technology policy, and technology standards. According to Heinich, technology is the systematic application of science to practical tasks and the accumulation of acquired information. He also associates technology with the following five main factors.

The topic of "Application of technology based on global experience in enhancing efficiency models in industrial enterprises" is a matter of increasing interest and practical application in recent years. This model is a strategy aimed at enhancing efficiency and productivity in industrial enterprises by making maximum use of technologies. Technologies based on global experience provide effective tools in the industrial sector to improve quality and productivity, minimize financial expenses, and enhance efficiency. The implementation of this model results in a significant increase in performance among enterprises and significant advancements in efficiency, productivity, and innovation.

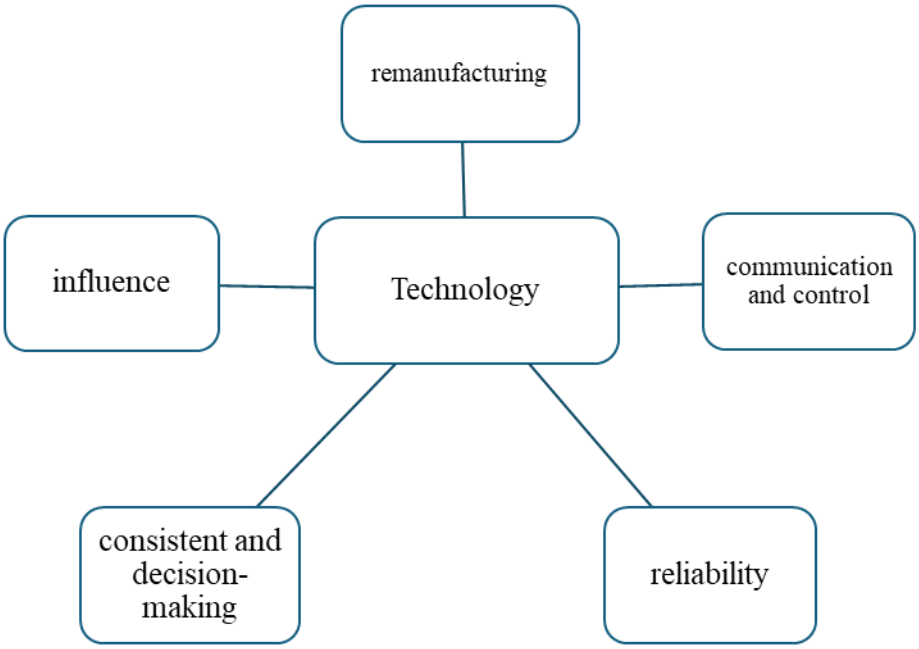

Figure 1. The factors affecting technology. [2].

The application of technology in industrial enterprises enhances efficiency and enables production to be carried out more effectively. Through the implementation of technologies, automation and optimization of production processes improve product quality and create a competitive advantage among stakeholders. The application of technologies in industrial enterprises allows for more effective management and sharing of information, thereby speeding up decision-making processes.[1]

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As a result of the application of technologies in industrial enterprises, there is a reduction in labor demand and the streamlining of automated processes leads to cleaner job roles. The implementation of technologies that reduce labor, material, and energy consumption decreases the financial expenditures of industrial enterprises and enhances the content of the product. The application of technologies in industrial enterprises improves the efficiency of repair and service operations, thereby requiring less time and financial investment in maintenance services.
It is possible to categorize technologies as follows (Figure 2).

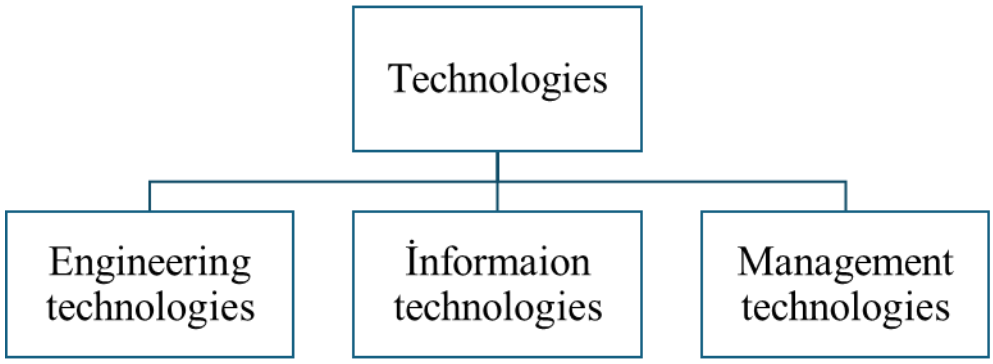

Figure 2. Types of Technologies. [2].

The outcomes of implementing technologies in industrial enterprises result in quicker fulfillment of product demand, timely delivery, and increased customer satisfaction. By applying technologies, industrial enterprises establish well-secured and managed databases, enabling swift decision-making and adaptability of strategies. The automation and monitoring of business processes serve as significant means for enhancing efficiency in industrial enterprises and promptly identifying and resolving potential issues. The application of technologies in industrial enterprises fosters the promotion of innovation and incubation centers, making industrial enterprises more receptive and adaptable to other technologies.
The indicators of using industrial robots in the world experience during 2019-2023 are shown in Figure 3.

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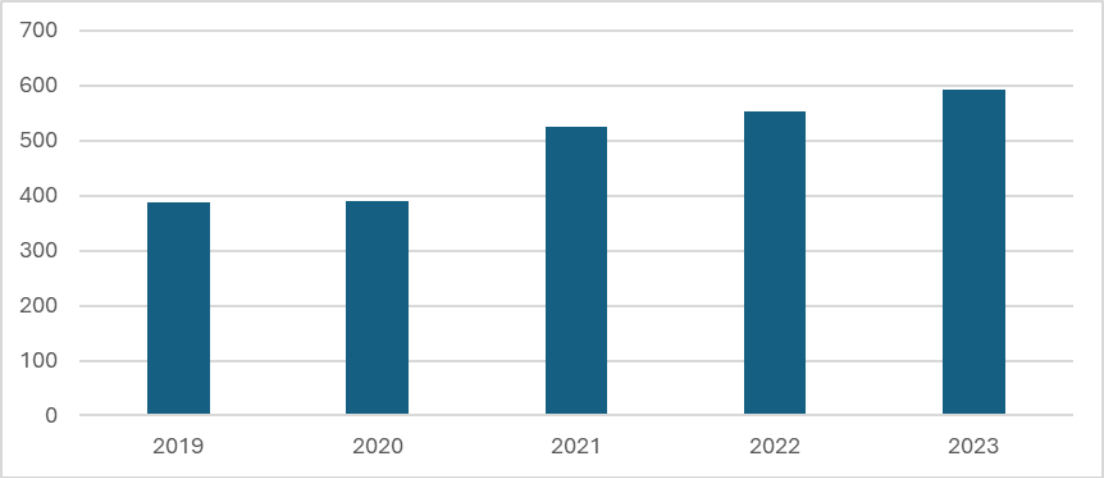

Figure 3. The number of industrial robots deployed worldwide in the years 2019-2023. [3]

By 2025, it is expected that the global robotics market will exceed $499 billion. Leading industrial robot manufacturers include ABB (Sweden), FANUC (Japan), KUKA (China), Mitsubishi Electric (Japan), and Yaskawa (Japan).[2]

According to the International Federation of Robotics, a total of 553,000 industrial robots were deployed worldwide in 2022, with over 50% of these robots in China. Compared to 2022, the number of industrial robots increased by 7% in 2023, reaching 593,000 units.

In the Republic of Kazakhstan, favorable conditions are created for the development of robotics, supported by both local integrators and government initiatives. Due to the rapid development in this field, KUKA, one of the influential industrial robot manufacturers, plans to relocate its headquarters from Russia to Kazakhstan. In addition to these steps, Kazakhstan is a member of the Robotics and Automation Association. To promote the development of robotics technology, the national standard ST RK 3824-2022 was adopted in 2022.

Emphasis should be placed on integrating learning standards and instructional strategies with examples from the Technology Integration View features. It is important to increase instruction by professionals in the use of technology to meet learning needs. [5]

According to data from the Kazakhstan Automation and Robotics Association in 2022, Kazakhstan had only 4 robots per 10,000 industrial workers. Although this number is twice as high as the indicators in 2017, it still indicates that Kazakhstan lags behind leading countries in terms of robotization. South Korea leads in the number of robots per worker, with 1,000 robots per 10,000 workers, followed by Singapore with 670 robots and Japan with 399 robots. According to global averages, there are 141 robots per 10,000 workers.

In recent years, Turkey has achieved significant success in various fields such as artificial intelligence, robotics, biotechnology, nanotechnology, metaverse, virtual reality, Big Data, energy technologies, supercomputing, agricultural technologies, cybersecurity, and others. In 2023, Turkey transitioned to 5G services, introducing faster and next-generation technologies to its population. Work on 5.5G is expected to begin between 2025 and 2030, aiming to provide services with even faster and higher-level technologies.

Today, the R&D and innovation ecosystem play a crucial role in positioning Turkey as a leader in household appliances, commercial vehicles, solar panels, and cement production in Europe. The

Ministry of Industry and Technology continues its efforts to lead Turkey's progress through investment, production, employment, and trade policies, aiming to maintain independence, increase high-tech exports, and expand value-added production. Due to its geographical position, Turkey is capable of producing for the entire world, including the Arctic, and is enhancing its cooperation with other countries to increase its diversity in this area.[6]

Turkey utilizes a range of innovation and methods for the modernization of its industry. Some of these are highlighted below:

Turkey focuses on Industry 4.0 technologies such as automation, Internet of Things (IoT), artificial intelligence, and cloud computing to promote digitization.

Many industrial enterprises in Turkey invest in smart manufacturing systems for modernization. These systems are used to increase production efficiency, reduce failure rates, and improve product quality.

Digital design and prototyping methods are crucial for the development of innovative products. Through these methods, the development process is accelerated, and production costs are reduced.

Turkey supports continuous development through investment in clean production methods and eco-friendly technologies. In this framework, investments in Renewable Energy and strategies for reducing emissions are crucial.

Industrial enterprises use technologies such as artificial intelligence and data analytics to optimize production processes. This provides advantages such as predicting equipment failures, improving inventory management, and better understanding customer demands.

Turkey establishes education and innovation centers to facilitate the adoption of new technologies by industrial workers and entrepreneurs. These centers provide education programs and infrastructure for learning and implementing new technologies.[7]

The effectiveness of innovative technologies and methods used for the modernization of Turkey's industry depends on several factors. Increasing productivity, innovative technologies and methods can enhance the efficiency of production processes. Technologies such as automation, robot systems, and smart manufacturing systems can reduce labor costs and increase production speed. Cost reduction, modern technology, and methods can help companies reduce operating expenses. More efficient inventory management, energy-saving systems, and emission reduction strategies can increase a company's profitability. Improving quality, innovative technologies and methods can improve the quality of products and services. Digital design and prototyping improve the development process of the product, while quality control systems and data analytics can help improve product quality.

Turkey's efforts to modernize its industry are aimed at enhancing its international competitiveness. Industry 4.0 technologies and digital transformation strategies enable Turkish companies to be more competitive internationally. The use of innovative technologies stimulates research activities and promotes innovation. Research centers and technology parks in Turkey enable companies to develop innovative ideas and offer new products and services. Modern technology and equipment can contribute to environmental sustainability. Green technologies and eco-friendly production processes help protect natural resources and reduce environmental impact. The application of innovative technologies and methods contributes to the development of labor reserves. Training and improvement programs help workers learn and apply new technologies. Industrial modernization contributes to Turkey's economic growth. A more efficient and competitive industry can increase a country's exports and contribute to economic development.[3]

Companies that successfully implement Industry 4.0 and increase their productivity outpace their competitors in competitive races. As the advantages of Industry 4.0 become apparent, these successful companies serve as examples to others. Companies that successfully apply Industry 4.0 technologies, lead the fourth industrial revolution, and demonstrate the advantages of Industry 4.0:

Understanding the economic aspect can be challenging as it considers both negative and positive economic outcomes and involves analyzing and deciding on a matter based on economic indicators, effects, and impacts. The economic aspect is used to evaluate the necessity, efficiency, and negative effects of economics.

The economic aspect is the evaluation of a business's economic activity from several perspectives, which can be divided into various types:

Financial aspect: Financial indicators such as the organization's finances and budget, income and expenses, profit margin, liquidity, and management of loans form the basis of this aspect.

Technological aspect: Technological indicators such as the organization's level of technology usage, degree of automation, application of new technologies, and development of technology infrastructure are part of this aspect.

Human resources aspect: Factors such as the productivity of workers and employees, job training, workforce management, employees' position within the organization, and quality of life are significant aspects of this category.

Productivity aspect: Indicators of productivity such as the quality of the organization's products and services, increase in revenue, efficiency of production processes, product development, and innovation are included in this aspect.

Market aspect: Market indicators such as the organization's market share, market share, acceptance of products and services by customers, customer loyalty, and competitiveness form part of this aspect.[4]

Each of these types helps evaluate various aspects of a company's operations and plays a significant role in improving the efficiency and competitiveness of industrial enterprises.

The economic aspect understanding refers to evaluating a concept, event, or issue from an economic perspective. This understanding involves considering economics, industry, commerce, finance, and other economic activities. The economic aspect helps analyze a matter in terms of economic indicators and effects. It is used to assess a business's profits, expenses, revenues, and other economic issues. This perspective is an important tool for planning, managing, and evaluating a business's activities. The economic aspect also helps assess the financial efficiency of industrial enterprises and their activities. This understanding is a significant guide for discussing issues related to a business's interests, goals, and objectives. The economic aspect understanding helps evaluate and improve the efficiency of products, services, and business processes. This perspective is an effective tool for assessing and planning a business's current situation.[8]

As a result, learning about such relationships can be realized through several methods, including:

- Using specific indexes and indicators;
- Valuation of all available reserves;
- Replacement of all reserves with labor equivalents;
- Use of special equivalents for the analysis of individual group reserves.

It is necessary to differentiate between economic aspect understanding and production potential understanding. The economic aspects of industrial enterprises vary according to many sources, but mainly include the following issues:

1. Production: Industrial enterprises engage in production activities and support the economy by creating products. Industrial enterprises have a significant impact on the economy by increasing production and raising the national budget.
2. Production Independence: Industrial enterprises influence the economy positively by increasing the supply of goods through their own production processes. Activities in the industrial sector provide a significant opportunity to create jobs and reduce unemployment.
3. Labor Supply: Industrial enterprises value workforce supply and play a significant role in reducing unemployment and supporting the economy by creating a wide workforce base. Industrial enterprises finance new projects and research to develop technologies.
4. Innovation: Industrial enterprises promote innovations and engage in various fields by investing in research and developed technologies. Companies operating in the industrial sector gain advantages by improving product quality and gaining customer trust.
5. Product Content and Quality: Industrial enterprises strive to improve product content and quality to meet customer demands and gain market share. Industrial enterprises play an important role in the development of foreign trade and international economic cooperation and attract foreign investments to the country.
6. Investments and Finance: Industrial enterprises play a significant role in supporting new projects and technologies through financial investments. Companies operating in the industrial sector support cultural development and infrastructure improvement and enrich the country culturally.
7. Foreign Trade and Economic Relations: Industrial enterprises support foreign trade and play an important role in the development of economic relations between countries. The activities of industrial enterprises are significant in terms of increasing income and collecting industrial taxes in the country.
8. Infrastructure and Engineering: Industrial enterprises play a role in the development of infrastructure and the implementation of engineering projects. Activities in the industrial sector support infrastructure development and restrict transportation, energy, and communication infrastructures.

These aspects confirm the importance of industrial enterprises in the economy and their significant role.

Improving the economic aspects of industrial enterprises is an important issue for increasing their efficiency and improving productivity.

REFERENCES

1. Andrusevich, S. Omarov, N. Starodubcev, V. Nevliudova. “Study of the influence of the modern robotisation level on the challenges and risks of the economic security of an industrial enterpriseg”. Innovative technologies and scientific solutions for industries. 2022.
2. Cetron, Marvin and Owen DAVIES(2014), “Trends Now Changing the World: Technology, the Workplace, Management, and Institutions”, The Futurist; Mar/Apr 2014.
3. Kulzhambekova Barno Shakirovna, Tashenova Larissa Vladimirovna. “Industry4.0: digitalization and robotization of industrial enterprises of Kazakhstan”. Business economics 2023.

4. Freeman, C. (2014). The Economics of Industrial Innovation, Harmondsworth, Penguin Books.
5. Heinich, R. (2014). The proper study of ınstructional technology.
6. Maxwell, Ian E. (2017). Managing Sustainable Innovation - The Driver for Global Growth, Springer, New Zealand.
7. Rogers M.E Diffusion of innovations (Fifth edition) New York Free Press 2016.
8. Goncharenko L.P. Innovatsionnaya politika: Uchebnik/M.: KNORUS, 2015 28. Il'shev A.M. (2015).

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ORGANIZATION OF CADASTRAL WORK IN "LAND CONSTRUCTION" PROJECTS PREPARED IN CONNECTION WITH CONSTRUCTION WORKS IN KARABAKH AND EASTERN ZANGEZUR ECONOMIC REGIONS

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ABSTRACT

The purpose of this report is that the Karabakh and East Zangezur economic regions, which are known as the regions that will benefit agriculture more, have been under occupation for almost 32 years, the lack of information about the actual use of the lands located in those zones creates the need for the assessment, economic evaluation, and updating of the quantitative and qualitative indicators of those lands. It is possible to complete the information gap created in those areas by completing land construction works on the basis of cadastral data.It is no coincidence that the establishment of a modern road-transport infrastructure here is one of the main priorities within the framework of the rehabilitation program of the territories freed from occupation after the victory.

Jabrayil, Zangilan, Gubadli, Lachin Kalbajar, Aghdara, Aghdam, Shusha, Khankendi regions have quite a large tourism potential. The new roads designed as part of the rehabilitation program will provide easy access to the liberated areas even in the winter months. In short, the roads built in different directions in the liberated territories are of great importance both economically and socially. The restoration of territorial integrity as a result of victory will change the thinking of national identity. Because the main obstacle to the completion of the national identity was the occupation.

Keywords: victory, road-transport infrastructure, territories freed from occupation, restoration of territorial integrity, national identity thinking

QARABAĞ VƏ ŞƏRQİ ZƏNGƏZUR İQTİSADİ RAYONLARINDA QURUCULUQ İŞLƏRİ İLƏ ƏLAQƏDAR HAZIRLANAN “ YERQURULUŞU LAYİHƏLƏRİNDƏ KADASTR İŞLƏRİNİN TƏŞKİLİ

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XÜLASƏ

Bu məruzənin məqsədi kənd təsərrüfatına daha şox fayda verəcək rayonlar kimi tanınan Qarabağ və Şərqi Zəngəzur iqtisadi rayonlarının 32 ilə yaxın işğalda olması, həmin zonalarda yerləşən torpaqların faktiki istifadə vəziyyəti barədə olan məlumatların azlığı, həmin torpaqların bonitrovkası, iqtisadi qiymətləndirilməsi, kəmiyyət-keyfiyyət göstəricilərinin yenilənməsi tələbatını yaradır.

Məhz həmin ərazilərdə yaranan informasiya boşluğunun doldurulmasına yerquruluşu layihələrinin kadastr məlumatları əsasında nail olmaq mümkündür.

Yerquruluşu işlərində kadastr məlumatlarının tətbiqi işğaldan azad olunmuş ərazilərdə formalaşacaq İƏD-nin və İƏV-nin qonşuluq hüdudlarının müəyyənləşdirilməsi, yaşayış məntəqələri üçün ərazilərin ayrılması, emal və infrasturuktur obyektlərinin tələb edilən sahələrinin formalaşdırılması, ixtisaslaşmaya uyğun uqodyaların təşkilinə imkan verəcək. Həmçinin, qeyri kənd təsərrüfatı sahələrinin təşkili, yolların və digər komunikasiya xətlərinin, qurğu və körpülərin planlaşdırılması və müasir tələblərə cavab verən idarəetmə sisteminin tətbiqinə böyük imkanlar yaradır.

İlk andan həmin ərazilərdə yol-nəqliyyat infrastrukturunun təşkili, enerjiyə olan tələbatın qarşılanması üçün işıq xətlərinin çəkilməsi, kiçik SES-nın qurulması, yeni qaz xətlərinin çəkilməsi, ən əsası isə yüni şəhər ,qəsəbə və kəndlərin salınması üçün tələb edilən kadastr məlumatları əsasında plan, xəritə və profillər tərtib edilir.

İşğaldan azad edilmiş ərazilərin bərpası proqramı çərçivəsində burada əsas prioritetlərdən biri kimi müasir yol-nəqliyyat infrastrukturunun qurulmasının müəyyənləşdirilməsi heç də təsadüfi deyil. Cəbrayıl, Zəngilan, Qubadlı, Laçın Kəlbəcər, Ağdərə, Ağdam, Şuşa, Xankəndi rayonlarında turizm potensialı kifayət qədər böyükdür. Bərpa proqramı çərçivəsində layihələndirilən yeni yollar işğaldan azad olunmuş ərazilərə qış aylarında da rahat gediş-gəlişi təmin edəcək. Bir sözlə, işğaldan azad olunmuş ərazilərdə müxtəlif istiqamətlərdə çəkilən yollar həm iqtisadi, həm də sosial baxımdan böyük önəm daşıyır. Zəfər nəticəsində ərazi bütövlüyünün bərpası milli kimlik düşüncəsini dəyişəcəkdir. Çünki milli kimliyin tamamlanmasının qarşısındakı əsas maneə işğal idi.

Respublikamızın 14 iqtisadi rayonundan biri olan Qarabağ iqtisadi rayonu-tərkibində Ağdam, Ağdərə, Bərdə, Füzuli, Xocalı, Xocavənd, Şuşa, Tərtər inzibati rayonları və Xankəndi şəhəri daxil olmaqla 7330 km² ərazini, Şərqi Zəngəzur rayonu isə tərkibində Cəbrayıl, Kəlbəcər, Laçın, Qubadlı və Zəngilan rayonlarını əhatə etməklə 7448 km² ərazini . əhatə edir. Məhz dövlət və özəl şirkətlətlərin xidmətlərinə əsasən dağıdılmış yaşayış məskənləri, kənd təsərrüfatı təyinatlı torpaqlar, meşələr və digər təyinatlı torpaqların, o cümlədən onların hüdudları daxilində yerləşən bütün komponentlərin koordinatları çöl-ölçmə işləri mütəxəssislər tərəfindən müasir cihazlarla təyin olunur. Ərazidə Global Positioning System (GPS) vasitəsilə çöl-ölçmə işlərini aparmaq üçün fasiləsiz fəaliyyət göstərən AzPOS stansiyalarına istinad edilir, naturada (yerdə) mövcud olan bütün növ daşınmaz əmlak obyektləri qeydiyyata alınır.

Çöl ölçmələri məlumatlarına əsasən ərazidə mövcud vəziyyətlə bağlı göstəricilər qeydiyyata alınır. Ərazilərdə vəziyyətə uyğun çatışmamazlıqlar aşkarlanır və onlara qarşı mübarizə tədbirləri nəzərdə tutulur. Hazırlanmış məlumatlar nəzərdə tutulan İƏD-ri üzrə tələb edilən islahat işlərinin həyata keçirilməsini və mülkiyyət növlərinin müəyyənləşdirilməsinə imkan verəcək

İşğal müddətində flora və faunaya, ümumilikdə torpaq fonduna dəymiş ziyan işğaldan əvvəlki illərə nəzərən müəyyyənləşdirilmiş işğalçı tərəfin beynəlxalq təşkilatlar qarşısında ödəyəcəyi kompensasiyanın miqdarı dəqiqləşdirilmişdir.

Aparılmış çöl ölçmələrinin və onlardan alınan informasiyaların təhlili Elektron Məlumat Bazasının (EHM tətbiqi ilə) formalaşmasını, VDTF-na həmin zona üzrə nəzarəti bərpa etməklə torpaqlardan təyinatı üzrə səmərəli istifadə edilməsini müəyyənləşdirir.

Açar sözlər: zəfər, yol-nəqliyyat infrastruktu, işğaldan azad olmuş ərazilər, ərazi bütövlüyünün bərpası, milli kimlik düşüncəsi

ƏDƏBİYYAT

1. Hacı Nərimanoğlu "Şərqi Zəngəzur". Bakı 2022
2. "İşgaldan azad edilmiş ərazilərdə iqtisadi inkişaf potensialının araşdırılması" Əsgərova Aynur. Bakı-2022
3. "Qarabag və Şərqi Zəngəzur iqtisadi rayonlarında post-konflikt quruculuğu"- R.Hüseynov, Y.Cəfərli, E.Zeynalova. Bakı-2022
4. Yunis Hüseynov "Qarabağ" Bakı 2018
5. "Azərbaycan Respublikasında iqtisadi rayonların yeni bölgüsü haqqında" Azərbaycan Respublikası Prezidentinin Fərmanı Bakı ş. 07 iyul 2021.

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CULTIVATING PROFESSIONAL COMPETENCIES IN ADVERTISING STUDENTS AMIDST DIGITAL TRANSFORMATION

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ABSTRACT

Objective: This article explores the impact of digital transformation on fostering professional competencies among advertising students, underscoring the integration of digital tools and artificial intelligence (AI) into educational practices. Focused on the current Ukrainian context, it investigates how educational technologies, including information and communication technologies (ICT), gaming, and practice-oriented approaches, are applied within a competency-based framework. The research highlights the necessity for both students and educators to access technical resources and develop digital skills to successfully incorporate innovative methods alongside traditional pedagogies.
Methods: Through a comprehensive methodology that combines literature review, analysis of educational practices, case studies, surveys, interviews, and comparative analysis, the study assesses the effectiveness of gamified learning and AI tools in improving educational outcomes for future professionals in advertising and public relations. It identifies the digital tools and AI as crucial for cultivating professional competencies amidst the ongoing digital shift. This includes an in-depth evaluation of modern digital technologies, gamification strategies, and AI's role in enhancing key professional attributes such as creativity, analytical prowess, innovation capacity, and adaptability to a fast-evolving media landscape.
Results: Findings reveal that the utilization of digital tools and AI not only aids in acquiring technical know-how but also enriches students' comprehension of the creative and strategic dimensions of advertising work. This dual approach effectively prepares students for the dynamic field of marketing communications. Although challenges related to accessibility and the development of digital skills persist, the advantages of digital transformation in promoting learning achievements and professional readiness are substantial.
Conclusion: Conclusively, the article advocates for an assertive integration of digital technologies and AI in advertising education, emphasizing ongoing educator professional development to adeptly manage digital pedagogy's intricacies. Contributing to the discourse on digital transformation in higher education, this research offers significant insights for educators, curriculum planners, and policymakers, aiming to synchronize advertising education with the digital age's requisites.
Keywords: digital technologies, advertising student competencies, educational technologies, online games, artificial intelligence.

Introduction

Contemporary education cannot be conceived without the quest for new teaching and learning approaches. The COVID-19 pandemic in Ukraine, followed by the ensuing war, catalyzed a transformative shift in the educational sector, promoting a transition from traditional face-to-face instruction to online learning modalities. This enforced gambit towards remote education became feasible thanks to the exponential growth of digital technologies.

The initiation of our research is tied to the recognition that, in today's era of societal informatization and the advancement of innovative information and communication technologies (ICT), educational technologies have emerged as one of the most potent tools for preparing specialists for the marketing communications market. These technologies are continually influenced by the gradual digital transformation. The trend towards digitization is expected to accompany education in the forthcoming years, increasingly intensifying virtual pedagogy and the exploration of active educational applications [1]. In this context, the application of digital tools to support more traditional educational processes through a competency-based approach in the training of advertising students is of current relevance.

The objective of this article is to explore the impact of digital transformation on the development of professional competencies among advertising students, focusing on the incorporation of contemporary digital tools and artificial intelligence into the educational process. This paper seeks to evaluate the potential and challenges of integrating cutting-edge technologies into teaching and learning, as well as to examine the effectiveness of using gamified learning formats and AI-based tools to enhance the quality of education for future professionals in advertising and public relations.

The research object is the educational process of advertising students in higher education institutions, particularly the use of digital tools and artificial intelligence as means to develop professional competencies in the context of digital transformation.

The subject of the research encompasses the methodologies and tools of digital transformation employed in the teaching process for preparing advertising students. This includes an analysis of modern digital technologies, gamified educational technologies, artificial intelligence, and their application for developing key professional skills such as creativity, analytical thinking, the capacity for innovation, and the ability to adapt to a rapidly changing media landscape.

The scientific novelty of this article lies in its comprehensive exploration of the integration and application of digital tools and artificial intelligence (AI) in the education of advertising and public relations students amidst the ongoing digital transformation. It provides a methodical analysis and classification of modern digital instruments, including AI-based software and online games, assessing their suitability and potential drawbacks for the specified educational program. This research pioneers in systematically examining the impact of these tools on enhancing professional competencies, creativity, and technical skills among future specialists. Further, the study introduces an innovative approach to teaching and learning by demonstrating how AI and digital technologies can be effectively used to consolidate theoretical knowledge through interactive and engaging means. It emphasizes the role of AI in automating routine tasks, thereby freeing students to focus on creative idea generation and strategic planning. The article also underscores the necessity for continuous professional development of educators to adapt to the rapid advancements in technology and integrate them into the curriculum. By highlighting the benefits and challenges of incorporating AI into the educational process, it opens new avenues for research on the balance between technological innovation and maintaining academic integrity and standards. In essence, this research contributes to the academic discourse by offering a novel

perspective on the pedagogical implications of digital transformation in the field of advertising and public relations education, providing a roadmap for future research and practical application in curriculum design.

Research Methodology.

The theoretical and methodological foundation of the study is grounded in the research of Ukrainian and foreign scholars on educational technologies and the competency-based approach to bachelor's preparation using innovative tools in teaching and learning. In the course of the research, various general scientific and specific methods of inquiry were employed: structural analysis and logical generalization for analyzing trends in the development and implementation of digital technologies in learning and teaching processes; classification-analytical method in the classification of software products, online games, and artificial intelligence tools designed for creating advertising materials and training skills in their development.

Theory and Calculation.

The extraordinary pace at which information spreads and the previously unattainable scales of information reach significantly enhance the possibilities and quality of teaching and learning. Scholars argue that contemporary education is undergoing a transformation as we stand on the threshold of a "digital technology culture" [2]. This necessitates a more thoughtful approach to the integration of digital tools, taking into account the specifics of their application for certain specialities in higher education institutions.

Both fields – digital technology and education – are highly dynamic and susceptible to change. Digital means have transcended their novelty status outside the traditional analog world and have permeated all aspects of life [3, 4]. Consequently, the relevance of traditional tools is steadily declining. The internet continues to evolve rapidly – futures lie in virtual and augmented realities. For instance, in Germany today, 47% of young people under the age of 25 prefer communicating in virtual spaces over the real world. The younger the individuals, the quicker and more readily they adopt new technologies. "Live" videos have long replaced pamphlets or letters [5]. A trend towards smartphone saturation is observed globally. The contemporary individual rarely parts with their smartphone, using it to perform numerous operations, saving time and not being confined to a specific place for information retrieval. People continue to read, but increasingly do so online via their devices. Mobile access facilitates almost continuous information search and serves as an essential communication channel. "Mobile blindness" describes the behavior of the modern individual. In Japan, they refer to the "Oyayubi sedai" or the "thumb generation" [6, p. 53]. With the introduction of the ChatGPT service in 2022, artificial intelligence has made significant inroads into many aspects of our lives. These trends have not gone unnoticed by the realms of science and education.

One of the key competencies of the "Advertising and Public Relations" educational program is the development of students' skills in applying information and communication technologies [7]. Recent research has extensively addressed the formation of this competence. The challenge of preparing specialists capable of meeting the demands of the current digital society has been analyzed by M.I. Pukalo [8]. Smart technologies and cloud computing for the training of future economists have been explored by T.V. Nalyvayko [9]. The peculiarities of preparing students for professional activity through distance educational technologies have been delineated in the dissertation by H.M. Aliyev [10]. The use of digital technologies to support learning processes has

been examined in numerous studies by Western researchers, such as the works of R. Lazarides, L. Seiler, M. Kuhnel, A. Honal, D. Ifenthaler [11, 12]. However, there is a scarcity of up-to-date research findings that reveal the extent to which digitization alters the competencies and abilities necessary for working in advertising and public relations, due to the rapid development of information technologies. The analysis of approaches to applying digital technologies in the professional training of future advertisers can be found in the works of researchers from the USA: G.A. Auger, M.A. Cho [13]; and from Austria and Germany: J. Bernhard, U. Russmann [14].

Digitalization permeates our world; yet, analog and digital means in education cannot be considered in isolation [3, 4]. Let's examine traditional educational technologies—systems of interaction between the educator and the student, whereby the latter develops certain competencies relevant for a competitive specialist in the field of marketing communications: information and communication technologies (ICT); gaming; practice-oriented technologies, and the nuances of their implementation amidst digitalization.

It is theoretically posited that the integration and successful application of cutting-edge technologies within more traditional teaching and learning processes primarily depend on access to hardware and software for participants in the educational process, as well as the digital skills of the educator themselves [15, 16].

Information and Communication Technologies (ICT) aims to develop students' ability to work with software products in professional activities. The digitization of advertising and public relations has created a demand for new skills regarding the use of specialized software. According to R.R. Golub, D.A. Gorbachova, and I.E. Shcherbakov, educational and training processes in advertising through information and communication technologies are nothing but processes of preparing and transmitting information, facilitated by computer equipment and technologies. This is essential for the future advertiser, whose competencies include the ability to use IT tools in advertising development [17].

Undoubtedly, the formation of such skills is impossible without specialized software [18]. The software that can be used in the educational process for the development of advertising materials is shown in Table 1:

Table 1. Software for the Development of Advertising Materials.

No	Software Name	Main Functions of the Product
1.	Adobe Creative Cloud	Graphic design, photo and video editing, web development.
2.	GIMP	Functions similar to Adobe Photoshop and partially Adobe Illustrator.
3.	Corel Draw	Vector graphics editor for creating illustrations, branding, photo editing, text formatting, and layout.
4.	Sketch	Vector graphics editor used for designing mobile app interfaces and websites.
5.	Inkscape	Vector graphics editor for creating artistic and technical illustrations.
6.	Vectr	Graphic editor for creating and editing vector graphics.
7.	Photo Pos Pro	Editor for photo retouching. Offers various effects and filters, cropping, colour correction, and layer work.
8.	Krita	Raster graphics editor for digital painting: illustrations, comics, animations, concept art, or storyboarding.
9.	Artweaver	Raster graphics editor with emulation of many artistic effects.

10.	Photoscape	Software for editing and formatting photographs taken with digital cameras or mobile phones.
11.	Gravit Designer	Cross-platform vector graphics editor with an online version that works in the browser.
12.	Infogram	Creation of presentations and infographics, data visualization through interactive marketing reports, sales data, real-time interactive maps. Visual effects for social networks.
13.	Vecteezy Editor	Creation of vector designs directly in the browser.
14.	Renderforest Graphic Maker	Tool for creating presentations, branding, mockups, print materials, SMM, and advertising creatives.
15.	Pixlr	Cloud suite of image editing tools, including several photo editors and a photo-sharing service.
16.	Canva	Online web service for graphic design creation.
17.	Prezi	Online editor for creating presentations.
18.	FIGMA	Web design software.
19.	Creately	Software for creating diagrams and flowcharts.

Modern digital tools, most suitable for the educational professional program "Advertising and Public Relations", have both advantages and disadvantages, and their use will depend on many factors. For example, most programs are paid, the availability of ready-made templates leads to uniformity of created materials, and some programs require considerable time for mastering and installation on computers.

One of the basic forms of activity in contextual learning is quasi-professional activity – game forms of organizing education. In the game, the subject, social, and psychological content of a specialist's professional activity is recreated – the context of professional activity. Traditional methods of game educational technologies are applied with the aim of developing practical skills and expanding theoretical knowledge through simulation modelling. Research shows that the perception of this technology by higher education students is positive and significantly effective in mastering disciplines [19].

Recently, digital games have become widely popular as an interactive, personalized, constantly updated learning tool and communication channel. They offer the opportunity to stimulate the search process for educational material within the game itself, as well as to link virtual spaces with the real world. Games can have levels, which require specially designed tasks to be completed for progression. They can be integrated with a website where additional information sources are available. Networked games with a group of participants allows them to interact with each other and engage in team play.

Interactive online games can be utilized for advertising students to master new tools, practice copywriting rules, design, and the development of core professional skills such as compositional construction, typography, and color work. This engaging and informative approach solidifies existing skills and facilitates the acquisition of new ones [20]. The functional purpose of games in education lies in providing information and organizing learning, taking into account the individual capabilities of each student. Multisensory elements in games, such as visual feedback, support the

assimilation of new knowledge and the memorization of material through the repetition of game actions.

Games used in the education of advertising students can be categorized into demonstrative and formative types. Demonstrative games can offer visual information and illustrate the processes involved in creating advertising and PR materials.

Furthermore, there are games designed to develop knowledge, skills, or competencies. These include computer simulators that mimic real processes and situations for the student, aiming to reinforce skills, and computer programs founded on gaming technology that manage the learning process to achieve educational goals

Particular attention, in terms of the possibility and appropriateness of use for advertising student education, is merited by online games, as listed in Table 2:

Table 2. Online Games for Consolidating Theoretical Material and Acquiring Professional Skills by Advertising Students.

No.	Game Name	Main Functions
1.	Brandseen (Identify the Brand)	Displays desaturated logos of famous brands, challenges players to recall their shade and match it on the color wheel.
2.	It's Centred That (Designer's Eye)	Trains visual estimation and quick identification of errors in element placement.
3.	The Bézier Game	Enhances skills in working with vector objects.
4.	Boolean Game	Introduces operations for quick creation and modification of 2D shapes in vector graphic editors.
5.	Type connection (Font Matchmaking)	Facilitates mastery of combining typefaces online, enhances knowledge of the history of typography and font creation, and practices English language skills.
6.	Typewar	A trainer for identifying fonts.
7.	I shot the serif	Trains the speed of font recognition.
8.	Kern Type	Helps acquire kerning skills to improve text readability or logo creation, also familiarizes students with information on typeface names, their creators, and the times of creation.
9.	Shape Type	Allows for the refinement of creating vector shapes and letterforms.
10.	Color	Aids in developing color perception: shades, saturation levels, as well as complementary, analogous, and triadic color combinations.

The interactive game Brandseen (Identify the Brand) is particularly beneficial for students studying advertising and PR. This game displays desaturated logos of well-known brands, challenging players to recall their hue and select the most appropriate color on the color wheel. The accuracy of each response is scored on a scale from 0 to 100, with the percentage of correct answers displayed at the end [21].

The game It's Centered That, or "Designer's Eye," is excellent for training visual judgment and helps quickly identify placement errors of elements. The student's task is to determine whether a point is located at the center of a shape. The game is challenging, as the points are often positioned very close to the center [22]. Through It's Centered That, students can in an engaging and exciting way:

- Test their understanding of design concepts;
- Deepen their knowledge of design fundamentals such as spacing, alignment, and color;
- Train their eyes to recognize subtle nuances in design;

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- Improve their ability to detect visual errors in design elements;
- Gain tips to quickly alter the overall appearance of a design and see it in different contexts.

The Bézier Game facilitates the refinement of skills in working with vector objects. It offers mastery of the "Pen" tool (fig. 1) for creating contours [23].

Figure 1: Contour Formation in The Bézier Game

The Boolean Game introduces operations designed for the rapid creation and modification of 2D shapes in vector graphic editors [24].

Typeconnection allows for the mastery of typeface pairing principles. Students can, in an online mode, pair the most harmonious fonts. This interactive trainer aids in developing a design sense, teaching the differentiation of similar text drawings, and recognizing differences. Additionally, it enhances knowledge in the history of typography and font creation [25].

Typewar is a font identification trainer. In each round, a letter appears on the screen, and the student must choose the correct font name from two options (fig. 2). Answering questions can lead to gaining or losing points, with the amount depending on how many players correctly answered the same question. Instant feedback, real-time statistics, and the discovery of lesser-known fonts make this an engaging and educational tool [26].

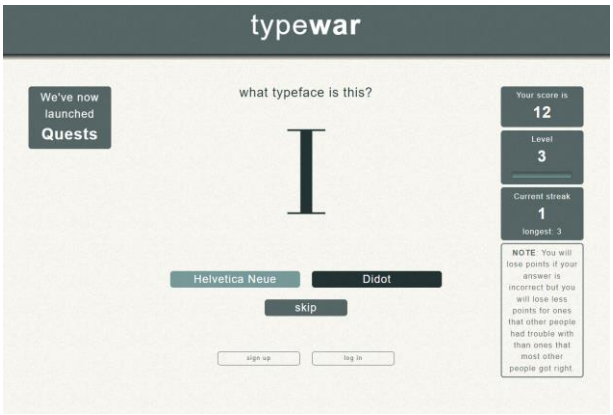

Figure 2: Font Identification in Typewar.

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The game I shot the serif tests how quickly a student can recognize fonts. Initially, two letters are displayed. The task is to "shoot" the letter with serifs by clicking on it before time runs out (fig. 3). As the game progresses, more letters appear simultaneously, making font recognition increasingly challenging [27].

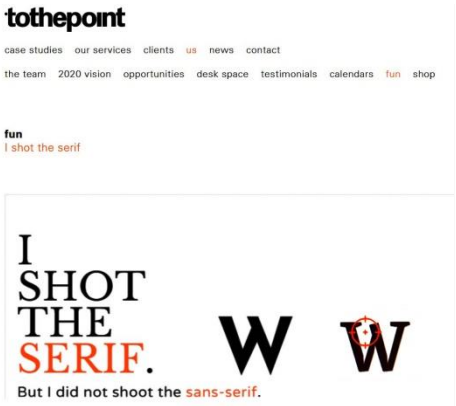

Figure 3: Font Recognition in the Game "I shot the serif".

The game Kern Type assists in acquiring skills in kerning (the spacing between two characters) as a method to improve text readability or logo creation (fig. 4). For each word, the student scores points, up to a maximum of 100. It's possible to switch between three views: the student's solution, optimal kerning, and their combination for comparison. Additionally, the student is introduced to information regarding the names of typefaces, their developers, and times of creation [28].

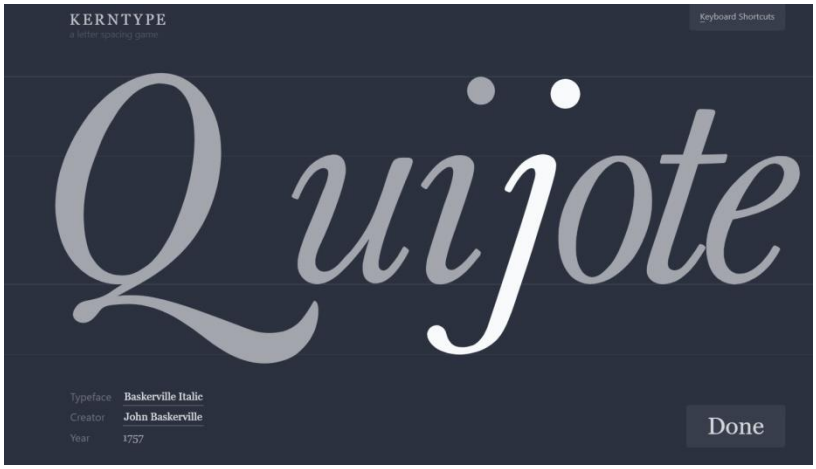

Figure 4: Working with Kerning in Kern Type

The game Shape Type allows for the correct shaping of letters by dragging various anchor points (fig. 5). Shape Type not only enables the refinement of skills in creating vector shapes, but it also offers an excellent way to closely examine the construction of different fonts [29].

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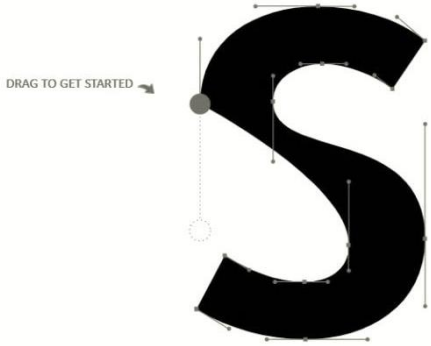

Figure 5: Letter Construction in Shape Type

The Color game is crucial for educating advertising students as it aids in developing color perception. Within a set time, participants need to identify shades and saturation levels, as well as complementary, analogous, and triadic color combinations. While the choice may seem simple initially, the colors gradually become more similar to each other. As a result, skills in discerning even the subtlest differences in the color palette are formed, aiding in the creation of more thoughtful designs. An interactive color wheel is displayed on the screen, with a specific color or colors positioned at its center (fig. 6). The task is to determine the color within 10 seconds. The challenge intensifies when required to select shades for different color schemes [30].

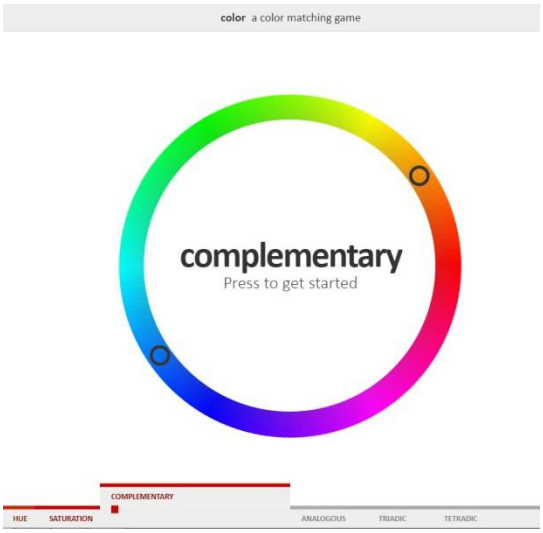

Figure 6: Forming Color Schemes in the Color Game.

Online games offer an opportunity to reinforce theoretical material through visual animations. They develop compositional thinking through interactive trainers, building knowledge and skills regarding the nuances of color design in publications. Practicing font application rules helps establish a visual hierarchy, ensure text readability, and better convey its content through imagery,

appropriateness, and harmony in typeface combination. Understanding fundamental design principles can aid students in creating projects while avoiding common mistakes, and develop their imagination, artistic, and technical abilities.

With each passing year, artificial intelligence (AI) plays an increasingly significant role in human life. Initially, there was a notion to ban the use of this technology in education, but attitudes have since shifted towards welcoming AI's application in educational contexts. For example, a survey conducted among Stanford University students in January 2023 revealed that nearly 20% of students had already used ChatGPT to assist with homework, exams, and educational projects [31, 32].

According to O. Pasichnyk, finding a balance between educational needs and the tools to meet them, between innovation and tradition, and technological solutions and their application context is essential [33]. O. Sodel believes that educators and educational institutions must embrace this technology and find ways to integrate it into their teaching methods while maintaining academic standards and ensuring academic integrity. With careful control and proper management, artificial intelligence (AI) tools can be powerful for both students and teachers [34].

We agree that the use of artificial intelligence in education presents both challenges and opportunities. In our view, students should be prepared for work in the advertising sector, where many functions are already performed by artificial intelligence. It cannot be ignored or banned. Below are opportunities for applying artificial intelligence technologies to facilitate and improve the process of developing advertising material layouts, and its use in the initial training process of advertisers:

- Best Practices Analysis. Machine learning algorithms allow students to analyze advertisements.
- Idea Generation for Advertisements. Based on the analysis of potential audience preferences and behaviors. AI can analyze data on search queries, interests, and social media activities to suggest new approaches to add creation.
- Personalization. AI can create personalized images for each user based on their online behavior, gender, age, purchase history, and other data.
- Ensuring Advertisements or Corporate Identity Meet Latest Global Trends.
- Ad Creation and Automatic Design. Students can create advertisements using deep learning algorithms that optimize ad appeals for the best outcome regarding optimal color balance, balanced composition, readable fonts, and other design elements.
- Analysis of the Compositional Organization of Advertisements. AI can improve design quality, identify weaknesses, e.g., object placement – following the law of subordination, using color, and choosing attributes for text to determine which elements harmoniously complement each other and create a cohesive composition, and which could be improved or replaced.
- Color Scheme Selection. The complex work of forming a color palette requires a lot of time. AI can suggest the best color combinations in advertising based on various parameters such as theme, mood, and associations.
- Font Recognition. Students can use AI to recognize fonts in images and find alternatives, helping them choose the most appropriate typeface for their design.
- Creating Images for Advertising with Generative Adversarial Networks (GANs) and other machine learning technologies. Generative adversarial networks, introduced by Ian

Goodfellow in 2014, are a class of AI algorithms used in unsupervised learning. This technique allows the creation of photographs that, at a glance, appear real and contain many realistic elements [35].

- Image Optimization. AI can optimize images for different platforms and devices to ensure they look as effective as possible. For example, determining the optimal size and format of an image for each social network, website, or advertising channel.

For instance, AI-based tools applicable in advertising development [36] are outlined in Table 3:

Table 3. AI-Based Tools for Developing Advertising Materials.

No.	Tool	Main Functions
1.	Uizard	Generates design mockups from text prompts, converts hand-drawn sketches to digital wireframes, and creates editable project screenshots.
2.	Midjourney	Creates images from textual descriptions.
3.	Fontjoy	A web tool for generating font combinations using deep learning systems.
4.	Copy.ai	Content generator for creating text, product descriptions for online stores, digital ads, emails, SMM, and blog content.
5.	Khroma	Website for creating color combinations.

Let's delve deeper into the AI-based tools listed in Table 3.

Uizard is a free alternative to Figma, designed with speed, ease of use, and customization in mind. Utilizing machine vision and learning, it scans sketches and automatically converts hand-drawn images into digital screens and components. Uizard enables the creation of websites and software interfaces without special training, making it an ideal tool for advertising students unfamiliar with design. Its AI development assistant offers a user-friendly interface, collaborative capabilities, and the ability to quickly transform sketches into wireframes, generate ideas and text, and import themes from other websites. Uizard works on all platforms and operating systems: Windows, Linux, Chrome, and Mac, without the need for software or plugin installation. It provides students with 10 templates and allows the creation of three projects for free, offering 100 frame scans per month, conversion of screenshot images into editable UI designs, theme creation from images, URLs, and Sketch files, and a text assistant. This enables students, especially those new to advertising design, to perform basic tasks and automate the implementation of their ideas [36].

Midjourney is AI software that creates images based on textual descriptions using generative adversarial network technology. Users generate images by sending commands to a bot in the Discord messenger: entering a message with a verbal description of the desired image, then choosing the best out of four images generated by the program [37]. Midjourney is used in professional settings; for example, the British magazine The Economist used Midjourney to create its cover for the June 2022 issue.

Font joy is a web tool that generates font combinations. Choosing harmonious fonts is crucial, for instance, in creating brand graphics or formatting headlines and main text in advertising publications. Developers seek fonts that share common characteristics and sufficient contrast to avoid visual conflict. Fontjoy uses deep learning technology to create such pairs, taking into account many specified font characteristics (fig. 7). Students are presented with a map showing typefaces from which they can select several for further design work [11].

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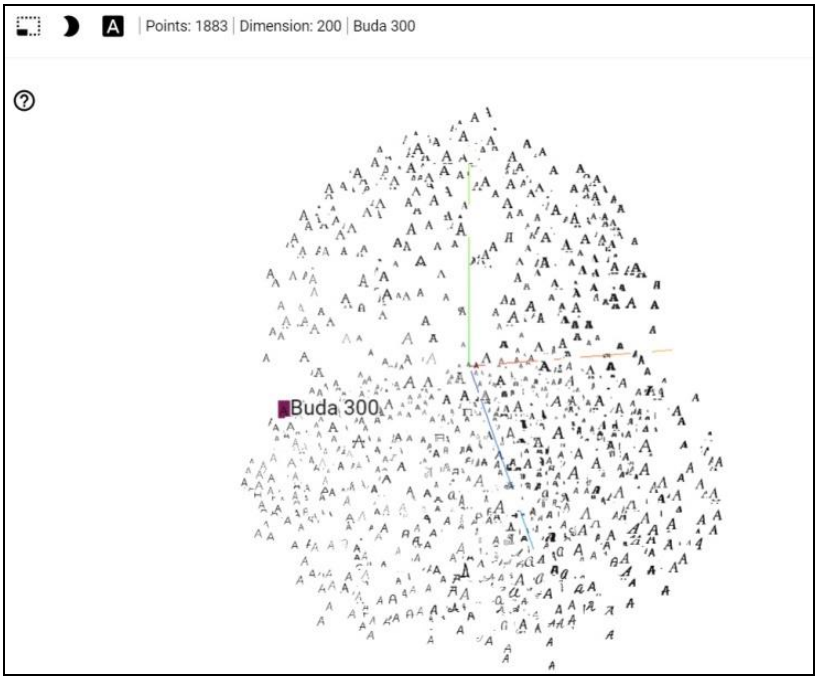

Figure 7: Selecting Font Combinations in Fontjoy.

Copy.ai is a content generator that aids in creating texts, product descriptions for online stores, digital advertisements, emails, SMM, blog content, headlines, and much more using artificial intelligence for subsequent publication on social media and websites. Users simply enter a brand or product name and a brief description. To start with Copy.ai, a project template is created, where the final publication source, theme features, product details, and other parameters are selected. The service offers ready-made templates that help the AI create content relevant to the theme. Copy.ai generates texts within seconds, offering several options. These can be saved, copied, edited, or more variations can be requested. The service produces content in 25 languages.
Khroma is a free website for creating color combinations. AI identifies the user's preferred colors and then generates many palettes based on the gathered data for further use in corporate identity design and advertising publications.
Artificial Intelligence (AI)-based functions simplify complex design tasks, enabling students to create professional-quality advertisements. Integrating AI into advertising design offers several advantages, including significantly reduced development time, as AI can quickly generate composition elements and layouts based on user input. It also facilitates collaboration between teams. Artificial Intelligence can provide suggestions for advertising idea development using information from vast datasets that humans cannot process quickly. Moreover, AI automates repetitive tasks, allowing focus on more creative and strategic aspects of advertising work.
AI can also streamline the teaching process in terms of data search, processing, and basic analysis. This opens new creativity horizons for educators in lesson preparation, as AI already knows how to generate and visualize specific queries. The importance of this new direction in education is highlighted by the fact that the global integration of AI into the educational process in Ukraine is

currently discussed at expert conferences, roundtables, and informational campaigns by the Ministry of Education and Science and other government institutions [31].

Overall, the development of AI systems in education and their global implications are distinguished by preparing for socio-economic changes through promoting the modernization of education and training systems, supporting talents, diversity, and interdisciplinary.

Practice-oriented educational technology involves students performing practical tasks. This is an educational-professional activity where the student functions as a specialist: industrial practice, participation in creative expeditions and competitions, conferences, and forming an author's portfolio. At this stage, educational activity is transformed into professional activity [17].

Knowledge gained through interdisciplinary integration from a range of subjects such as "Marketing Communications", "Advertising", "Mass Communications", "Design in Advertising", "Computer Graphics in Advertising", "Layout in Advertising", "Advertising Technologies", etc., is poised for experimental and creative breakthroughs. Participation in advertising contests and festivals allows for self-expression, portfolio enhancement, and the collection of diplomas and awards, while providing educators with opportunities to adjust course programs based on competition outcomes.

Students undertake numerous educational projects utilizing specialized software. For instance, in the process of working on a project to develop a corporate identity for a company, students are required to complete the following tasks:

- Conduct an analysis of the company name using an online phonosemantic word analysis service.
- Justify the concept and create elements of the corporate identity using CorelDraw or Adobe Illustrator.
- Develop a corporate identity standards manual in the publishing system Adobe InDesign.
- Design advertisements using elements of the corporate identity in the graphic editor Adobe Photoshop.
- Prepare an electronic presentation in MS PowerPoint or Canva – an online application for graphic design and presentations.

The best projects participate in creative competitions, significantly emphasizing this educational technology. It allows future specialists to apply theoretical knowledge, methodology, and develop practical skills [16, p. 29]. Showcasing developed projects at exhibitions, contests, and festivals is a primary evaluation criterion. For instance, in 2020-2021, students from DTEU won 55 awards in various creative competitions. Despite the war in Ukraine, dozens of students participated and won prizes in student competitions both in Ukraine and abroad during 2022 and 2023.

Another key issue is the professional-pedagogical qualification of teachers, who are advocates of innovative knowledge. The modern educational process encompasses many innovations: artificial intelligence, flexibility of educational offerings, digitization of the educational environment, and transformation of the teacher's role. According to Ya. Lisun, social transformations and new university requirements for teaching indicate new learning methods where accessibility, flexibility, and mediation of learning in virtual and hybrid environments are priorities. There is a need for virtual and hybrid models, combining face-to-face and virtual sessions, utilizing electronic and blended learning systems (b-learning). Digitization and the COVID-19 pandemic have changed the requirements for not only student but also teacher training programs. Ideally, teachers who exhibit leadership qualities are needed. This involves a lot of creativity and innovation to continuously implement new ideas and creatively develop various ways of

accessing knowledge. This underscores the necessity for quality teacher training, including participation in various professional community events: conferences, roundtables, marketing and advertising festivals, workshops, internships in advertising agencies and other universities, international academic mobility as a component of European integration, various professional development courses, and most importantly – continuous self-education.

Ukrainian science and education are significantly focused on improving the training and qualifications of pedagogical staff, for instance, through the incorporation of digital technologies with AI elements into the educational environment. With the support of the Ministry of Education and Science (MoES) and the Institute for the Modernization of the Content of Education, the Association for Innovative and Digital Education and UBOS.tech company organized an advanced training course for educators titled "Artificial Intelligence in Education". Prometheus, in collaboration with Microsoft, offered a free course "Getting Started with ChatGPT" [32].

In the academic sphere, significant emphasis is placed on the development and implementation of technologies for managing information hygiene. In this context, it is imperative to cultivate in students not only the technical skills to work with advanced digital tools but also an understanding of their role in societal processes. Educational programs for future advertisers should encompass the study of information hygiene, ethics in digital advertising, and the critical analysis of media content. This holistic approach ensures that students are well-equipped to navigate and contribute positively to the digital landscape, particularly in the realms of marketing and advertising, where ethical considerations and the ability to critically assess information are paramount.

It is imperative to acknowledge that in the context of global urbanization and digitalization, social life, particularly in urban environments, is being enriched with new social forms and challenges for preserving identity. The training of advertising students necessitates a focus on understanding urban changes and the development of adaptive digital advertising strategies. Educational programs should cultivate critical thinking and the capacity for innovation in advertising among students, considering the dynamics and complexity of contemporary urban processes. This approach ensures that future professionals are adequately prepared to navigate and effectively respond to the evolving landscape of urban life and digital integration, thereby contributing meaningfully to the discourse on identity and social cohesion in the digital age.

In the context of digital transformation and the use of innovative advertising tools, social networks represent key platforms for brand communication with their audience. Social networks, with their advantages of multimedia, interactivity, and accessible analytics, become an integral tool in advertising strategy. Training should encompass the development of visually appealing and targeted content, considering the significance of visual perception on platforms like Facebook and Instagram. Students must learn to create content that not only enhances brand recognition but also fosters active engagement with the audience. Preparing future specialists involves not only the technical mastery of social media tools but also the formation of a deep understanding of the dynamics of digital communication and its impact on consumer behavior. This approach ensures that advertising students are equipped to navigate and leverage the complexities of social media in crafting effective and resonant advertising campaigns.

In conditions where remote learning has become the new standard due to the pandemic and the subsequent full-scale war in Ukraine, universities are tasked with adapting the educational process to the changing circumstances. This is particularly pertinent in the training of specialists in the field of advertising, where a proficient approach to the use of new digital tools is essential. Stress and procrastination during remote learning can significantly impede this process, highlighting the

need for effective teaching methods. Adapting to new digital technologies and tools becomes a key aspect of preparing advertisers. In this context, gamification and the use of interactive digital platforms can contribute to increasing student motivation, reducing stress levels, and combating procrastination. Teachers and educational institutions must not only provide access to modern advertising tools but also support their mastery, helping students adapt to the rapidly changing market demands. In times of war, it is particularly important for universities to offer students not just material, but also psychological support, easing the transition to new learning formats. Thus, it is crucial for universities to adopt a comprehensive approach to teaching, combining theoretical knowledge with practical digital skills. Preparing advertisers to use new digital tools amidst digital transformation and social challenges should be a priority for educational programs aimed at producing competitive specialists in the advertising industry.

Conclusions

This research initiative is driven by the development of digital technologies that are actively integrated into educational processes, optimizing them, including in the formation of professional competencies for students – future marketing communication specialists.

The successful use of cutting-edge technologies in teaching and learning processes primarily depends on the ability of all participants in educational communication to access technological equipment and the digital skills of the educator themselves.

The educational technologies we have examined – systems of interaction between the educator and the student, in which the latter develops specific competencies relevant to a competitive specialist in the field of marketing communications, namely: information and communication technologies (ICT); gaming; practice-oriented, are gradually transforming under the influence of technical innovations. Modern education must integrate new achievements into its teaching methods, while maintaining academic standards and ensuring academic integrity.

Our study can serve as a foundation for further analysis aimed at identifying, classifying, and applying modern digital tools most suitable for the educational professional program "Advertising and Public Relations," many of which have both advantages and disadvantages. Their use will depend on numerous factors, such as the majority of programs being paid, the presence of ready-made templates leading to uniformity in created materials, and some programs requiring significant time to master and install on computers.

Online games offer the opportunity to consolidate theoretical material in vivid, animated forms. Understanding and assimilating the fundamental principles of advertising through gaming can help students create projects while avoiding common mistakes, and develop imagination, artistic, and technical skills.

AI-based tools can simplify the process of creating advertising materials, assisting future advertisers and PR specialists in exploring and utilizing rapidly evolving information technologies. This liberates time for generating creative ideas by eliminating the performance of routine operations.

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The development and implementation of cutting-edge tools in the educational process necessitate the continuous professional development of educators. In conclusion, the journey towards cultivating professional competencies in advertising students within the digital transformation framework is both challenging and rewarding. It calls for an educational ethos that is adaptive, innovative, and supportive, fostering a learning environment where students can thrive both technically and creatively. As we advance, the prioritization of digital competencies, coupled with a commitment to holistic development, will be instrumental in shaping advertising professionals who are not only adept at navigating the digital sphere but are also ethically grounded and critically engaged, ready to meet the demands of the advertising industry in the digital age.

Adapting the outcomes of this research in teaching and learning will help ensure a highly relevant education by implementing a competency-based approach in the training of advertising students.Adapting the outcomes of this research in teaching and learning will help ensure a highly relevant education by implementing a competency-based approach in the training of advertising students.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

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Conflict of Interest.
The authors declare that there are no conflicts of interest regarding the publication of this paper.

Ethical Approval.
In the preparation of this article, strict adherence to all academic, methodological, and ethical standards required for publication was maintained. The authors ensured that the material presented is original, all sources used are properly cited and listed in the bibliography, and the data and findings of the research are presented honestly without any false or deliberate distortion. The study was conducted in compliance with the principles of academic integrity, including honesty, transparency, and responsibility. All participants in the study were informed about its goals and provided their consent where applicable. There was no conflict of interest in the writing of this article. This article is the result of the collective efforts of the authors, each of whom has made a significant contribution to the research and the writing of the article and has agreed to the final version submitted for publication.

REFERENCES

1. M. S. Ramírez-Montoya, L. Andrade-Vargas, D. Rivera, and M. Portuguez Castro, "Trends for the Future of Education Programs for Professional Development," Sustainability, vol. 13, p. 7244, Apr. 2021, Accessed on 2 Mar. 2024. [Online]. Available: https://doi.org/10.3390/su13137244
2. F. Stalder, Culture of Digitality, Feb. 2024, p. 200.
3. M. Kerres, "Education in the Digital World: We Have a Choice," Education in the Digital World: We Have a Choice, denk-doch-mal.de, Online Magazine for Work-Education-Society, issue 02-18 (Professional) Learning in Digital Environments, 2018. Accessed on 2 Mar. 2024. [Online]. Available: https://learninglab.uni-due.de/sites/ default/ files/Kerres_denk-doch-mal.pdf
4. M. Kerres, "Education in the Digital World: (How) Can Digital Competence be Imparted?" in Learning in and for the School in the Age of Digitality – Opportunities and Challenges for Teachers, Teaching, and Learners, N. McElvany, R. Lorenz, M. Becker, H. Gaspard, and F. Lauermann, Eds., vol. 6, Münster: Waxmann Verlag, 2023. Accessed on 2 Mar. 2024. [Online]. Available: https://learninglab.uni-due.de/sites/default/files/DigitaleKompetenz-Kerres-final.pdf
5. B. Mersch, "New Technologies Will Change Learning," Goethe-Institut e.V., Editorial Magazine Language, Feb. 2018. Accessed on 2 Mar. 2024. [Online]. Available: https://www.goethe.de/ins/ru/de/spr/mag/21183184.html

6. Michael and B. Salter, Mobile Marketing: Creating Competitive Advantage through Wireless Technology, translated by O. B. Dutova, Moscow: LLC "Group IDT", 2007, p. 400, ill. Additional title page in English, p. 53.
7. H. Aldankova and T. Bozhko, "Generation of Professional Competencies of Advertisers," Foreign Trade: Economics, Finance, Law, vol. 2022, no. 6, pp. 125-134, Series. Economic Sciences, 2022. Accessed on 2 Mar. 2024. [Online]. Available: https://doi.org/10.31617/3.2022(125)08
8. M. I. Pukalo, "Formation of Professional Competence of Future Specialists in the Automotive Profile by Means of Information Technologies," Ph.D. dissertation, 015 Professional Education (by specialisations) 01 "Education / Pedagogy", National University "Lviv Polytechnic", Lviv, 2020, p. 272. Accessed on 2 Mar. 2024. [Online]. Available:https://lpnu.ua/sites/default/files/2020/radaphd/1839/ dysertaciy apukalom ariyiigorivny.pdf
9. T. V. Nalyvaiko, "Formation of Professional Competence of Future Economists by Means of Innovative Technologies in the Process of Professional Training," Abstract of Cand. Sc. (Pedagogy) Dissertation, 13.00.04 "Theory and Methods of Professional Education", 01 "Education / Pedagogy", State Institution of Higher Education "Pereiaslav-Khmelnytskyi State Pedagogical University named after Hryhorii Skovoroda", Pereiaslav-Khmelnytskyi, 2019, p. 21. Accessed on 2 Mar. 2024. [Online]. Available: http://ephsheir.uhsp.edu.ua/handle/8989898989/3801
10. H. M. Aliev, "Preparation of students at pedagogical universities for professional activity using distance educational technologies," Abstract of the dissertation for the scientific degree of Candidate of Pedagogical Sciences: Speciality 13.00.04 - Theory and Methods of Professional Education, 015 - Professional Education, Ministry of Education and Science of Ukraine, H. S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, 2018, p. 20. Accessed on 2 Mar. 2024. [Online]. Available: https://dspace.hnpu.edu.ua/handle/123456789/1938?mode=full
11. D. Fayvishenko,O. Mitchuk, I. Lorvi, M. Konopliannykova, S. Chernobrovkina and O. Sytnyk/ Communication Strategies of Brand Management and Online Marketing of Digital Products // Economic Affairs, Vol. 68, No. 01s, pp. 289-298, February 2023 https://economicaffairs.co.in/Journal/lastissue/year/MjAyMw==/month/RmVicnVhcnk= http://ndpublisher.in/admin/issues/EAv68n1sz12.pdf (Scopus)
12. R. Lazarides, "Quality Instruction with Digital Technologies: Challenges and Opportunities in Implementing Digital Technologies in Teaching and Learning Settings," in Media in Science, vol. 78, 2021. Accessed on 2 Mar. 2024. [Online]. Available: https://www.waxmann.com/index.php?eID=download&buchnr=4456
13. L. Seiler, M. Kuhnel, A. Honal, and D. Ifenthaler, "Mobile Learning Analytics: Potential for Learning and Teaching at the University Level," in C. de Witt & C. Gloerfeld (Eds.), Handbook of Mobile Learning, pp. 585–608, Wiesbaden: Springer VS, 2018. Accessed on 2 Mar. 2024. [Online]. Available: https://link.springer.com/ chapter/10.1007/978-3-658-19123-8_29
14. G. A. Auger and M. A. Cho, "A comprehensive analysis of Public Relations curricula: does it matter where you go to school, and is academia meeting the needs of the practice?" Journalism & Mass Communication Educator, vol. 71, no. 1, 2016. Accessed on 2 Mar. 2024. [Online]. Available: https://journals.sagepub.com/ doi/10.1177/1077695814551830

15. J. Bernhard and U. Russmann, "Digitalization in Public Relations – changing competences: a longitudinal analysis of skills required in PR job ads," 2023. Accessed on 2 Mar. 2024. [Online]. Available: https://www.sciencedirect.com/ science/ article/abs/pii/S0363811122001382?dgcid=rss_sd_all
16. G. Knezek and R. Christensen, "Extending the will, skills, tools model of technology integration: Adding pedagogy as a new model construct," Journal of Computing in Higher Education, vol. 28, pp. 307–325, Dec. 2016. Accessed on 2 Mar. 2024. [Online]. Available: https://doi.org/10.1007/s12528-016-9120-2
17. K. Drossel, B. Eickelmann, and J. Gerick, "Predictors of teachers' use of ICT in school – the relevance of school characteristics, teachers' attitudes and teacher collaboration," Education and Information Technologies, vol. 22, no. 2, pp. 551–573, Mar. 2017. Accessed on 2 Mar. 2024. [Online]. Available: https://doi.org/10.1007/s10639-016-9476-y
18. R. R. Golub, D. A. Gorbacheva, and I. E. Shcherbakov, "Preparation of specialists in the field of advertising: an overview of educational technologies and competencies being formed," World of Science, Culture, Education, no. 2 (87), pp. 27-29, 2021. Accessed on 2 Mar. 2024. [Online]. Available: https://cyberleninka.ru/article/n/ podgotovkaspetsialistov-sfery-reklamy-obzor-obrazovatelnyh-tehnologiy-i-formiruemyh-kompetentsiy
19. "23 Programs for Graphic Design," Accessed on 2 Mar. 2024. [Online]. Available: https://media.contented.ru/znaniya/instrumenty/top-14-programm-dlya-graficheskogo-dizajna/
20. A.A.Verbitsky and N. P. Khomyakova, "Principles of Contextual Learning in Foreign Language Training of Lawyers," Higher Education Today, no. 2, pp. 37–41, 2010. Accessed on 2 Mar. 2024. [Online]. Available: https://journals. indexcopernicus.com/api/file/viewByFileId/242086.pdf
"Honing Our Skills: 10 Exciting Online Games for Designers," Accessed on 2 Mar. 2024. [Online]. Available: https://www.uprock.ru/articles/ottachivaem-svoi-navyki-10-uvlekatelnyh-onlayn-igr-dlya-dizaynerov
21. Brandseen, Accessed on 2 Mar. 2024. [Online]. Available: http://brandseenapp.com/
22. It's Centred That, Accessed on 2 Mar. 2024. [Online]. Available: https://www.supremo.co.uk/designers-eye/
23. The Bézier Game, Accessed on 2 Mar. 2024. [Online]. Available: https://bezier.method.ac/
24. Boolean Game, Accessed on 2 Mar. 2024. [Online]. Available: https://type.method.ac/
25. P. Taranat, "Type Connection: Educational Games Critique," Medium, Mar. 2023. Accessed on 2 Mar. 2024. [Online]. Available: https://proudtaranat.medium.com/type-connection-educational-games-critique-6637b9d56455.
26. Typewar, Accessed on 2 Mar. 2024. [Online]. Available: https:pewar.com/
27. I shot the serif, Accessed on 2 Mar. 2024. [Online]. Available: https://www.tothepoint.co.uk/us/fun/i-shot-the-serif/
28. Kern Type, Accessed on 2 Mar. 2024. [Online]. Available: https://type.method.ac/
29. Shape Type, Accessed on 2 Mar. 2024. [Online]. Available: https://shape.method.ac/
30. Color, Accessed on 2 Mar. 2024. [Online]. Available: https://color.method.ac/
31. V. Pokatilova, "Artificial Intelligence in Education: How Technology Affects Learning in Ukrainian Schools," Accessed on 2 Mar. 2024. [Online]. Available:

https://fakty.com.ua/ua/ukraine/suspilstvo/20231220-shtuchnyj-intelekt-v-osviti-yak-tehnologiya-vplyvaye-na-navchannya-v-ukrayinskyh-shkolah/
32. I. Prymachenko, "Artificial Intelligence in Education: Opportunities, Challenges, and the First Steps of Major Adaptation," Ukrainian Truth, Aug. 2023. Accessed on 2 Mar. 2024. [Online]. Available: https://life.pravda.com.ua/columns/2023/08/4/255650/
33. O. Pasichnyk, "Artificial Intelligence in Education: Three Aspects," Accessed on 2 Mar. 2024. [Online]. Available: https://osvita.ua/school/method/91077/
34. O. Sodel, "The Potential of AI in Higher Education," Apr. 2023. Accessed on 2 Mar. 2024. [Online]. Available: https://nubip.edu.ua/node/126807
35. I. Goodfellow, J. Pouget-Abadie, M. Mirza, Xu Bing, D. Warde-Farley, Sh. Ozair, A. Courville, and J. Bengio, "Generative Adversarial Networks," arXiv, Jun. 2014. Accessed on 2 Mar. 2024. [Online]. Available: https://arxiv.org/pdf/1406.2661.pdf
36. Uizard, Accessed on 2 Mar. 2024. [Online]. Available: https://uizard.io/
37. Midjourney, Accessed on 2 Mar. 2024. [Online]. Available: https://docs.midjourney.com/

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GLOBALIZATION PROS AND CONS OF MODERN MIGRATION RIGHTS PROCESSES AS A SOCIO-PHILOSOPHICAL ASPECT

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ABSTRACT

The article examines the pros and cons of globalization of modern migration and legal processes from a socio-philosophical perspective. It is well known that the history of mass migration dates to ancient times. Philosophical, legal, and political studies have already addressed the problems of numerous waves of migration in societies. Social science concepts help to explore the causes and consequences of migration in global society. Methods of social allows research to allow us to study the causes and consequences, political and legal aspects of contemporary global issues that we face in the academic sphere.

I consider the topic, based on research approaches, as a process of modernity and in connection with multicultural synthesis. The work has managed to conceptualize aspects of describing migration processes, which makes it possible to systematize them in terms of socialization and the transition of society from traditional to modern in times of conflict and war, as well as the peculiarities of social transformations in times of social upheaval. Aspects of migration in the globalized world are related to acculturation and assimilation, which are problems of modern societies where migrants can preserve their religious and cultural identity.

Keywords: globalization processes, convergence, evolution of civilization, migration, multiculturalism, modern societies.

Objective

the article examines the problem of modern migration in the global world, which is an objective aspect of social, cultural, philosophical, economic, and political life. The focus is on the causes of migration and methods of solving acculturation problems in a globalized world. The research is based on methodology, social surveys, conclusions of classic and modern authors of a similar problem. Recognizing that we are studying the experience of countries with a traditional influx of migrants and how the country deals with these issues at the state and socio-cultural level. Focusing on the processes of globalization now sweeping Europe, the southern United States, and other regions of the planet contributes to the debate about how countries should absorb or reduce the flow of immigrants into countries. I relate questions about the causes of migration to aspects of contemporary culture, politics, sociology, religion, which are conceptualized as capable of shaping global responses and remaining important players along the way.

Methods

The work is based on the method classical evolutionism proposed by G. Spencer sample of the British school of sociology and philosophy of religion; the representative French sociological school E. Ethis, where culture is the central meaning of modern politics; Théofil I. Kis and E. Martyniuk analyzes convergent processes in socio-religious life, to study multi-confessionalism in society. D. Soros, S. Huntington, Z. Brzezinski paid attention to the study of this problem in the

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USA as lawyers and politicians. M. Herskovits, R. Lintonu, J. Powell, R. Redfield – studied acculturation processes. On the base given the results of sociological surveys modern societies and I would like to reflect on

a) the societies evolution – from homogeneity to diversity;
b) consolidation and differentiation;
c) culture and socio-geographical features;
d) convergent processes of modern society.

Results

The modern world is facing many long-term problems of humanity, among which are wars, transformations of societies, legal foundations of society, political relations, and changes in cultural and religious foundations. Globalization processes in the world play a special role in almost all modern processes taking place today. As a result, the phenomenon of mass migration in Eastern Europe, the United States, and the Middle East has once again become one of the most pressing and historically determined issues. The global world only confirms its forms of existence, which is emphasized by cultural, religious, and socio-political discourse.

The article is based on the study of the aspects of "globalization", which appeared as a concept in the 60s of the XX century and was initially used in economics as a process of transcending state borders, forming a single market and economic zone. Today, globalization is seen as a multidimensional process that includes the heterogeneity of interstate economic, political, social and cultural ties, the transformation of the world economy, the spread of democratic values, their convergence and divergence.

Some of the first researchers and founders of globalism are considered to be: Karl Popper [Popper], Jacques Attali [Attali], Immanuel Wallerstein [Wallerstein], Francis Fukuyama [Fukuyama], Alvin Toffler [Toffler], Zbigniew Brzezinski [Brzezinski], Samuel Huntington [Huntington] and others who laid the foundations of the modern social theory of globalization as a form of political, economic, cultural and religious phenomena that transcends the borders of a single country.

The various aspects of globalization that resulted from this process manifested themselves in the diversity of social, cultural, and political life in countries. These aspects have subsequently become the objects of modern scientific research.

In the context of our research, we must define the optimal forms and ways, aspects of freedoms, security of the citizen and the process of globalization of legal concepts in the world, in the context of integration and secularization, which allows for a reasonable combination of national and international interests.

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From my point of view, it is necessary to outline a system for describing migration processes in the era of globalization, which I managed to conceptualize while writing this paper. Migrations are divided into:

- cultural – the principles of which outline the types and forms of cultures of societies in the process of acculturation of ethnic groups;

- Integration – where the phenomenon of multiculturalism is understood as the integration of migrants into the host society;
- demographic – description of differences in demography, national communities under the influence of endogenous and exogenous immigration;
- ideological – concepts of national ideologies;
- political — application of the principles of multiculturalism as a political programme aimed at systematizing relations between the state and the minority groups that make up the state;
- legal — to regulate relations in social minorities.

This analytical perspective invites consideration of several aspects of migration processes in global society, leading to informed conclusions. Faced with this challenge, I show how to do so by examining the processes and foundations of migration processes in today's globalized society.

The doctrinal foundations of modern multicultural processes allow us to characterize the processes of migrants' adjustment to new societies. It is well known that the phenomenon of acculturation in society is the mutual influence of cultures (heterogeneous). Assimilation, on the other hand, is a process that leads to the disappearance of cultures through absorption by another culture. At the same time, acculturation occurs at the level of social groups and can lead to both enrichment and erasure of cultures. The phenomena of global migration also affect the processes of inculturation, which take place individually and become the subject of convergence or divergence in societies.

Legal globalization, including the observance of legal norms on freedom of religion in the country receiving migrants, implies the formation of a modern system of legal regulation of social life.

In this context, questions arise about freedom and human rights in a global society. Issues related to the new challenges of the twenty-first century: terrorism and wars, hybrid, and environmental threats, etc. At the same time, the role of the state in guaranteeing the rights of citizens in society remains open.

Here is an opinion on societies after the second half of the twentieth century. Immanuel Wallerstein tries to explain what to do when economic interests prevail over ideological ones: that the current world system is entering a period of transition, that the privileged people who run it are not ready to give up their positions, and that the rulers are not united around a common project to start a "war" for succession. [Wallerstein 3]; [Paquot]

One of the problems of our time, according to Balibar Étienne and Wallerstein Immanuel, is why racism is growing in the world after the defeat of Nazism, and after decolonization and the recognition of the civil rights of African Americans? Scholars come to the idea that this is the basis of social relations and "bourgeois" universalism. At the same time, convergent solutions to these trends arise in the analysis of social conflicts, in the space of world politics, where the crisis of the national form is accompanied by an outbreak of nationalism. [Balibar]

The idea of the "right to be different" in society in the 1980s and 1990s - the consequences of multiculturalism - aroused interest and provoked resistance. Today, with the resurgence of xenophobic sentiments in the world and the fear caused by terrorism, the policy of multiculturalism may be questioned in the societies of democratic countries that have adopted it.

The concepts of "moral universalism and cosmopolitan federalism" appear in the political scientist Seyla Benhabib's works and draw attention to the "rights of others", echoing the statements of philosopher Immanuel Kant. She advocates for non-open, but even transparent borders, recognizing the rights of refugees and asylum seekers to be admitted, as well as regulatory rights in democratic countries. "The Rights of Others is an important contribution to contemporary

political theory that will be of interest to a large number of students and professionals in politics, law, philosophy, and international relations." [Benhabib]

Let's look at the consequences of migration, which lead to changes in the perception of cultures, assimilation, or acculturation, and how society responds to this. The multiculturalist theorist R. Brubaker advocates "differentiated citizenship" and "special rights of subordinate minorities". Elsever, "The ambiguity and two-dimensionality of appeals to 'the people' do not result from the conflation of populism and nationalism; they are a constitutive feature of populism itself, a practical resource that can be exploited in constructing political identities and defining lines of political opposition and conflict". [Brubaker]

According to Michel Vivercq, a French sociologist and author of texts on violence, terrorism, racism: accepting a globalized and multicultural worldview, this means introducing political measures and legal exceptions to guarantee equal treatment for ethnic minorities when existing standards do not work for them. These measures allow, for example, for the adaptation of the national calendar or dress code to minority traditions (a paradigmatic case in the literature on multiculturalism is the Sikh turban and kirpan in Canada, a country where the law allows members of this community to deviate from the rules on wearing helmets and weapons). [WIEVIORKA]

At the same time, we note that perception in the context of civic status, a particular culture, confirms the dominance of an identity that is considered an accepted civilizational norm. However, in such a culture, the acceptance of the identities of others is marginalized. Therefore, the rights and responsibilities of minorities need to be accepted and systematized at the state level. The universalism of human rights must accept equality in society. In this direction, it should also embrace "diversity and difference", i.e. promote the political representation of dominated and non-dominated groups to include them in the process of socialization and globalization. Understandings of contemporary multiculturalism and multi-religious societies touch on this issue.

However, the diversity of cultures does not exclude, but presupposes the universality of human rights as universal human interests, needs and diversity, as well as when they embody the cultural and social representations of a person, generated by relations that characterize the individual's position, both factual and legal, in each state. [Bessarabov V.G.]

The concept of "multiculturalism," according to Robert Stam, Ella Shohat R. Stam, and E. Shohat of New York University, can vary: "Rather than attacking Europe as such, anti-Eurocentric multiculturalism, in our view, relativizes Europe as a geographical fiction that equal to the cultural diversity of even Europe itself. Europe has always had its peripheral regions and stigmatized communities, such as: Jews, Irish, Gypsies, Huguenots, Muslims, peasants, women, gays, lesbians. We also do not support Europhobic sentiments, our own text appeals to European thinkers and concepts. We emphasize the "reverse side" of European history, and this does not mean that we do this to recognize the "reverse side" of scientific, artistic, and political dogmas. [Stam R.]

Today, Europe is faced with a flow of migrants from Ukraine who are forced to leave their country due to the invasion of the Russian Federation after February 2022. Let's turn to some of the reasons for migration today, which were determined even before the full-scale war in Ukraine. According to the religious expert, head of the State Service of Ethnopolitics and Freedom of Conscience of Ukraine Viktor Yelenskyi, even in 2020 it was believed that religion has become a serious factor of anti-Ukrainiane, and the structures of the Moscow Patriarchate on the territory of

Ukraine are one of the most organized and legally existing forces that demotivate resistance to aggression, spread Kremlin narratives and spread capitulatory sentiments. The refusal of the priests of the Moscow Patriarchate to condemn the Russian invasion and, in fact, to support the Armed Forces of Ukraine against the background of an openly accommodative policy towards the aggressor country and the occupation administrations, caused a wave of indignation in Ukraine. A group of People's Deputies of the Verkhovna Rada initiated a draft law that provides for a special status of religious organizations whose management centers are in a state recognized by the Verkhovna Rada of Ukraine as an aggressor state. [Yelenskiy V.]

In 2016, Ukraine created a Draft Law on the special status of religious organizations whose management centers are in a state recognized by the Verkhovna Rada of Ukraine as an aggressor state.

Scientists have already drawn attention to the circumstances of the development of Ukraine, the formation of the Ukrainian community on the border of civilizations, the intersection of Orthodox-Byzantine and Catholic traditions. In particular, the academic S. Huntington noted that the fault line between civilizations, which separates the West from Orthodoxy, has been passing right through its center for several centuries [Huntington: 312].

It is known, for example, that one of the main reasons for migration from Mexico to the USA is the difference in economic development. GDP per capita in Central American countries is about 10 times lower than in the United States. [Koval'chuk YA. S.] These strategies involve fortuitous alliances today when the US migration field is heavily used during the 2024 election campaign.

Conclusion

This article is based on research conducted in the field of contemporary migrant environment in a globalized society. The consequences of the processes of multicultural society - the "right to be different" caused a certain interest in society earlier. Today, in connection with new xenophobic attitudes and fear caused by terrorism, multicultural societies are somewhat questioned in the democratic countries that have adopted them.

The adoption of an inductive point of view inspired by the study of the causes of migration today can be attributed to religious, social, political factors that lead to new ways of solving this problem in a globalized world.

In addition to the heuristic contribution of the research, social processes: conflicts, wars, hybrid attacks historically lead to migrations, it is worth noting that public opinion and the state apparatus always perceive it ambiguously. Migration, which leads to the development of multiculturalism in globalized societies, is a multifaceted socio-political phenomenon, and its real impact is still being investigated by scholars. It is necessary to note the processes of convergence and divergence in modern social life, which are often euphemistically called the consequences of civilizational trends. Regarding modern migrants, for whom the primary priority is not the perception of traditions, which are often erased in a globalized society, but the perception of them themselves from the point of view of the rights (responsibilities of the migrants themselves) in the host state.

Migrations lead to:

- to a multicultural picture of the world;
- political processes of societies;
- globalization of politics, economy, traditions, religious views;

- assimilation and acculturation;
- changes and mixing of society's values;
- legal and state reforms.

In the work, it was possible to conceptualize aspects of the description of migration processes in the era of globalization, which provides opportunities for their systematization. Today, world communities are on the threshold of transforming the legal framework for new waves of migration, the causes, and consequences of which are still being considered in the global world.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

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REFERENCES

1. Attali Jacques, (1972) Modèles politiques (les) Abraxas-libris Bécherel. 178 p. Balibar Étienne et Wallerstein Immanuel, (2007) Race Nation Classe, les identités ambiguës, Paris, La Découverte. Soliman Lotfallah (Traduction) 322 p.
2. Benhabib Seyla, Cambridge (2004) Aliens, Citizens, and Residents, The Rights of Others: Aliens, Residents, and Citizens University Press [Elektronnyy resurs]. Rezhim dostupu: https://doi.org/10.1017/CBO9780511790799
3. Brubaker Rogers, (2019) Populism and nationalism. https://doi.org/10.1111/ nana.12522
4. Fukuyama Francis, (2016) "Political Order and Political Decay: From the Industrial Revolution to the Globalization of Democracy". Stanford.edu.
5. Huntington Samuel, (1996) The Clash of Civilizations: and the Transformation of World Order. New York: Simon & Schuster, 353 p.
6. Wallerstein I. (1930-2019), (2020) Une pensée-monde, Thierry Paquot Dans Hermès, La Revue 1 (№ 86), Éditions: CNRS Éditions, pages 303 - 312 DOI10.3917/herm.086.0303
7. Wallerstein Immanuel (2011) The Modern World-System I Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century, With a New Prologue University of California Press, 440 p.
8. Wallerstein Immanuel, (1990) Culture as the Ideological Battleground of the Modern World-System https://doi.org/10.1177/02632769000700200
9. Wieviorka M., (2001) La différence, Paris: Balland.
10. Wieviorka, M., (1997) Une société fragmentée ? Le multiculturalisme en débat, Paris : La Découverte & Syros.
11. Toffler Alvin, (1985) Future Shock. Pan Books New édition, 528 pages

12. Stam, R. & Shohat E., (2014). Unthinking Eurocentrism Multiculturalism and the Media Ed. by: Routledge. Taylor and Francis group London New York, P. 4.
13. Zbigniew Brzezinski, (1998) The Grand Chessboard: American Primacy And Its Geostrategic Imperatives. 240 p.
14. Bessarabov V. G. (2002) Ponyatiye prav i svobod cheloveka i grazhdanina / Filosofskiye nauki. – № 4. S. 71 – 86.
15. Popper K., (1994) Otkrytoye obshchestvo i ikh vragi. Tom 1. Kiyev: Osnovy. 444 s.
16. Yelenskiy V., (2020) Mezhdu religioznoy svobodoy i natsional'noy bezopasnost'yu: Dokument OBSE «Svoboda religii ili ubezhdeniy i bezopasnost'» v zapadnom, russkom i ukrainskom kontekstakh. Religioznaya Svoboda № 25 URL: https://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=58849 21
17. Koval'chuk YA. S., (2020) Problema nelegal'noy migratsii SSHA i perspektivy yeye resheniya. Seriya mezhdunarodnykh otnosheniy. Ostrog: Izdatel'stvo Natsional'nogo universiteta Ostrozhskaya akademiya, V. № 5. S. 160 -166

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IMPROVING THE EFFICIENCY OF OPERATION OF ENTERPRISES IN THE CONSTRUCTION AND OIL AND GAS INDUSTRIES UNDER THE INFLUENCE OF CRISIS PHENOMENA

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ABSTRACT

The work explores the content, significance, classification of crises and crisis phenomena, identifies the impact of war on the economy, construction, oil and gas industry, and entrepreneurial activity in Ukraine. It discusses methods for forecasting crisis phenomena in the activities of enterprises in the construction and oil and gas industries, evaluates the impact of crisis phenomena on the effectiveness of the limited liability company "Ukrainian Service Drilling Company-1", proposes directions for improving the efficiency of the process of forecasting crisis phenomena in the activities of the limited liability company "Ukrainian Service Drilling Company-1" and assessing their possible consequences, as well as developing measures to ensure the development of enterprises in the oil and gas industry under the influence of crisis phenomena.
Keywords: efficiency, enterprises, construction and oil and gas industry, crisis phenomena, forecasting.

Introduction

Forecasting crisis phenomena in the activities of oil and gas industry enterprises is a critically important aspect of strategic management. It enables enterprises to anticipate and prepare for potential disruptions that could adversely affect their operations. In a dynamic business environment, enterprises are exposed to various risks such as economic downturns, market fluctuations, natural disasters, technological issues, and geopolitical events. By utilizing forecasting methods, enterprises can gain insights into potential crisis scenarios and develop proactive strategies to mitigate their impact.

One of the key aspects of forecasting crisis phenomena is risk management. By identifying potential crises in advance, enterprises can implement risk mitigation strategies to minimize negative consequences. This proactive approach not only helps preserve the financial health of the enterprise but also enhances its resilience to unexpected challenges. Additionally, forecasting allows enterprises to efficiently allocate resources, ensuring they are well-prepared to navigate turbulent times. Considering the above, along with the high level of uncertainty in the external environment during wartime conditions, the chosen research topic can be recognized as highly relevant.

Form starts.

The aim of the research is to conduct a critical analysis of theoretical and methodological approaches to forecasting crisis phenomena in the activities of construction and oil and gas industry enterprises, assess their possible consequences, and develop practical recommendations

for improving this process using the example of the limited liability company "Ukrainian Service Drilling Company-1" (LLC "USDC-1").

The main objectives of the work are as follows:

to disclose the content and significance of crises and crisis phenomena;

to determine the impact of war on the economy, construction, and entrepreneurial activities in Ukraine;

to examine methods of forecasting crisis phenomena in the activities of enterprises in the construction and oil and gas industries;

to assess the impact of crisis phenomena on the effectiveness of oil and gas industry enterprises using the example of LLC "Ukrainian Service Drilling Company-1";

to propose directions for improving the efficiency of the process of forecasting crisis phenomena in the activities of LLC "Ukrainian Service Drilling Company-1" and evaluate their possible consequences;

to develop measures to ensure the development of enterprises in the oil and gas industry, including LLC "Ukrainian Service Drilling Company-1", under the influence of crisis phenomena.

The object of the research is the process of forecasting crisis phenomena in the activities of enterprises in the oil and gas industry, using the example of LLC "Ukrainian Service Drilling Company-1", and assessing their potential consequences.

The subject of the research is theoretical and methodological approaches to forecasting crisis phenomena in the activities of enterprises in the oil and gas industry.

During the research, the following methods are employed: theoretical generalization to determine the essence of crises and crisis phenomena; comparative analysis to analyze models and methods for assessing the crisis state of enterprises in the oil and gas industry; economic-statistical and techno-economic analyses; SWOT analysis; balanced scorecard system; Edward Altman's bankruptcy prediction model, Taffler's bankruptcy diagnostic model, Roman Lys model, Springate model, Matviychuk model, Tereshchenko model, as well as the Beaver coefficient for forecasting crises in LLC "Ukrainian Service Drilling Company-1" and assessing the probability of enterprise bankruptcy; graphical and tabular methods for better visualization of the research results; planning and forecasting for the development of measures aimed at ensuring the development of the researched enterprise, and so on.

Let's analyze the literature on this issue. The paper [1] addresses describes several transmission channels of the two major global crises which have been following covid pandemic and military conflict in Ukraine. The economic development of countries is influenced by many factors with effects that can be modified only to a very limited extent by these countries. Raw material dependence, migration, climate change, or imported inflation are just some of the phenomena to which countries are exposed and which are indirectly transmitted to inhabitants and business entities. Besides the fact that risk management techniques must be applied for securing enterprises, inhabitants as employees are the immediate receivers of the benefits that risk management brings to enterprises, Hudáková (2017) or Mošková (2021). Lange emphasizes that the state should be able to provide sufficient resources for solving crisis phenomena, Kelíšek (2011).

The present paper [2] investigates discusses how the concept of the circular economy can inform responses to such crises by addressing four elements of a socio-economic system: technological innovation, supply chains and markets, public policy, and consumer behaviour. Synthesizing emerging insights from the scholarly and policymaking arenas, the article identifies the following

ways that the circular economy concept can be effectively framed as crisis response: focusing on circularity in a more holistic way, adopting global value chains as the primary unit of analysis, pinpointing specific circularity aspects like drivers and barriers in value chains and business models, and extending the prevailing focus on technical aspects and material flows to often overlooked trade and geopolitical considerations. This discussion aims to articulate lessons for industry, policymakers, and scholars in leveraging a circularity approach to address the world's most pressing issues.

The following study [3] focuses on the analysis of the economic category "multi-crisis". These risks can cause societal disruption and political instability in times of uncertainty, as evidenced by the water crisis, stagflation, COVID-19, population growth, and wars. Hence, it is critical to mitigate geopolitical risks and promote peace. These risks can have significant impacts on government effectiveness, the rule of law, and political stability.

Also, a number of authors [4] explore the concept of economic efficiency and develop measures to enhance it. According to their view, economic efficiency of an enterprise is one type of efficiency, the criteria of which are determined by the ratio of the achieved result of an industrial enterprise to the incurred expenses. Several measures to improve the efficiency of industrial enterprise activities have been proposed.

The article [5] examines efficiency as one of the key aspects of enterprise functioning in a market environment. It is proven that an essential prerequisite for increasing efficiency (productivity) in production enterprises is a sufficient level of development and active operation of various institutions of market, production, and social infrastructure. The level of economic and social efficiency of production depends on numerous factors that determine it. Classification features of factors contributing to efficiency growth are identified.

Main Body

In conditions of a state of war and the accompanying negative consequences, the increased level of risks and crisis phenomena existing in the external environment make it crucial to assess the effectiveness of enterprise functioning. There is no single methodology for conducting such an assessment; however, contemporary scholars mostly recommend using methods and models for forecasting the probability of enterprise bankruptcy. Moreover, such an evaluation should be conducted dynamically, covering a minimum period of three years.

To assess the impact of crisis phenomena on the effectiveness of LLC "Ukrainian Service Drilling Company-1", the following models were used: the Altman five-factor model, the Taffler model, the Beaver model, the Springate model, the Lys model, the Tereshchenko model, the Matviychuk model, and the Kovalyov model.

The simultaneous use of such a variety of models will allow for the consideration of various aspects of the enterprise's activities and coefficients that take into account different aspects of the effectiveness of LLC "Ukrainian Service Drilling Company-1".

Edward I. Altman is a finance professor who developed the Altman Z-Score, a widely used bankruptcy prediction model. The Altman Z-Score is a formula that combines several financial ratios to assess a company's financial health and predict the likelihood of bankruptcy.

The Z- the indicator is calculated based on these five financial ratios, and the result is used to classify companies into different zones, indicating their financial distress or bankruptcy risk. These zones are:

Z- the indicator > 2,99 – low bankruptcy risk;

1,81 < Z- the indicator < 2,99 – the indicator points to caution and moderate bankruptcy risk;
Z- the indicator < 1,81 – high bankruptcy risk.
Table 1 provides an assessment of the probability of bankruptcy for LLC "Ukrainian Service Drilling Company-1" using the Altman model.

Table 1. Assessment of the probability of bankruptcy for LLC "Ukrainian Service Drilling Company-1" according to the Altman model in 2020-2022.

Coefficient	2020 p.	2021 p.	2022 p.
K1	-1,10	-0,39	-0,42
K2	0,005	0,202	0,054
K3	0,006	0,210	0,073
K4	-0,365	0,066	0,127
K5	2,574	0,973	1,415
Z_A	1,06	1,52	1,31
Probability of bankruptcy	High risk of bankruptcy	High risk of bankruptcy	High risk of bankruptcy

According to the Altman model, LLC "Ukrainian Service Drilling Company-1" has consistently exhibited a high risk of bankruptcy throughout the entire study period. It is noteworthy that an improvement in the financial condition of LLC "USDC-1" occurred in 2021, coinciding with a highly favorable external environment. In 2020, the operations of LLC "USDC-1" were adversely affected by crises associated with the Covid-19 pandemic, while in 2022, the full-scale war and its negative consequences had a significant impact.
Another model is the Taffler bankruptcy diagnostic model. Professor Richard J. Taffler is known for his work in accounting and finance, particularly in the field of bankruptcy prediction. Taffler's work has contributed to the development of models aimed at forecasting the likelihood that a company will encounter financial difficulties or bankruptcy. According to this model, if the value $Z < 0,2$ – the probability of bankruptcy is quite high; $0,2 < Z < 0,3$ – bankruptcy is possible; $Z > 0,3$ – the probability of bankruptcy is low. Table 2 presents the assessment of the probability of bankruptcy for the company according to this model.

Table 2. Assessment of the probability of bankruptcy for LLC "Ukrainian Service Drilling Company-1" according to the Taffler model in 2020-2022.

Coefficient	2020 p.	2021 p.	2022 p.
T1	0,13	0,29	0,42
T2	0,30	0,59	0,53
T3	1,46	0,91	0,85
T4	2,57	0,97	1,41
Z_T	0,78	0,55	0,67
Probability of bankruptcy	The probability of bankruptcy is low		

According to the Taffler model, the probability of bankruptcy for LLC "Ukrainian Service Drilling Company-1" remained low throughout the analyzed period. This contrasting result compared to the Altman model is due to the fact that the Taffler model incorporates different financial coefficients, which provided a higher level. When assessing the effectiveness of the

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company's operations, it is necessary to consider the results from various models, which will allow for a reliable conclusion and monitoring critical coefficient values.
The Roman Lys model has gained widespread use for assessing the probability of bankruptcy of companies in the United Kingdom, and it is also used for domestic companies. The threshold value for this model is set at 0.037. Therefore, if $Z_л$ if it is less than 0.037, then it is characterized as a crisis state of the enterprise. Table 3 provides an assessment of the probability of bankruptcy for LLC "Ukrainian Service Drilling Company-1" according to the Roman Lys model.

Table 3. Assessment of the probability of bankruptcy for LLC "Ukrainian Service Drilling Company-1" according to the Roman Lys model in 2020-2022.

Coefficient	2020 p.	2021 p.	2022 p.
L1	-1,10	-0,39	-0,42
L2	0,19	0,27	0,36
L3	-0,74	0,02	0,07
L4	-0,37	0,07	0,13
Z_L	-0,094	0,001	0,011
Probability of bankruptcy	Crisis state of the enterprise		

According to the results obtained from the Roman Lys model for LLC "Ukrainian Service Drilling Company-1" throughout 2020-2022, a crisis state is evident. Similar to the calculations from previous models, it is noticeable that the situation slightly improved in 2021. However, the impact of negative crisis phenomena such as war and its several adverse consequences had their influence, negatively affecting the effectiveness of the operation of the investigated company.
The Springate model, according to which, if Z- the indicator < 0,862, the company is considered a potential bankrupt. Table 4 provides an assessment of the probability of bankruptcy for LLC "Ukrainian Service Drilling Company-1" according to the Springate model.

Table 4. Assessment of the probability of bankruptcy for LLC "Ukrainian Service Drilling Company-1" according to the Springate model in 2020-2022.

Coefficient	2020 p.	2021 p.	2022 p.
A	-1,10	-0,39	-0,42
B	0,006	0,210	0,073
C	0,004	0,23	0,09
D	2,57	0,97	1,42
Z_C	-0,084	0,783	0,419
Probability of bankruptcy	The probability of bankruptcy is high		

The Springate model calculations indicate that LLC "Ukrainian Service Drilling Company-1" had a high probability of bankruptcy throughout 2020-2022. In 2020, the company was considered a potential bankrupt according to this model. The situation significantly improved in 2021, but the full-scale war and its negative consequences once again worsened the financial condition of the investigated company in 2022. Based on this, it can be concluded that LLC "Ukrainian Service

Drilling Company-1" is quite susceptible to various crisis phenomena and has a low level of adaptation to new challenges.
The calculation of the probability of bankruptcy for the company using the rating assessment method of the financial state of the enterprise (rating score) is provided in Table 5.

Table 5. Assessment of the Probability of Bankruptcy for LLC "Ukrainian Service Drilling Company-1" using the Rating Assessment Method of the Financial State of the Enterprise in 2020-2022.

Coefficient	2020 p.	2021 p.	2022 p.
Кз	-1,10	-0,39	-0,42
Кпл	0,32	0,60	0,56
Кі	-5,62	10,78	9,26
Км	0,07	0,27	0,25
Крвк	-0,01	3,25	0,48
$Z_к$	-2,596	3,514	0,549
Probability of bankruptcy	Financial crisis situation	Stable financial condition	Financial crisis condition

According to the rating assessment of the financial condition of LLC "USBC-1," a crisis financial condition was characteristic, resulting in a high probability of bankruptcy in 2020 and 2022. Interestingly, in 2021, LLC "USBC-1" exhibited a stable financial condition according to this method. A similar trend is observed with other models assessing the probability of bankruptcy of the company. The negative impact of economic crises in 2020 and 2022 deteriorated the financial performance of LLC "USBC-1."
The A. Matviychuk model was developed for Ukrainian enterprises, where the resulting indicator is a value of 1.104. Table 6 provides an assessment of the probability of bankruptcy for LLC "USBC-1" according to the A. Matviychuk model.

Table 6. Assessment of the probability of bankruptcy for LLC "USBC-1" according to the A. Matviychuk model in 2020-2022.

Coefficient	2020 p.	2021 p.	2022 p.
M_1	0,89	1,22	0,89
M_2	1,77	1,07	1,67
M_3	-4,48	15,69	12,54
M_4	0,39	1,03	0,71
M_5	-2,09	-0,65	-0,80
M_6	1,58	0,94	0,89
M_7	-0,37	0,07	0,13
$Z_м$	0,02	1,05	1,11
Probability of bankruptcy	Threat of financial crisis and high probability of bankruptcy	The financial condition is satisfactory, but the enterprise requires the development of a complex of crisis management measures	

According to the model by A. Matviychuk, the threat of financial crisis was only present in 2020 for "USBC-1" LLC, while during 2021-2022, the financial condition was considered satisfactory.

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However, even a minor deterioration in the calculated coefficient during 2021-2022 could lead to a precarious situation. Therefore, it would be advisable for "USBC-1" LLC to develop crisis management measures in case of any deterioration in its financial condition.

The most widely used bankruptcy diagnosis model in Ukraine is O. Tereshchenko's model. The discriminant model developed by O. Tereshchenko has significant advantages over traditional domestic methods. Let's outline the main ones:

ease of application;

incorporation of modern international practices when using domestic statistical data;

resolution of critical indicator issues through the utilization of various modifications of the basic model for enterprises of different types of activities;

consideration of the industry-specific characteristics of the enterprise.

Table 7. Assessment of bankruptcy probability for LLC "USBK-1" according to the Tereshchenko model in 2020-2022.

Coefficient	2020 p.	2021 p.	2022 p.
X_1	1,77	1,07	1,67
X_2	0,69	1,10	1,18
X_3	0,003	0,325	0,055
X_4	0,003	0,216	0,052
X_5	0,10	0,03	0,003
X_6	-4,48	15,69	12,54
$Z_к$	3,14	2,29	1,63
Probability of bankruptcy	Bankruptcy is not imminent	Bankruptcy is not imminent	Financial stability is disrupted

According to Tereshchenko's model, there was no threat of bankruptcy for LLC "USBC-1" during 2020-2021, but in 2022, the situation significantly deteriorated, and the company experienced disrupted financial stability. Therefore, the company needs to take measures to improve its financial situation and adapt to the new challenges of the external environment. It is crucial for the company to develop a continuous monitoring system for the financial state of LLC "USBC-1". Figure 1 illustrates the bankruptcy probability assessment using the Beaver ratio.

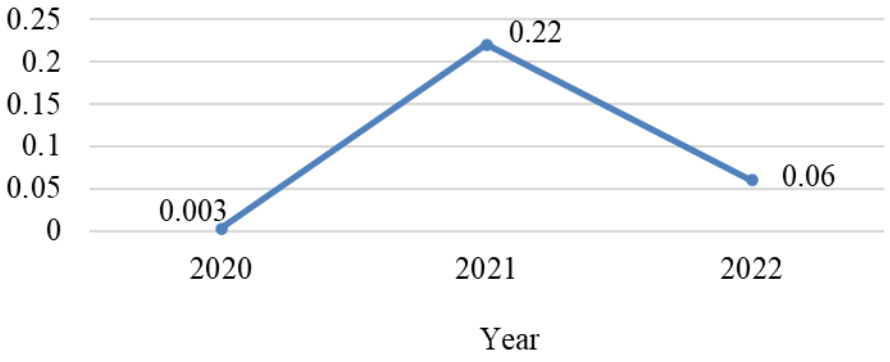

Figure 1. Dynamics of the Beaver Ratio for LLC "USBC-1" for the years 2020-2022

The Beaver Ratio clearly indicates that the best financial condition for LLC "USBC-1" was in 2021. During this period, the national economy also experienced growth after the negative consequences of the COVID-19 pandemic. In 2022, amidst the state of war, the situation resembled that of the pandemic period, and the financial condition of the company deteriorated significantly.
The calculations assessing the scale of the crisis at LLC "USBC-1" and its bankruptcy probability are summarized in Table 8.

Table 8. Assessment of the crisis scale at LLC "USBC-1" in 2020-2022 and its bankruptcy probability.

Models of bankruptcy diagnosis	2020	2021	2022
1. Altman's bankruptcy prediction model	1,06	1,52	1,31
2. Taffler's bankruptcy diagnosis model	0,78	0,55	0,67
3. Roman Lys's model	-0,094	0,001	0,011
4. Springate's model	-0,084	0,783	0,419
6. Financial condition rating method (rating number)	-2,596	3,514	0,549
7. A. Matviychuk's model	0,02	1,05	1,11
8. Tereshchenko's model	3,14	2,29	1,63
9. Beaver's coefficient	0,003	0,22	0,006
Probability of bankruptcy	High	Low	Average
The scale of the crisis	The company is in a financial crisis	The financial condition is satisfactory	The financial equilibrium is disrupted, but with the implementation of crisis management measures, there is a possibility of stabilization

Summarizing the results of the calculations, we can conclude that LLC "USBC-1" had its best financial condition in 2021, which is in line with the stability of the Ukrainian economy and a favorable environment for business development during the post-pandemic recovery. However, the positive trends changed with the disruption of financial equilibrium for LLC "USBC-1" in 2022, which can be attributed to the impact of war and its negative consequences on the entire business activity in Ukraine. Therefore, this confirms that crisis phenomena in the economy significantly affect the efficiency of operation of the researched company.
Thus, a range of modern methodologies and models were used to assess the impact of crisis phenomena on the efficiency of LLC "USBC-1". The obtained results indicate that crisis phenomena have a significant impact on the efficiency of the operation of the researched company. During periods of economic crises in the country, the financial condition of LLC "USBC-1" deteriorates significantly, affecting its operational efficiency. Based on the data obtained, it can be concluded that in 2020, LLC "USBC-1" experienced a financial crisis and had a high probability of bankruptcy. In the stable market environment of 2021, the financial condition improved significantly, and the company experienced stable financial status. However, during the war in 2022, the situation deteriorated significantly again, and LLC "USBC-1" experienced disrupted financial equilibrium.

Considering the high level of turbulence in the external environment, significant risks and threats, and the dependency of LLC "USBC-1" on them, it is advisable for the company to develop strategies to enhance the effectiveness of forecasting crisis phenomena in its operations.

In the conditions of external instability and significant threats and crises for LLC "USBC-1", it is important to establish a systematic assessment of its financial status, bankruptcy probability, and monitoring of the market environment. Such a mechanism will allow timely detection of negative changes, identifying their causes, forecasting possible development scenarios, and reacting to them. To this end, it is advisable for LLC "USBC-1" to organize an early crisis diagnosis system. The idea is to apply bankruptcy prevention measures before LLC "USBC-1" falls into a crisis "pit", and to adjust the main strategy in case of negative trends, taking into account the possible development of crisis phenomena and anticipating measures to overcome them. During normal operation of the enterprise, the early detection and resolution system of financial crises serves as a control tool, and in crisis situations, in addition to its control function, this system acts as a kind of signaling system about the possibility of emergence or occurrence of danger. In other words, the early detection and resolution system of financial crises involve making a binary decision about the presence or absence of a crisis situation in the enterprise. In our opinion, these measures will contribute to financial stability and prevention of crisis situations at LLC "USBC-1". Additionally, the proposed early diagnostic system will not only cover the internal environment but also encompass factors from the external environment. This will allow LLC "USBC-1" to analyze the state of the external environment, forecast potential changes in its individual factors, and adapt its operations accordingly.

The rationale for the need to establish a reliable early crisis diagnostic system at the enterprise is based on the constantly changing business environment and the inherent risks associated with it. In today's dynamic and interconnected global economy, LLC "USBC-1" faces numerous challenges, ranging from economic downturns and market instability to natural disasters and geopolitical uncertainties. LLC "USBC-1" needs to recognize the inevitability of crises and actively develop mechanisms for detecting, assessing, and responding to potential threats at their inception.

In this regard, we propose to establish a task force at LLC "USBC-1", which will hold weekly meetings. These meetings will focus on discussing the current company situation, addressing new challenges from the external environment, refining the development strategy, and formulating measures to mitigate risks and overcome crises. The existence of such a team and the regularity of such meetings will provide senior management with a comprehensive understanding of the current state of LLC "USBC-1", allowing for the timely detection and resolution of potential crises and threats at early stages. In the event of external threats, LLC "USBC-1" will have the opportunity to develop a pre-planned action plan aimed at mitigating any adverse impacts.

The proposed crisis early diagnosis group at LLC "USBC-1" will include top management of the company. Each of them is responsible for a specific strategic direction of the company's activities. Accordingly, each participant of the group will report changes in key performance indicators (KPIs) for the key areas of the company's operations: operational, human resources, marketing, financial, etc. If there are noticeable negative changes or initial signs of a crisis, employees will brainstorm ideas and explore options to change the situation. The main goal is to identify the root cause of deteriorating performance indicators in order to focus on addressing it effectively. Creating such a group will ensure timely crisis management. The effectiveness of further actions by the company depends on the informational support regarding the status of LLC "USBC-1".

Establishing a crisis early warning system for LLC "USBC-1" is important for several reasons. Firstly, it allows LLC "USBC-1" to identify crisis indicators and emerging issues before they escalate into a full-blown crisis. Timely identification provides a valuable window of opportunity for implementing preventive measures and strategic interventions, mitigating the impact of potential disruptions on the company's operations, reputation, and ultimate outcome.

Moreover, an effective early diagnostic system contributes to the resilience of LLC "USBC-1". By fostering a culture of preparedness and adaptability, LLC "USBC-1" can better overcome unexpected challenges and maintain business continuity. This resilience serves not only as a competitive advantage but also as a means of protecting the interests of stakeholders, including employees, clients, and shareholders.

A proactive approach to crisis management not only protects the enterprise but also contributes to the stability of supply chains, financial markets, and society as a whole. Establishing an early diagnostic system for crisis phenomena is a strategic imperative for LLC "USBC-1" in today's rapidly changing environment. By acknowledging the inevitability of crises and proactively preparing for them, LLC "USBC-1" can enhance its ability to withstand crisis events, protect its stakeholders, and become more competitive.

The integration of advanced technologies and data analysis plays a crucial role in enhancing forecasting capabilities. Leveraging predictive modeling, artificial intelligence, and machine learning algorithms can enable LLC "USBC-1" to identify patterns, anomalies, and potential crisis indicators in real-time. By harnessing the power of big data, LLC "USBC-1" will be able to gain valuable insights into market trends, consumer behavior, and external factors that may impact their operations, allowing them to proactively identify potential crisis triggers.

It should also be noted that regular reviews and updates of forecasting methodologies are necessary to adapt LLC "USBC-1" to the dynamic business environment. LLC "USBC-1" should continually evaluate the effectiveness of its crisis forecasting processes, taking into account past experiences and staying informed about new trends. Flexibility and adaptability to change are key elements for LLC "USBC-1" to effectively adjust to new challenges in the external environment.

Enhancing the efficiency of crisis forecasting processes at LLC "USBC-1" requires a multifaceted approach. By utilizing advanced technologies, fostering a risk-aware culture, promoting collaboration, and maintaining a commitment to continuous improvement, LLC "USBC-1" can strengthen its ability to anticipate crises and successfully overcome them. This proactive stance will not only protect LLC "USBC-1" but also empower it to thrive in uncertain conditions.

The proposed early crisis diagnosis system for LLC "USBC-1" consists of the following subsystems:

data collection and storage, which ensures the collection and storage of large volumes of external and internal information;

data analytics processing, which provides modeling of enterprise operations, real-time analytical processing, and intelligent data analysis;

decision-making, which is based on the use of data processing and opinion modeling procedures to assist managers in decision-making.

Thus, in conditions of martial law and increased risk levels, LLC "USBC-1" requires seeking to enhance the effectiveness of forecasting crisis phenomena in its operations and assessing their potential consequences. To this end, it is proposed to establish an early crisis diagnosis system for LLC "USBC-1". This will allow the enterprise to be proactive, accurately predict potential crises at LLC "USBC-1" and anticipate economic crises that affect its operational efficiency. To achieve

this, it is proposed to establish a permanent crisis management team consisting of the director, the financial director, the chief engineer, and the HR manager. To ensure proper information support and automation of this process, the implementation of specialized software is suggested. The latter will allow the automated collection, analysis, and processing of information, conducting analysis and evaluation of key indicators of crisis emergence, providing decision support, modeling different scenarios, and forecasting the occurrence of crises and crisis phenomena. Moreover, this software enables assessing the crisis not only based on the internal environment but also considering external factors.

Also, considering that the financial stability of LLC "USBC-1" is compromised and there is a real possibility of bankruptcy, there is an urgent need to develop effective measures to ensure the company's development in the face of crisis influences.

In addition to effective forecasting of crisis phenomena and their impact on the functioning efficiency of LLC "USBC-1", it is also necessary to develop measures for the development of the investigated company. Since the preliminary diagnosis has shown that LLC "USBC-1" currently has disrupted financial stability and a large number of calculations indicate a high probability of bankruptcy of the investigated company. The situation is further complicated by the still unsatisfactory state of the external environment, characterized by a high level of uncertainty, risks, and threats. Therefore, the development of measures to ensure the development of LLC "USBC-1" in the face of crisis influences is essential.

Ensuring the stable development of LLC "USBC-1" is only possible through a comprehensive approach that takes into account all aspects of its activities. To achieve this, a balanced scorecard system has been utilized, and a strategic development roadmap for LLC "USBC-1" for the years 2024-2028 has been formulated.

All business processes of LLC "USBC-1" are closely interconnected, so changes in one inevitably lead to a general increase or decrease in the effectiveness of the company's operations as a whole. Therefore, changes need to be implemented systematically while simultaneously improving all of the company's business processes.

In the area of personnel, LLC "USBC-1" needs to strengthen cooperation with leading higher education institutions, particularly with the National University "Poltava Polytechnic named after Yuri Kondratyuk," which educates future specialists in the oil and gas sector and has a well-developed research base. Such cooperation and combining efforts will allow finding better solutions in the field of exploration activities. This collaboration will enable the company to attract top talent. Additionally, in the personnel sphere, it is necessary to establish a fair reward system that includes paying employees based on their performance results.

In the conditions of war and economic recession, many potential clients of LLC "USBC-1" have a low level of solvency and are unable to pay for the company's services on time. Therefore, conducting effective marketing activities to win the competition for "better" clients is extremely important. In this regard, it is advisable for LLC "USBC-1" to create its own website to increase its presence on the Internet. Additionally, it would be appropriate to establish a loyalty program for clients, offering discounts for long-term cooperation with the company. The marketing activities of LLC "USBC-1" require optimization and a review of the policy regarding the recovery of accounts receivable, which currently has quite high indicators.

LLC "USBC-1" faces the threat of bankruptcy according to various indicators, and the company has an unstable financial position. Alongside this, investment in the development of the company's infrastructure, intensification of advertising, etc., are necessary. Therefore, it is

pertinent for LLC "USBC-1" to seek alternative sources of financial resources. In particular, participation in international government grant programs, attracting funds from the state within the framework of public-private partnerships, as well as utilizing financial leasing opportunities for the adoption of innovative technologies, could serve as such alternatives.

Figure 2 illustrates prospective innovative technologies aimed at enhancing the efficiency of the investigated company's operations.

The production sector of "USBK-1" LLC, which generates the main revenue for the company, is in most urgent need of improvement, as its efficiency significantly declined in 2022. Additionally, the natural gas and oil extraction industry remains quite promising. Therefore, "USBK-1" LLC can capitalize on this opportunity to expand its production capacity and enhance its capabilities. The use of 3D modeling for reservoirs stands out as a highly effective and innovative strategy for exploring oil and gas deposits. This approach relies on specialized software for creating three-dimensional images. These 3D models offer "USBK-1" LLC valuable access to information, simplifying decision-making processes related to drilling operations. By applying 3D modeling to the reservoir, various drilling options can be prepared, optimal extraction technologies can be identified, safety issues can be addressed, and excellent economic and qualitative results can be achieved. The geological model of the reservoir is becoming increasingly important and beneficial in the smart management of resource reservoirs. Planning exploration goes beyond simply selecting a drilling location. The implementation of 3D modeling in the activities of "USBK-1" LLC enables strategic planning of geological exploration, determination of on-site resources, reservoir 3D modeling, as well as optimization and assessment of resources according to international standards and best industry practices.

Additionally, the implementation of 3D modeling will enable "USBK-1" LLC to diversify its services. Currently, the company is limited to providing drilling services due to the lack of specialized software and innovative technologies. The introduction of new technologies and software aims to expand the range of services, leading to additional sources of income.

The new solution involves the use of wireless green seismic exploration technology, an innovative seismic approach using wireless recording devices. This technology is deployed using compact all-terrain vehicles, eliminating the need for traditional clear-cutting, which could reach up to five meters. This environmentally conscious seismic exploration method helps preserve forests. The abandonment of heavy equipment by "USBK-1" LLC significantly reduces fuel and lubricant expenses, minimizes impact on land and soil, and enhances industrial safety. "Green" seismic technology is now an industry standard in geological exploration, providing optimal efficiency and accuracy in hydrocarbon exploration while demonstrating the company's commitment to environmentally responsible project implementation.

Up to this point, "USBK-1" LLC has exclusively offered drilling services to depths of up to 3,500 meters. However, with the depletion of existing reservoirs and the need to ensure Ukraine's energy security, gas extraction companies are now drilling to depths of up to 7,000 meters.

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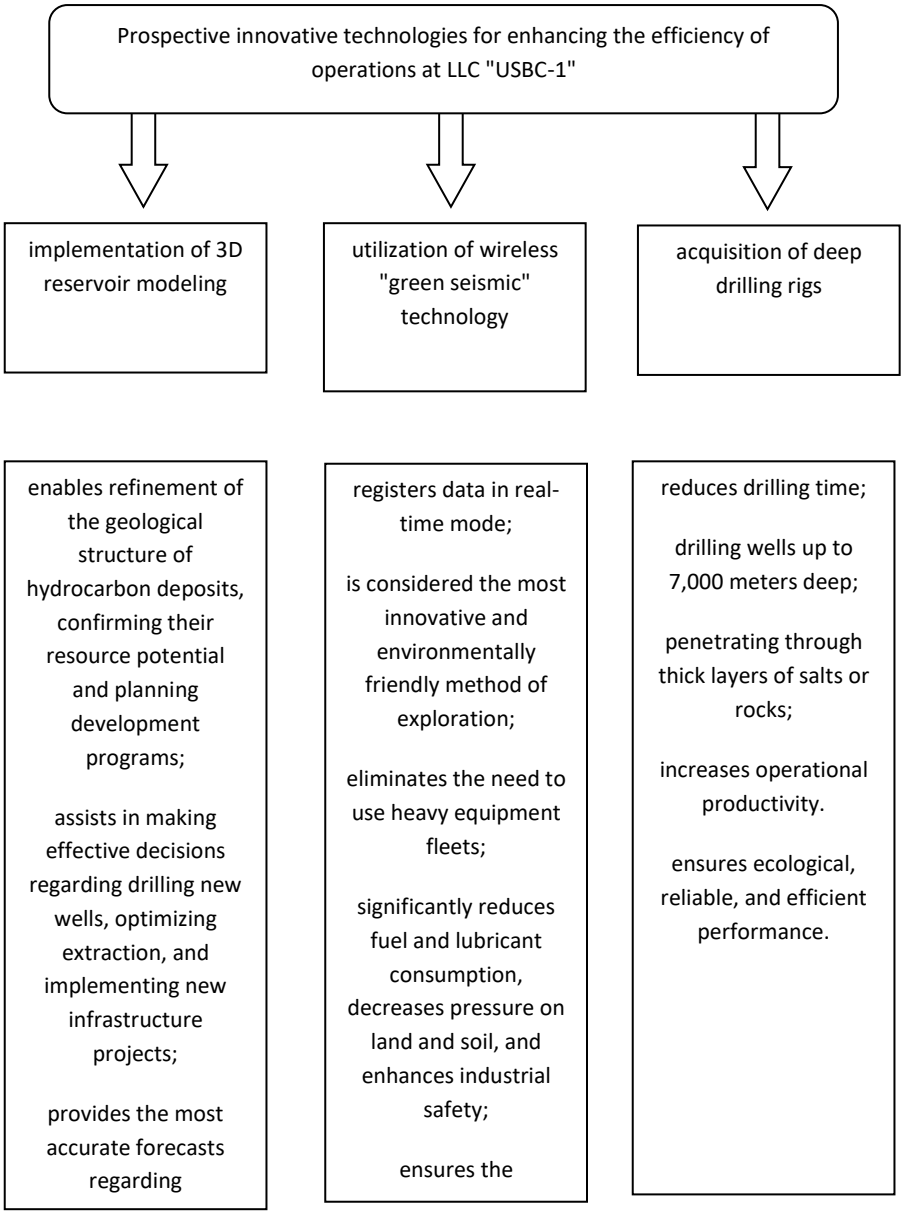

Figure 2. Promising Innovative Technologies to Enhance the Efficiency of "USBK-1" LLC

Unfortunately, "USBK-1" LLC currently cannot undertake such projects, leading to the loss of clients and the inability to execute significant deep drilling projects. To address this issue, it is crucial for the company to acquire state-of-the-art drilling rigs specifically designed for depths of up to 7,000 meters. It is expected that this strategic investment will enable "USBK-1" LLC to successfully implement large-scale projects, optimize the drilling process, and enhance overall operational quality.

To enhance the production base of "USBK-1" LLC, it is proposed to strengthen the elements of its innovative potential. Increasing qualifications will promote the systematic integration of innovative entrepreneurship, ensuring the adoption of advanced scientific and technological achievements. For financing inventive projects, the proposal suggests using financial leasing and

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engaging in state programs for financial support and public-private partnerships. To engage people in innovative entrepreneurship, it is recommended to incentivize them to generate inventive ideas and provide additional bonuses for acquiring knowledge of innovative technologies. To enhance the scientific and technical potential of "USBK-1" LLC, it is recommended to establish cooperation with educational institutions, particularly with the National University"Yuri Kondratyuk Poltava Polytechnic".

On Figure 3, the strategic initiatives and development goals of "USBK-1" LLC for the period of 2024-2028 are summarized.

It is expected that the implementation of these measures at LLC "USBC-1" will significantly increase its innovative potential, leading to the activation of innovative entrepreneurship. Priority should be given to the implementation of innovative technologies such as 3D modeling of deposits, the application of wireless "green seismic exploration" technology, and the acquisition of advanced drilling equipment for deep drilling. Next, we determine the economic efficiency of the proposed measures. It should be noted that a favorable outcome of implementing the proposed measures will be an increase in revenue from service and work sales.

The exact amount of additional revenue from sales is quite complex, as it is influenced by many factors. Therefore, we will use probabilistic and expert assessment methods. It is anticipated that by investing in the development of the material and technical base of LLC "USBC-1," it will be possible to increase the number of offered services. In particular, the acquisition of drilling equipment for deep drilling not only ensures the efficiency of the service but also expands the scope of the service. To determine the potential additional income from sales, we surveyed four experts: the director, chief engineer, and financial director.

According to the expert assessment, an average increase in revenue from sales of 21.66% is forecasted. Accordingly, in 2022, the company generated revenue from service and work sales amounting to 34,980.8 thousand UAH. Taking into account the expected growth of 21.66%, the projected increase in revenue will be 7,576 thousand UAH in the first year, with this figure increasing annually by an average of 5.

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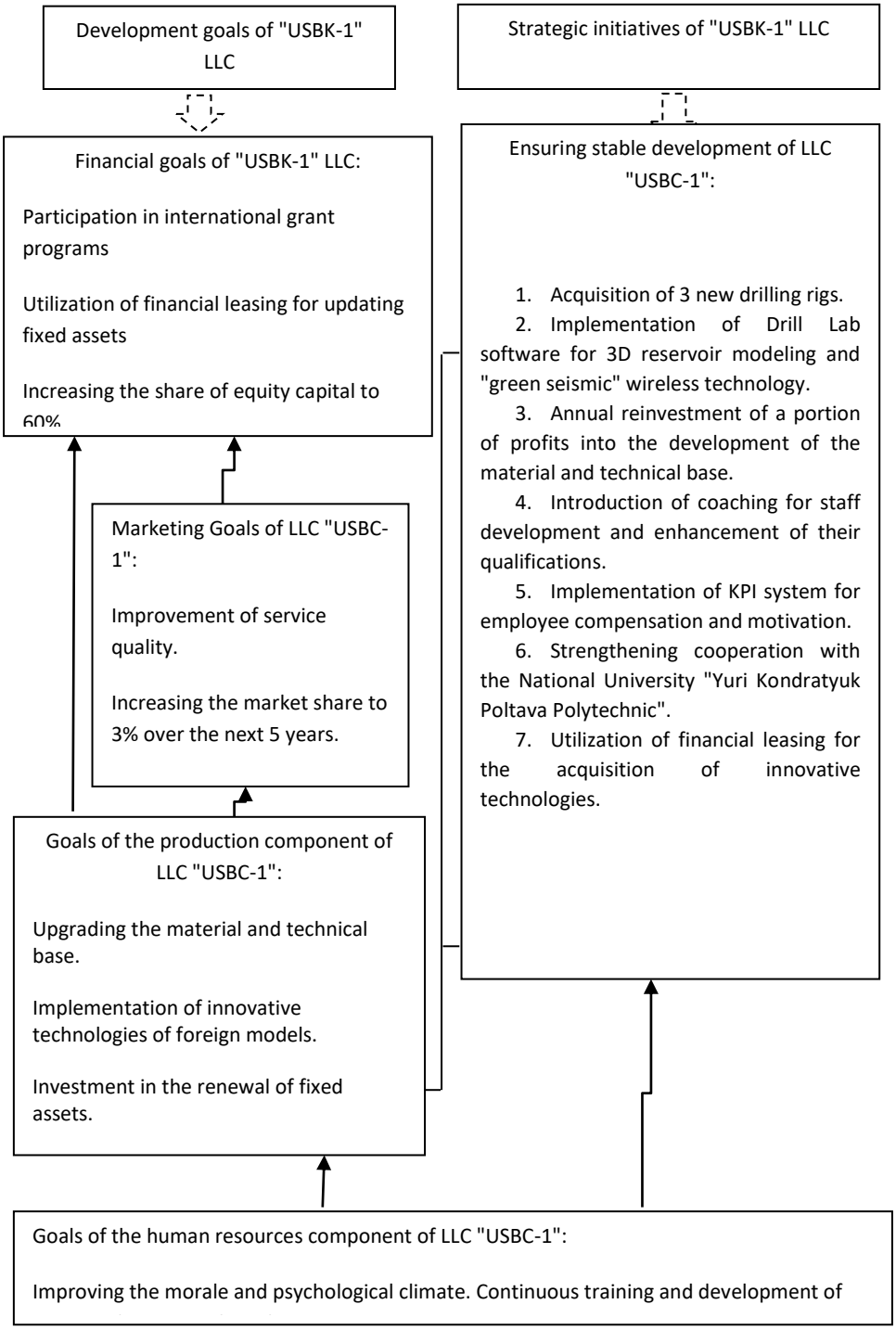

Figure 3. Strategic Initiatives and Development Goals of LLC "USBC-1" for 2024-2028

In Table 9, we will present the summary indicators of the effectiveness of the proposed measures.

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Table 9. Summary indicators of the effectiveness of proposed measures.

Period	Revenue, thousand UAH	Expenses, thousand UAH	Profit, thousand UAH	Income tax, thousand UAH	Cash flow, thousand UAH	Discounted net cash flow, thousand UAH	Payback period
Investments	-	5000	-5000	-	-5000	-5000	-
1 year	7576	2500,08	5075,92	913,67	4162,25	3468,55	1,8 years
2 year	7954,8	2625,084	5329,72	959,35	4370,37	3641,97	
3 year	8352,54	2756,338	5596,2	1007,32	4588,89	3824,07	
4 year	8770,167	2894,155	5876,01	293,80	5582,21	4651,84	
5 year	9208,675	3038,863	6169,81	308,49	5861,32	4884,43	
Total	41862,18	18814,52	23047,66	3482,63	19565,04	15470,86	

The preliminary calculations indicate that implementing the proposed set of measures for LLC "USBC-1" is economically advantageous and will ensure the company's additional profit. The initial investment is estimated at 5 million UAH. LLC "USBC-1" will be able to cover this amount from its own profit and finance the remaining part through financial leasing or participation in an international grant program. The critical importance of LLC "USBC-1" in the national economy facilitates easier access to financial resources. The projected increase in revenue stems from the company's ability to enhance the quality of its services, increase labor productivity, and expand the volume of work performed simultaneously. However, all forecasts are based on subjective factors, particularly the expert survey of the senior management of LLC "USBC-1". More precise results will be determined after the initial months of implementing the proposed measures. According to preliminary forecasts, it is expected that LLC "USBC-1" will generate a cumulative profit of 23,047 thousand hryvnias over 5 years. Additionally, this will contribute to strengthening the company's competitiveness, enhancing its image, increasing national mineral extraction, and other benefits.

Thus, to ensure the development of LLC "USBC-1" in the face of crisis phenomena, a strategy for 2024-2028 has been developed, which includes a set of measures to improve the company's key areas of activity: marketing, personnel, production, and finance. Key measures within this framework include the following: purchasing 3 new drilling rigs, implementing Drill Lab software for 3D modeling of deposits and wireless technology for "green seismic," annual reinvestment of a portion of profits in the development of the material and technical base, introduction of coaching for staff development and skills enhancement, implementation of a performance-based pay system for employees, strengthening cooperation with the National University"Yuri Kondratyuk Poltava Polytechnic" and using financial leasing to acquire innovative technologies. The preliminary forecast assessment has shown that implementing the proposed measures will allow LLC "USBC-1" to achieve a cumulative net profit of 23 million UAH over 5 years, with a payback period for the initial investments of up to 2 years. These results provide grounds for making a decision regarding the feasibility of implementing the proposed measures into the practical activities of LLC "USBC-1".

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Conclusion

The article evaluates the impact of crisis phenomena on the efficiency of TOV "USBC-1". Various contemporary methodologies and models were utilized to assess the influence of crisis phenomena on the functioning efficiency of TOV "USBC-1", which belongs to the construction and oil and gas industries. The obtained results indicate that crisis phenomena significantly affect the efficiency of the investigated company's operation. During periods of economic crises in the country, the financial condition of TOV "USBC-1" deteriorates significantly, affecting its operational efficiency. Based on the gathered data, it is concluded that in 2020, TOV "USBC-1" experienced a financial crisis and a high probability of bankruptcy. However, in 2021, amidst a stable market environment, the financial condition improved significantly, leading to stable financial status. Nevertheless, during the period of war in 2022, the situation deteriorated substantially again, leading to disrupted financial equilibrium for TOV "USBC-1".

The proposed directions for enhancing the efficiency of forecasting crisis phenomena in the activities of TOV "USBC-1" and assessing their potential consequences have been outlined. Given the presence of an elevated risk level during wartime conditions, TOV "USBC-1" necessitates seeking improvements in the process of forecasting crisis phenomena and evaluating their potential impacts. To achieve this, the establishment of an early crisis diagnosis system for TOV "USBC-1" is proposed. This system will enable the enterprise to proactively anticipate and accurately forecast potential crises and economic downturns affecting its operational efficiency. To facilitate this, the creation of a dedicated crisis management team comprising the director, financial director, chief engineer, and HR manager is recommended. Additionally, for proper information support and automation of this process, the implementation of specialized software such as Microsoft Power BI is proposed. Furthermore, the implementation of this software will enable automated processes for data collection, analysis, and processing, facilitating the analysis and evaluation of key indicators of crisis emergence. It will provide decision-making support, facilitate scenario modeling, and forecast crises and crisis phenomena. Moreover, this software allows for crisis assessment not only based on internal factors but also considers external influences. The adoption of these proposals will establish an effective early crisis diagnosis system, enabling proactive responses at the earliest stages of their inception.

Measures have been developed to ensure the development of LLC "USBC-1" in the face of crisis phenomena. With the aim of ensuring the development of LLC "USBC-1" in the conditions of crisis phenomena, a strategy for 2024-2028 has been developed, which includes a complex of measures to improve the main areas of the company's activities: marketing, personnel, production, and finance. Key measures within this framework include the following: acquisition of new 3 drilling rigs, implementation of Drill Lab software for 3D modeling of deposits and wireless "green seismic" technology, annual reinvestment of part of the profit in the development of the material and technical base, implementation of coaching for staff development and enhancement of their qualifications, introduction of KPI system for payment and motivation of employees, strengthening cooperation with National University"Yuri Kondratyuk Poltava Polytechnic", Using financial leasing to acquire innovative technologies. Preliminary forecasting assessment has shown that implementing the proposed measures will allow LLC "USBC-1" to achieve a cumulative net profit of 23 million UAH over 5 years, with a payback period for the initial investments for the company of up to 2 years. The obtained results provide grounds for making a decision regarding the feasibility of implementing the proposed measures in the practical activities of LLC "USBC-1".

Declarations
The manuscript has not been submitted to any other journal or conference.

Study Limitations
There are no limitations that could affect the results of the study.

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REFERENCES

1. Pavol Prievozník, Stanislava Strelcová. The impact of crisis phenomena on economic security in the automotive industry and the quality of life of employees. Transportation Research Procedia. Vol. 74, 2023, Pages 1412-1418. https://doi.org/10.1016/j.trpro.2023.11.290.
2. Kris Hartley, Brian Baldassarre, Julian Kirchherr. Circular economy as crisis response: A primer. Journal of Cleaner Production. Vol. 434, 1 January 2024, 140140. https://doi.org/10.1016/j.jclepro.2023.140140.
3. George E. Halkos, Panagiotis – Stavros C. Aslanidis. Sustainable energy development in an era of geopolitical multi-crisis. Applying productivity indices within institutional framework. Resources Policy. Vol. 85, Part B, August 2023, 103854. https://www.sciencedirect.com/science/article/abs/pii/S0301420723005652
4. Khomenko T.Yu., Pohrebniak A.Yu. Directions of Improving The Efficiency of Industrial Enterprises. URL: https://core.ac.uk/download/pdf/47233744.pdf
5. Pohrebniak A.Yu., Medvedieva A.D. Directions For Improving Enterprise Efficiency. URL:https://ela.kpi.ua/server/api/core/bitstreams/cf68e544-4024-4941-83ab-4b285371a2d1/content
6. Onyshchenko V., Ichanska N., Skryl V., Furmanchuk O. Economic and Mathematical Modeling of Innovative Development of Enterprises in the Construction Industry. In: Onyshchenko V., Mammadova G., Sivitska S., Gasimov A. (eds) Proceedings of the 3rd International Conference on Building Innovations. ICBI 2020. Lecture Notes in Civil Engineering, vol 697-709. Springer, Cham.

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RELIGIOUS-ANTHROPOLOGICAL ASPECTS OF SELF-REALIZATION IN THE ERA OF GLOBAL UPHEAVALS

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ABSTRACT

In the context of global changes and upheavals, there is a growing interest in the spiritual potential of the individual. The article examines how crisis situations expose the shortcomings of existing models of self-realization, making them ineffective. Against this background, the restoration of connection with eternal religious values appears as an auxiliary factor for people seeking the meaning of life. The study aims to identify and comprehend the relationship between religious experience and personal fulfillment in the context of global transformations and challenges. It thoroughly analyzes the influence of religious experience on personal self-realization in the context of modern global changes. The authors explore aspects of religious worldview that can influence personal development, especially in times of significant global change. The article also examines how religious beliefs can contribute to the formulation of strategies for personal self-realization in the face of global challenges. Various methods and approaches were used to formulate theoretical conclusions, including textual analysis of literature, systematization and coding of information, phenomenological analysis of religious texts, and the study of expert statements. The authors highlight the impact of globalization on human understanding and awareness of the meaning of life. In particular, the emphasis of Christian existentialism on deep individualism and personal responsibility to God and oneself becomes crucial in times of global upheaval. It emphasizes the importance of engaging with other people, community, and moral values, offering valuable guidance in times of global upheaval. The authors conclude that a religious and anthropological approach allows people to perceive themselves as part of a larger spiritual order. In the context of global change and upheaval, religious values provide a stable basis for self-realization. Faith and spirituality become a support and moral force in difficult times. Religious concepts of the meaning of life, suffering, and justice offer guidelines for self-realization and understanding one's place in the world.
Keywords: self-realization, religious spiritual search, religious anthropology, globalization.

Introduction

Today, humanity is facing a deep crisis that has a multifaceted nature. One of the most acute aspects of this crisis is the alienation of people from society, which makes it difficult for individuals to realize their potential. In the era of large-scale changes that the world community is experiencing, there is a growing interest in the individual and his or her potential. Crisis moments

expose the shortcomings of existing models of self-realization, making them ineffective. Modern social, political, spiritual, and informational upheavals challenge traditional values. Culture is not always able to offer adequate guidelines for self-realization in the face of constant change [1]. In this difficult situation, turning to eternal religious values can be a lifeline for a person. Religion gives a person support, meaning in life, and an understanding of their place in the world.

Therefore, the goals of our research on "Religious and Anthropological Aspects of Personal Self-Realization in the Age of Global Turmoil" are aimed at revealing and understanding the relationship between religious experience and the process of self-realization in the context of global changes and challenges. Our research is aimed at studying how religious experience interacts with the process of self-realization of the individual, especially in the context of global changes and challenges. We seek to reveal how faith and religious beliefs can influence an individual, contributing to his or her personal development in an era of profound transformation in the world. This study also aims to clarify the role of religion in the context of global challenges and to determine its potential contribution to the formation of personal strategies for self-realization in the modern world.

The latest research on religious and anthropological aspects of personal self-realization is, in particular, related to the following scholars. In particular, the modern scholar P. Zgórecki, tracing the evolution of approaches in the French phenomenology of religion, focuses on new trends that highlight the transition from the general philosophy of religion to a more specific analysis of religious experiences, which is revealed through the phenomenological approach [2], [3]. N. Catrien, A. Tonnaer examine the interaction between gender and religion in the context of anthropological discussions of the Anthropocene, in particular, criticizing the traditional threefold division into "culture," "nature," and "supernatural." Scholars reveal new perspectives on the interaction between these aspects and highlight their mutual influences in the modern world, particularly in the context of global changes and challenges of the Anthropocene [4]. Swera Hafeez examines the interaction of religious beliefs and cultures from the perspective of anthropological concepts, reveals the factors that cause intolerance, and looks for possible ways to overcome religious conflicts [5].

Therefore, in the context of global economic, political and cultural integration and unification, the issue of personal self-realization is gaining new importance [6]. We believe that in an era of global upheaval, it is important to consider self-realization as a person's search for and finding God. This is not just a religious act, but also a deeply personal process that leads to the realization of the meaning of life, one's purpose and place in the world.

Globalization and urbanization are closely intertwined forces that exert significant influence on the global landscape of economics, politics, and religion. Conventional anthropological theories fall short in adequately identifying and analyzing phenomena like global migration, diasporas, and transnationalism. Innovations in anthropology and the social sciences that aim to explore these and similar trends have the potential to enable us to scrutinize and reshape the theology and implementation of Christian missions [7].

Globalization is making the world more homogeneous, blurring cultural and national boundaries. This can lead to human alienation, loss of identity and meaning in life. In this situation, the search for God can become a lifeline. It gives a person support, meaning in life, and an understanding of their place in the world.

The search for God can go in different ways: through faith in a traditional religion, through spiritual practices and self-knowledge, through creativity and service to people. Self-realization as

a search for God is not a static process, but a constant path that a person goes through throughout life. This path can be difficult and thorny, but it leads to self-knowledge, self-development, and spiritual maturity. In the era of globalization, the search for God is becoming one of the most important aspects of personal self-realization.

Research Methodology

In writing this article, a number of methodological approaches and methods were used to obtain and process scientific information. Below is a detailed overview of the methods used: textual analysis of the literature, systematization and coding of information, phenomenological analysis of religious texts, analysis of expert statements, and formulation of theoretical conclusions. In particular, for further analysis and synthesis of the concepts, the research works related to the religious and anthropological aspects of self-realization were selected. The purpose of using the method of systematization and coding of information is to create a clear methodological structure of analysis. Phenomenological analysis was used to identify key concepts in religious texts aimed at personal self-realization. We also conducted a literature review and analyzed the statements of experts in well-known scientific journals and books. We used the information obtained to synthesize and formulate conclusions about the religious and anthropological aspects of personal self-realization.

Results and Discussion

The problem of human self-realization has always been deeply intertwined with various aspects of the individual and society, attracting the attention of philosophers of all historical periods. The history of thoughts on this topic has its roots in the mythology of primitive communities, where obedience to higher powers turned into religious concepts and impressed philosophers of the Ancient East, Antiquity, and the Middle Ages. In these periods, individual self-realization was seen as a means to achieve the self-realization of the Universal Soul or God.

The analysis of scientific sources emphasizes the lack of unity in understanding human nature and the possibilities of its development. Two opposing orientations, which were formed in antiquity and have survived to the present day, are clearly marked. According to the first, essential orientation, self-realization is seen as the result of the influence of external factors (social system, historical or natural-geographical conditions, fate, chance), which limits a person's freedom to shape his or her own life and realize potential. According to the second, existential, model, a person is absolutely free from social constraints, realizes his or her value, and can rise above circumstances and his or her own self to realize his or her self.

The idea of self-realization originated in the philosophy of F. Nietzsche and in the analytical psychology of C. Jung. Since the middle of the XX century, self-realization of the individual has become an object of study mainly in humanistic and existential philosophy and psychology (C. Goldstein, A. Adler, A. Maslow, C. Rogers, V. Frankl, E. Fromm, I. Yalom, G. Allport). The concepts of self-realization are based on the principles of humanistic cognition and are phenomenological in nature.

In humanistic psychology (Maslow, Rogers, Fromm), which studies the phenomenon of self-realization of the individual, there is no clear distinction between the concepts of self-actualization and self-realization. These scholars identify the characteristics of a self-actualized personality, which include: a conscious vision of one's choices and goals, the ability to distinguish between progressive and regressive behavior, active realization of one's own potential and

abilities, focus on self-knowledge, and openness to new experiences. A characteristic feature is the rejection of dependence on external influences, instead focusing on internal feelings and one's own worldview, which serve as the basis for behavior and practical actions.

In V. Frankl's theory of the realization of transcendent values and the meaning of life, values, meanings, their embodiment and responsibility are key components of personal freedom and self-realization. G. Allport considers the personality as a developing system that has its own "I" in the center and the desire for self-actualization, i.e., the disclosure of its inner capabilities. In his research, C. Horney proceeds from the idea that a person strives for self-realization and full identification of his or her true capabilities in the process of personal development. The concept of self-realization is developed in theories of growth, development and achievement, in cognitive and Gestalt theories. F. Perls considers self-realization as an internal, active tendency to develop oneself.

Thus, the concept of self-realization in the humanistic and existential approaches is phenomenological in nature. They are based mainly on philosophical ideas about personality development. The considered theoretical approaches quite clearly distinguish three aspects of the consideration of self-realization of the individual: self-realization as a need (aspiration, motive, goal, meaning); as a process and as a result. The concept of self-realization is presented in theories of personal growth and development, as well as in cognitive and Gestalt theories. F. Perls considers self-realization as an internal, active tendency of personal development [8].

Thus, the concept of self-realization, within the framework of humanistic and existential approaches, is determined by its phenomenological nature, which is based mainly on philosophical views on personal development. The considered theoretical approaches clearly distinguish three aspects of understanding self-realization: as a need (aspiration, motivation, goals, meaning); as a process and as a result.

As you know, the main task of a person is to develop spirituality. In classical European philosophy, this is often seen as a unique prerogative of the mind, while in the Ukrainian ethical and philosophical tradition it is seen mainly as the most direct realization of human interaction with God. Thinkers see the true spirituality of a person primarily in his or her inner world, in the deepest aspects of his or her being. The act of internal communication with God enriches the inner world of a person with the necessary existential truths that shape his or her spiritual development.

In general, the philosophical tradition, beginning in antiquity and continuing into the twenty-first century, with the exception of atheistic existentialism, is based on the concept of the unity of man and Deity, in which man plays an active and personal role. The limits of human existence are determined by rational everyday realities, and the individual strives to go beyond them, reaching a state of meta-rational enlightenment and openness. This transformation of the individual leads to changes in the world [9].

Religions, as the oldest and most stable factor in human history, play a decisive role in shaping the key anthropological trait of spirituality. They undoubtedly play a leading role in satisfying the human need for self-realization and self-actualization.

Religion, as a means of satisfying the human need for self-actualization and self-realization, affects the deep foundations of immediate existence, activating the spiritual aspects of the individual. It acts as an essential reality that gives attributive features to the personality (spiritual "self"), turning it not only into an external transcendental foundation of the soul, but also into a constructive element of true spiritual reality.

In an attempt to overcome the tension caused by the culture's forced imposition of standardized forms of self-realization, the individual complains about irrational methods of perceiving the world, which are partially reflected in religious traditions. Religious culture acts as an integral system of socio-cultural regulation for individuals and their groups, expressed in the form of value orientations. A believer, living a spiritual life, focuses on overcoming mortality. For him or her, spiritual development becomes a key subordinating factor of self-realization, and the ultimate goal of life is the transition of the soul to a new stage of existence in the afterlife.

Religious certainty in the process of personal self-realization is manifested in the consideration of the transcendent idea of God as an integral part of personal cognitive experience. One of the features of the religious certainty of the studied process is the stimulation of the individual by means of religious culture for spiritual self-improvement and creative changes in the world to meet new spiritual needs. Religion offers the individual to abandon the model of self-realization as being-for-itself, and instead choose being-for-others (through self-denial, service to God, which can be expressed in monasticism or asceticism) or being-for-itself with an emphasis on being-for-others.

The content of spiritual search serves as a justification for human activity and existence. Depending on the level of development of a society, different philosophical systems have their own level of human need for self-determination, as well as their own means of cognizing the possibilities and ways of realizing this need. Religious spiritual search is an indicator of the degree of freedom in the realization of human essence. Religions dramatically rethink the idea of a person. A person who bears the imprint of the creator's personality gains his or her own intrinsic value. In Christianity, a person finds a human ideal that is understandable and acceptable to all. The religious aspect of spiritual search is a reproduction of the human ability to be a subject in his spiritual activity. In its historical development, it determines the nature and direction of human activity in comprehending the meaning of life and achieving ideals. Religious spiritual searches are conducted mainly in two directions: within the religion itself and externally, which is clearly manifested in the sphere of spiritual culture (philosophy, art, fiction, etc.).

Research shows that high ideals can give a person significant inner strength. In particular, religious beliefs are the most influential. When spiritual values are located at the top of the hierarchical model of the universe and above it, strong and stable ties are formed that unite all its components. The dominance of religious ideas contributes to the stability of the psyche through a coherent, consistent, and centuries-old system of value orientations. Higher-order goals optimize the regulation of all lower levels. As a result of their influence, the entire system acquires the characteristics of a single tool for cognizing reality. The regulating influence of the spiritual ideal shapes the believer's sense of being, causing a special understanding and perception of the social environment.

Religious faith can form a powerful sense of purpose in a person, which allows him or her to overcome the tendency to deviate and search for alternatives to the chosen path. Such extreme determinism ensures the stability of psycho-emotional balance or even a state of insight. At this new level of self-awareness, the individual acquires the ability not only to concentrate all internal resources to follow the chosen course, which requires a special integration of the individual. He or she also becomes capable of transcendence, i.e., the extension of his or her being beyond the limits of his or her own life experience.

Thus, the self-realization of a believer consists in the use of irrational methods of cognition of reality and a transcendental way of communication with the Absolute. The influence of religious

culture is manifested in stimulating the individual to spiritual self-improvement and forming a sense of responsibility through the interpretation of certain types of human activity as sinful.

In particular, adherents of religious movements resort to intuitive, emotional and other non-logical ways of comprehending existence, and seek a transcendent connection with the supernatural. In addition, the religious worldview motivates the development of the spiritual component and instills an understanding of the inevitable retribution for committing so-called "sinful" actions [10].

The life of each person reflects the revelation of infinity, the perception of the divine in humanity, which manifests itself in finite manifestations through sensations as a means of achieving the consciousness of the divine that is inherent in Christ as the God-man. Faith gives rise to religious feelings, and in turn, religious feelings form a "state of faith," which gains meaning in the "outdoors"-the rationalization of the intuitive-irrational. Personal religion is most clearly manifested in mystical experience, where transcending the self means opening the realm of the Divine to man. This understanding of religion gives it creative aspects in the corresponding religious states and processes. Religious conversion associated with an existential crisis is overcome in great trials: the greater the mental suffering, the deeper the transformation of a person. In this context, holiness is not only a spiritual state in which religious feeling prevails, but also a way of coexistence and co-creation that leads to the revival of not only the bearer of holiness, but also others associated with him, and thus, in general, to the renewal of life.

Interestingly, the highest, greatest manifestations of spiritual growth are achieved in interaction with prayer: in these states-processes, the subconscious mind acts as a specific means that provides a unique contact between man and God.

The main problem of the modern information society is the spread of simplified forms of self-identification at the mass level. Religion acts as a traditional method of self-identification that enables individuals to strive for their own improvement. This traditional method allows an individual to find an external image and an internal spiritual model of perfection with which he or she identifies.

Thus, a person who is constantly looking for the image of God in himself enters the sphere of moral and ethical reflection, where his spiritual development is realized.

The findings of studies by American and Western European psychologists indicate that transpersonal experiences can lead to significant and lasting positive changes, such as a deeper sense of meaning, alleviation of existential crisis (E. Sutich, K. Wilberg, Kr. Grof), development of altruism, compassion, acceptance of oneself, others, and the world around one (C. Tart, A. Watson, G. Allport, J. Lilly). These experiences expand the understanding and awareness of the significance of life. Belief in a higher idea acts as a basic component that permeates all aspects of the personality structure and influences the formation of a person's life strategy.

Christian existentialism emphasizes deep individualism and personal responsibility to God and to oneself. This philosophical trend, which emerged in the mid-20th century and aims to combine Christian traditions and existentialist ideas, emphasizes the individual experience of interaction with one's own existence and relationship to a higher principle.

In Christian existentialism, an important element is the uniqueness of each individual and his or her attitude to eternal questions such as the meaning of life, good and evil, salvation and faith. A person is perceived as a free individual who is able to choose his or her own path and make important decisions that determine his or her spiritual development [11].

One of the key ideas of Christian existentialism is the notion of absurdity, the lack of meaning in a world without God. A person faces the absurdity of his or her existence and seeks interaction with a higher principle, hoping to find meaning and direction in his or her life.

Christian existentialism also emphasizes the importance of interaction with other people, community, and moral values. The idea of love, mercy, and mutual understanding is defined as a necessary element for achieving the fullness of a truly human existence.

All of these aspects make Christian existentialism an important philosophical movement that helps people understand themselves, their place in the world, and their spiritual path in the face of global upheaval.

Religious philosophy seeks to expand on the Christian doctrine of freedom, emphasizing the importance of freedom for creativity and personal fulfillment, which are considered to be the results of responding to God's call. The freedom provided by religious philosophy goes beyond the moral guidance offered by Christianity. Often this freedom can turn into immorality and arbitrariness, but this circumstance does not diminish its value at all. In the context of the spiritual life of a person, freedom is its basis and a necessary element for the expression of the divine in human existence [12].

The ultimate goal of Christian anthropology is to provide man with guidance on the path of salvation from what distorts his true image, as well as to direct him to the path of spiritual growth and union with his Creator [13].

The development of Christian humanities is a stage-by-stage process of integration of traditional theological knowledge, existential philosophy and reflection on the accumulated practical experience of personality formation based on Christian values. The use of the educational potential of Christian humanities to improve the education system in the state can help optimize the formation of an active personality capable of full self-realization [14].

Self-realization, in the broadest sense, means an active search activity of a personality aimed at revealing his or her own potential, achieving personal meanings and determining his or her purpose. This concept reflects the result of the development of a person's inner positive spiritual essence. Self-realization is interpreted as a way of existence that involves the development of intentions for self-improvement. The essence of self-realization is to create conditions for the full manifestation of one's own self.

A person is unique by nature, and this uniqueness is manifested in the complexity of his or her existence. He belongs to two worlds - the earthly and the heavenly - simultaneously in the structure of cosmic existence. Man embodies both material and spiritual natures. His body is the material aspect, and his spirit and soul represent the spiritual aspect. The image of God is preserved in the spiritual essence of man, and his spirituality determines his interaction with God and the spiritual world.

Conclusion

Thus, self-realization is viewed as a purposeful process of self-development in which one's own individuality is asserted by making various life choices. This process involves the prevalence of internal factors of personal development over external ones. An individual approach to self-development excludes the possibility of setting a predetermined individualistic goal of improvement. It is important to note that self-realization is not an end in itself; on the contrary, it requires an individual to be directed towards the world and other people.

A religious and anthropological approach can help a person see himself or herself as part of a larger spiritual order, which opens up new perspectives for self-development and contribution to society.

Religious spiritual search is an indicator of the degree of freedom in the realization of human essence and reflects the ability of a person to be a subject in his or her spiritual activity. They determine the nature and direction of human activity in the context of the search for the meaning of life and ideals. Religious certainty of self-realization stimulates the individual to spiritual self-improvement and creative change of the world. In particular, in the current conditions of the challenges of the twenty-first century, when the alienation of man and society is an urgent problem, it is important to use religious values in the vision of self-realization as the search for and finding God.

In an era of global upheaval, religious and anthropological aspects of personal self-realization are of particular importance and are marked by specific features, in particular: the special significance of religious values; the search for meaning in a religious context; the specific role of the community in the religious dimension; dialogue with the inner world; the role of faith in overcoming difficulties; and the perception of a person as part of a higher, spiritual level.

It is worth noting that in difficult times of global change and instability, religious values can serve as a stable foundation for self-realization. Faith and spirituality can become a support and a source of moral support, helping people find meaning and direction in life. In an era of global turmoil, people can turn to religious beliefs to find answers to complex life questions. Religious teachings about the meaning of life, suffering, and justice can serve as a guide to self-realization and understanding one's place in the world. Religious communities can be important factors for self-actualization. They provide support and an opportunity to discuss spiritual issues. It is through community in a religious context that a person can find their place and develop their inner potential.

Religious practice may include elements of meditation, prayer, and conversation with the inner self. In a globally unstable environment, it can become a means of self-discovery and focus on inner values. In times of global upheaval, faith can be a source of strength and inspiration. It helps a person survive difficulties and recover from trials, giving hope for a better future.

In general, the religious and anthropological aspects of personal self-realization in the era of global upheaval are determined by a combination of faith, spirituality, and the search for meaning, which is becoming key to identifying inner potential and responding to the complex challenges of our time.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

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REFERENCES

1. O. Hudzenko, “Digital Transformation in Culture: Current Realities and Development Perspectives”. Skhid. Vol. 4, No. 3 (2023): Digital Transformations in Culture. January 2024. Pp. 29-33. https://doi.og/10.21847/2411-3093.2023.4(3).296605
2. P. Zgórecki, “From Philosophy of Religion to Philosophy of Religious Experience: On New Tendencies in French Phenomenology of Religion”, Religions, Vol. 15 (1), No. 120, January 2024. https://doi.org/10.3390/rel15010120
3. P. Zgórecki, “Świat życia religijnego we francuskiej fenomenologii”, Filozofia Chrześcijańska, no. 19, pp. 47-67, November 2022. doi: 10.14746/fc.2022.19.3
4. N. Catrien, A. Tonnaer, “Gender and Religion in the Anthropological Debate of the Anthropocene: A Critique on the Threefold Culture–Nature–Supernature Divide”, Religions, Vol. 15, No. 218, February 2024. https://doi.org/10.3390/rel15020218
5. Swera Hafeez, “Religious Intolerance: Exploration in the Light of Anthropology of Religion”, Pakistan Journal of Social Research, Vol. 5, No. 3, September 2023, pp. 28-36. https://doi.org/10.52567/pjsr.v5i03.1324
6. V. Skirbekk, Alex de Sherbinin, S. Beatriz Adamo, T. Chai-Onn, “Religious Affiliation and Environmental Challenges in the 21st Century”, Journal of Religion and Demography, no. 7, pp. 238–271, October, 2020. https://www.researchgate.net/publication/346333194_Religious_Affiliation_and_Environmental_Challenges_in_the_21st_Century
7. W. Bray, “Quantum Physics, Philosophy, Theological Anthropology, Commerce, and Extinction”; a Seven Volume Set. Vol V: “Religion and Theological Anthropology”. January 2024. 475 p. https://www.researchgate.net/publication/377264768
8. O.I. Kupryeyeva, «Psykholohichni osnovy samorealizatsii studentiv v intehrovanomu osvitn′omu seredovyshchi: monohrafiya», K.: Talkom, 2021. 407 s. https://lib.iitta.gov.ua/727960/1/%D0%9C%D0%BE%D0%BD%D0%BE%D0%B3._%D0%9A%D1%83%D0%BF%D1%80%D1%94%D1%94%D0%B2%D0%B0_%D0%9E.%D0%86..pdf
9. I. Chornomordenko, O. Dobrodum, S. Khrypko, O. Gold, O. Osadcha. Modification of Religion in the Future under the Influence of IT, IJCSNS International Journal of Computer Science and Network Security, Vol.22, No.8, August 2022, pp. 135-144. https://doi.org/10.22937/IJCSNS.2022.22.8.18
10. S.D. Glazier, Ch. Flowerday, “Selected Readings in the Anthropology of Religion: Theoretical and Methodological Essays”, Publisher: Praeger, December 2022. 291 p. https://www.researchgate.net/publication/366356603_Selected_Readings_in_the_Anthropology_of_Religion_Theoretical_and_Methodological_Essays
11. Potsiurko, M. M. Freedom as an Anthropological Problem in the Christian Philosophy of Aurelius Augustine and Hryhorii Skovoroda. Anthropological Measurements of Philosophical Research, No. 22, December 2022, pp. 124–140. https://doi.org/10.15802/ampr.v0i22.271367
12. L.H. Utami, S.H. Mingtio, A. Muhid, “The Effect of Spiritual Intelligence and Religious Faith on Self-Regulation International”, International Journal of Islamic Educational Psychology, Vol. 3, No. 2, December 2022, 142-158. http://dx.doi.org/10.18196/ijiep.v3i2.15296

13. G. Lawrence-Hart, Burabari S. Deezia, "Theories of Religion: Tools to understanding human religious beliefs, practices and Philosophy", Timsmek Global Publishers, January 2023, 271 p. https://www.researchgate.net/publication/369649751
14. A.R. Hatala, K. Roger, "Spiritual, Religious, and Faith-Based Practices in Chronicity: An Exploration of Mental Wellness in Global Context (Routledge Studies in Religion)", London: Routledge, September, 2021, 284 p. https://doi.org/10.4324/9781003043508

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YERQURULUŞUNUN LAYİHƏLƏNDİRİLMƏSİNDƏ NÖVBƏLİ ƏKİN SİSTEMİNİN TƏTBİQİ (ETİBARLI ƏRZAQ TƏMİNATI)

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XÜLASƏ

Bu məruzənin məqsədi hər bir vətəndaşın ərzaq məhsulları ilə etibarlı təminatını və sosial dayanıqlılığını təşkil etməkdir. Odur ki, əhalinin kənd təsərrüfatı məhsullarına və sənayenin xammala olan tələatını qarşılamaq, müasir becərmə üsullarının tətbiqinə əsasən növbəli əkin konsepsiyasının yerquruluşu layihələrinə əsasən formalaşdırılması günün tələblərindəndir. Yeni təsərrüfatların təşkili, müasir becərmənin tələblərinə uyğun əkin sahələrinin qurulması(formalaşdırılmas) strateji sahə olan taxılçılığın inkişafı daim diqqət mərkəzində olmalıdır.
İşğaldan azad edilmiş ərazilərdə yeni sahələrin kənd təsərrüfatı dövriyyəsinə cəlb edilməsi və hər bir hektarın məhsuldarlığının artirilması elmi –texniki tərəqqidən geniş istifadə tələb edir. Bu məqsədlə növbəli əkin sisteminin tətbiqi rotasiya müddərinə uyğun torpaqdan düzgün istifadə edilməsini, ən az əmək və vəsait sərf etməklə yüksək məhsul alınmasını təmin edir.
Əkin sahələrinin səmərəli forma və müasir becərmə sistemlərinin tələblərinə cavab verən konfiqurasiyalarda qurulması, bitkilərinin məhsuldarlığının yüksəldilməsi istiqamətində aparılan aqrotexniki tədbirlərlə birgə layihələndirmədə növbəli əkinlərin tətbiqi xüsusi əhəmiyyət kəsb edir.
Yerquruluşunun layihələndirilməsi təlimatına uyğun olaraq zonalar üzrə tərtib edilmiş rotasiya cədvəl məlumatlarına əsasən kənd təsərrüfatı sahələrinin (bitkilərin) bir-birini əvəzləməsi təbii münbitliyin və məhsuldarlığın armasına təsir edən amillərdir.
Planalma ərazisinin konfiqurasiyasına, mövcud iqlim xüsusiyyətlərinə və torpakların faktiki keyfiyyət göstəricilərinə əsaslandırılmış qaydada növbələşdirilməsi, torpaqda qida maddələrinin miqdarının artması ilə birdə xəstəlik və ziyanvericilərə qarşı mübarizənin düzgün təşkilinə, torpaqların erroziyadan qorunmasına zəmin yaradır.
Kəndli fermer təsərrüfatları kiçik əraziləri əhatə etdiyindən eyni bitkinin eyni sahədə təkrarən bir neçə il əkilməsi (fitotoksiki maddələrin toplanması) məhsuldarlığa və məhsulun keyfiyyətinə mənfi təsir göstərməklə kənd təsərrüfatına marağı azaldır. Məhz qabaqcıl təcrübələrə əsaslanaraq monokultura əkinlərindən uzaqlaşmaqla, yeni layihələr bitkinin bioloji xüsusiyyətinə və becərmə texnalogiyalarına uyğun zonalaşdırılır.
Növbəli əkinlər ücün rotasiya sıralamasında hər bir bitkinin zonanın iqlim xüsusiyyətlərindən asılı olaraq həssaslığı nəzərə alınmalı intensiv becərmənin tətbiqinə nail olunmalıdır.
Yerquruluşunun layihələndirilməsində növbəli əkinlərin təşkili ərazi göstəricilərini təhlil etməklə birgə hər bir bitkinin sort və növünə uyğun seləflərinin düzgün təyini, əsas və aralıq bitkilərinin düzgün seçilməsi məhsularlığın müjdəsidir. Dövlət ehtiyat fond torpaqlarının bir hissəsinin kənd təsərrüfatı dövriyyəsinə (təyinatının dəyişdirilərək) cəlb edilməsi hesabına taxıl və yem istehsalını artırmaq üçün yeni "Avropark" ların təşkilini misal göstərmək olar.
Bu isə formalaşan yeni kəndli təsərrüfatlarda növbəli əkinlərin tətbiqinə marağı artırmaqla təsərrüfatların rentabelliyinə müsbət təsir göstərəcək.
Açar sözlər: növbəli əkin, kənd təsərrüfatı məhsulları, rotasiya müddəti, aqrotexniki tədbirlər.

ƏDƏBIYYAT

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1. Rzayev M.Y, Abdullayeva Z.M - "Növbəli və fasiləsiz əkinlərin torpağın bəzi münbitlik elementlərinə və bitkilərin məhsuldarlığına təsiri". // AZ.ETƏİ-nin Elmi əsərləri məcmuəsi, XXII cild, Bakı 2010, s. 227-231
2. Hacıyev C.Ə. Hüseyinov M.M. "Əkinçilik" Bakı 2008.
3. "Azərbaycan Respublikasının Torpaq Məcəlləsi" Bakı, "Qanun", 2002.
4. Hümbətov H.S. Məmmədov Q.Y. Nəzərəliyeva E.H. "Bitkiçiliyin nəzəri əsasları" Bakı-2023.

APPLICATION OF ROTATIONAL CROPPING SYSTEM IN THE DESIGN OF LAND STRUCTURE (RELIABLE FOOD SUPPLY)

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ABSTRACT

The purpose of this report is to organize a reliable supply of food products and social stability of every citizen. Therefore, to meet the demand of the population for agricultural products and raw materials of the industry, it is a requirement of the day to formulate the concept of rotation of crops based on the application of modern cultivation methods in land construction projects. Organization of new farms, establishment of arable land in accordance with the requirements of modern cultivation, development of grain growing, which is a strategic area, should always be in the center of attention.

Involvement of new areas in the agricultural cycle in the liberated territories and increasing the productivity of each hectare requires extensive use of scientific and technical progress. For this purpose, the application of the rotational cropping system ensures the correct use of the land in accordance with the rotation amount, and high yield with the least amount of labor and resources.

The application of crop rotation is of particular importance in designing the fields in an efficient form and in configurations that meet the requirements of modern cultivation systems, along with the agrotechnical measures carried out in the direction of increasing the productivity of plants.

According to the information of the rotation table prepared by zones in accordance with the land structure design manual, the alternation of agricultural fields (plants) are the factors affecting the maintenance of natural fertility and productivity.

Sorting based on the configuration of the planning area, the existing climate characteristics and the actual quality indicators of the soil, disease along with the increase in the amount of nutrients in the soil and creates a foundation for the proper organization of pest control and soil erosion protection. Since rural farms cover small areas, repeated planting of the same plant in the same area for several years (accumulation of phytotoxic substances) reduces the interest in agriculture by having a negative effect on productivity and product quality. By moving away from monoculture crops based on advanced practices, new projects are zoned according to the biological characteristics of the plant and cultivation technologies.

The sensitivity of each plant depending on the climatic characteristics of the zone should be considered in the rotation sequence for alternate crops, and the application of intensive cultivation should be achieved.

The arrangement of alternating crops in the design of the land structure, together with the analysis of the area indicators, the correct determination of the predecessors according to the variety and type of each plant, the correct selection of the main and intermediate plants is the gospel of productivity.

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An example is the organization of new "Europarks" to increase the production of grain and fodder due to the involvement of a part of the state reserve fund lands in agricultural circulation (by changing their purpose). This will have a positive effect on the profitability of farms by increasing the interest in the application of crop rotation in newly formed peasant farms.
Keywords: crop rotation, agricultural products, rotation period, agrotechnical measures.

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HISTORICAL BACKGROUND OF IRAVAN KHANATE

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ABSTRACT

The great ancestors of Azerbaijanis lived in the territory of the present Republic of Armenia in the VIII-VII centuries BC. Since ancient times, powerful states of Azerbaijanis have replaced each other in these lands, written a rich political history and created a rich cultural heritage. At that time, Armenians still lived in Asia Minor. Since Armenians did not come to the territory of present-day Armenia, there are no ancient toponyms in the Armenian language. Only during the period of Karagoyunlu, the center of the Armenian-Gregorian Church was moved to Uchmuazzin near Yerevan. Mass resettlement of Armenians trying to establish their statehood in Asia Minor and Ottoman lands to Azerbaijani lands took place in 1828. All this is reflected in Article XV of the Turkmenchay Treaty. A.S. Griboyedov wrote about this in his notes: "It is necessary to transfer all Armenians from the regions occupied by the Russian army - Tabriz, Khoy, Salmas, Maragha to Nakhchivan, Iravan and Karabakh provinces."
Keywords: previous centuries, The Blue Mosque, khanates of Ganja, Karabakh and Nakhchivan.

Introduction

However, let alone the previous centuries, even in the last century the names of the villages whose population consisted entirely of Armenians and a number of villages where Armenians and Azerbaijanis lived together were in Azerbaijani. All this shows that Armenians began to live in those villages later, because the mentioned villages did not have Armenian names [12].

The Blue Mosque, built in memory of Jahan Shah by his wife Khatun Janbeyim in Tabriz, is a masterpiece of 15th century Azerbaijani architecture. It is no coincidence that Taverniyen called it "Turquoise of Islam". It is not by chance that this mosque was built in 1465 by the skilled Azerbaijani architect Nematulla. At that time, Haji Ali Hafiz, who built the famous madrasa in Herat, Ahmed Shamistan, who built the Majnun Shah Mosque in Mashhad, and Bibi Khanim Mosque in Samarkand, were famous not only in Azerbaijan, but throughout the East [13].

Main part

Located north of the Araz River, the Iravan khanate bordered Iran, Turkey, Georgia, as well as the khanates of Ganja, Karabakh and Nakhchivan. The khanate, which united one city and 521 villages, was divided into the districts of Kirkhbulag, Zangibasar, Garnibasar, Vedibasar, Sharur, Surmeli, Deraken, Saatli, Talin, Seyidli-Akhsakhli, Sardarabad, Karpibasar, Abaran, Darachichak, Goycha [18]. Shoragil sultanate and Pambak province located in the north of the khanate also belonged to the Iravan khanate. The total area of the khanate is 21,554 square meters. verst was [14]. The population (excluding Pembak-Shoragil) was 17 thousand families [18] and about 90,000 (in some sources 115 thousand) [16] people. About 16,000 of this population were Muslim Kurds (2,924 families), 20,073 Armenians, 324 Yezidi Kurds, and the rest, i.e. 59%, were Azerbaijanis [18].

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The Khanate's troops consisted of two battalions of horsemen and several six-pounder field guns. In addition, there was special artillery of fortresses [18].

The list compiled by priest Hovhannes Shahkhatuna answers the question of who ruled the Yerevan Khanate from 1441 to 1828.

In the works of Jean Baptiste Tavernier, who came to Yerevan in 1655, it is mentioned that only Muslims live in the city fortress. The toponyms in these sentences, which Sharden wrote at the same time, in the same road notes, are proof of another reality. The land of the city is watered by the Qirkhbulag rivers flowing from the southwest and the Zangi rivers flowing from the northwest. Sardar's palace is a very beautiful, magnificent building. A thousand paces away, a tower rises up, it is called "Kechi Galasi(it means Goat Castle)" here.

After Tavernien and Chardin, European travelers such as Gemelli, Ger-Perter, James Morien, Montperaud, Cameron, Lynch, Dubois and others also visited Irevan Castle, Khan's Palace, which was built with high craftsmanship and rich in remarkable and pleasing architectural monuments, the Khan's Palace, its name "Shushabandi". They described with exceptional admiration the famous hall with mirrors, thousand and one ornate mosques in the castle, swimming pool and baths, the underground road with marble steps leading down to the Zangi river, the mansions in the city around the castle, the caravanserai and the squares.

From the end of the 14th century, it was recognized as the administrative center of the 15th century. Due to its geographical location and local conditions, during the rule of the Garagoyunlu (1410-1467) and Aggoyunlu (1467-1500), its name was widely spread and it was the administrative center of the Chukhursad province. A tomb still standing in the village of Jafarabad, adjacent to the city, is a relic of that period.

The tomb was built of baked bricks and stones. The names of Amir Said and his son Pir Husayn are mentioned in his inscription. Before Huseyin Pir Yaqub Bey, he was the emir of Chukhursad province. The inscription also mentions the leadership of Gara Yusif (1410-1420), the head of the Karagoyunul dynasty, and it is mentioned that his son Pir Budag was a great ruler. Undoubtedly, the tomb was erected in connection with the decree issued by Kara Yusif to place his son Pir Budag on the royal throne in Tabriz after defeating the Timurids and capturing the lands of Azerbaijan, Georgia, Armenia, and Arab Iraq south of Kur [13].

In the first volume of the ten volumes of the French traveler Jean Chardin, who visited Yerevan in 1683, it is shown that the Yerevan fortress can be considered a small city. There are 800 houses in the castle. Only Turks live here [9].

Armenian historian V. Parsamyan writes: "It is an undeniable fact that Armenians did not live in this area as a whole during the period when the South Caucasus was annexed to the Russian Empire."

The statistical collection of the Central Statistical Office of Armenia published in 1962 shows that in 1831, 15,992 (85.2%) of the 18,766 inhabitants of Yerevan were Azerbaijanis [10].

The neighborhoods, springs, rivers, gardens, mountains and hills of Yerevan have preserved their names among the people. Issue. According to Chopin's information, there were three large neighborhoods of Yerevan in the 18th century. City, Tepebaşı, Demirbulag. Those neighborhoods with the same name are still considered the biggest neighborhoods of the city. The neighborhoods of sila dyers, soap makers, and blue fabric dyers described by 18th century travelers still bear the names "Shilachi", "Sabunchu", "Boyagchi" as before.

The following facts once again prove that the Azerbaijani language, not Persian, Arabic, or Armenian, has a superior influence and is widespread in Irevan, as well as in the entire territory

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of the khanate. The letter of Matenadara kept in the archival fund was written by priest Gukas in 1784. In the letter, a list of seeds sent to Georgia to Irakli II, Beyazid, Isaac Pasha was given, and the quantity and price were indicated. Although it may seem strange, it is a fact that this priest, who is a master of the Armenian language, wrote the names of almost all seeds in Azerbaijani: wheat, watermelon, black watermelon, alfalfa, cucumber, spinach, basil, eggplant, rose...etc.

Place names are given in this order in all works, even in textbooks, where there is a discussion about the territory and borders of the khanate. From the Arpa River to the village of Gizil Church - from the village of Haji Bayramali to the mountain of Gabir... from the mountain of Koroglu to Arazboyu to Nakhchivan, to Sharur... Or let's consider the names of the districts included in the khanate: Kirkhbulag, Vedibasar, Sharur, Sürmeli, Saatli, Seyidli, Sardarabad, Talin, Zangibasar, Abaran, Derachichek, Derakand, Garnibasar, Goyche.

There is very little information about the ancient history of Yerevan. One of the reasons for this is the 366 years of intermittent wars between the Iranians and the Ottomans, the city changing hands 14 times and finally being destroyed in the 1679 earthquake. The first and relatively accurate information about the number and national composition of the population living here was provided by I. Chopin gave. According to his calculations, 2,400 families and 12,000 people lived in Yerevan during the time of the last Sardar. After the city was taken over by the Russians, some of the local Kubar families moved to Iran, and Armenians returned here from Iran and Turkey. At the end of the war, the national composition of the population was as follows: Azerbaijanis - 1807 families, 7331 people, Armenians - 567 families, 2379 people.

And in playing the trumpet they play very hard, but sometimes they play so loud that, to tell the truth, we have to stop our own ears and say to ourselves with horror: "What noisy nonsense we are hearing!" Probably, in order to show Kutuli how smart Armenians are and how well they manage to adapt to modern life requirements, they taught him some Armenian proverbs: for example, "What do you need to know who made this bread?" If it is tasty, even if it is cooked by a Jew, "eat it", or "live where you find bread!" It is quite legitimate that there is now a large field of activity for such sages. It is true that whoever follows such doctrines now wins, but I do not believe that he deserves praise and glory. On the contrary, these proverbs are a disgrace to the people who created them [5].

In the middle of the 18th century, the Iravan Khanate, a feudal state, was established in a large part of Armenia. The khanate covers the Ağrıdag valley, the shores of Lake Goycha and a large area extending southwest from the Araz river. The khanate consisted of 12 districts and these districts were headed by viceroys. Iravan Khanate was ruled by Hasanali Khan, Huseynali Khan, Gulameli Khan, Muhammad Khan, Aligulu Khan and other rulers in different years.

Historical facts confirm that Armenians came to the Caucasus and Eastern Asia much later. In fact, they never called themselves Armenians, they called their nationality "hay", "homeland", "Hayrenik". Turkic tribes called "Armenians" once lived in the territory of today's Armenia, and these territories were named "Armenia" after those tribes. The fact that the ethnonym "Armen" is a purely Turkish word also confirms what has been said. Later, the Hays who moved to these areas gradually settled in the lands of the local Armenian tribes and began to be called "Armenian", i.e. "Armenian", "Armenian" after the name of those areas [8].

"The territory of the Iravan Khanate is historically the homeland of Azerbaijanis. No matter how much the Armenians try to turn Yerevan into "Erebuni" in their own name, the historical facts tell the truth. This city was built in 1504 by Ravangulu Khan Shah Ismayil's suggestion. The last ruler of Iravan was Huseyngulu Khan (1828)" [1].

Armenians are greedy and covetous, seditious and confused, they don't like anyone. They have a talent for exaggerating a small matter, they love to create intrigue [1].

When Peter I, who marched to the Caucasus in 1721 and two years later occupied the Caspian territories of Azerbaijan, including Baku, saw the strong resistance of the local population, he launched the "Armenian card" and ordered the settlement of Armenians in the historical lands of Azerbaijanis, especially in Baku and Darbend. The historical testament addressed to the successors of Peter I formed the basis not only of the Russian Empire, but also of the Bolshevik repression in the South Caucasus. In 1768, Catherine II, who was the first to act on that situation, issued a decree on the ownership of the empire by Armenians. In 1802, Tsar Alexander I sent specific instructions to A. Sisianov, the viceroy of the Caucasus: "Armenians should be used at any cost to seize the Azerbaijani khanates." [2].

In the 18th paragraph of the instruction sent to Count V. Zubov, Tsarina Catherine II stated that the Iravan province, located on the border of the Ottoman state, and the entire upper part of the Araz river should be cleaned. He considered it appropriate to entrust this work to the Georgian Tsar Irakli II.

Georgian tsar Irakli was also inclined to occupy the Iravan fortress. However, he well understood that he could no longer take the Iravan fortress by his own strength, and he openly admitted that he would not be able to cope with this task without the military assistance of Russia.

Some Armenians living in the Iravan Khanate wrote letters to Irakli and tried to tempt him to attack Iravan. Armenians also addressed V. Zubov with such a letter. Zubov tried to convince Iraklin that he could attack Yerevan without worrying about Georgia's security when Russian troops were in Georgia.

The death of Tsarina Catherine II in November 1776 caused a change in the action plans of the Russian troops in Transcaucasia, and the attack on the Iravan Khanate was postponed. Russian troops were recalled from Transcaucasia by order of the new Tsar Paul I.

With the arrival of Russia in the Caucasus, its influence on the local khans began to increase. After the fall of Ganja, all the Muslim khans located east of Georgia began to become subjects of Russia one after another. Imeretia, Migrelia and Guria, which are located west of Georgia, have already accepted Russian citizenship, and the Abkhaz ruler has also started to lean towards Russia. Baba Khan tried to prevent this activity of Russia by all means. The judges of Yerevan and Nakhchivan also had a special role in the growth of Baba Khan's hatred towards the Russians. Thus, Mohammad Khan from Yerevan and Kalbali Khan from Nakhchivan, who were interested in deepening the contradictions between Russia and Iran, wanted to become independent. Muhammad Khan was appointed the judge of Iravan by his Safavids on the recommendation of Baba Khan's mother. Muhammad Khan, who aspired to independence, was able to attract Kalbali Khan from Nakhchivan, who was enmity with them, after being blinded by Agha Muhammad Khan, the representative of the Gajars who were in power in Iran. In such a situation, Muhammad Khan and Kalbali Khan were waiting for a favorable moment to realize their goals in their fortified fortresses [6].

Sisianov also focused on the subjugation of the Iravan Khanate. At that time, it was necessary for Russia to clash with Qajar Iran, and the marches to the Iravan khanate were considered in the thesis from the perspective of strategic goals.

An excuse was needed for the attack on the Iravan Khanate. Such an excuse is the case of Iravan Khan allegedly interfering in the religious affairs of Armenians - bringing David to the patriarchate of the Armenian church, seizing all the property of the Echmiadzin monastery.

However, Sisianov, who hoped to connect the territory of the khanate to Russia in an easy way, ended in fruitless negotiations with the ruler of Yerevan, Muhammad Khan, which led to the decision of the Russian troops to march into the territory of the khanate.

Although the Russians continued the siege of Yerevan from July 24 to September 2, 1804, no serious military operations were conducted by either side during this period.

During the second attack of the Russians on the Iravan Khanate and its fortress, serious changes had already taken place on both sides, Muhammad Khan was replaced by Huseyngulu Khan, and Sisianov was replaced by Gudovich. The defense of the Iravan fortress was strengthened with the help of England and France, who tried to remove the hand of Gajar Iran from the Caucasus, and serious quality changes took place in the Gajar army.

The Russian side, which had never given up on the plan to invade the Khanate of Iravan, was also making serious preparations for the upcoming operations. First, it was planned to capture Shurayel, an important strategic point on the road to Yerevan. Rich in grain, Shoreyel was important for the Russians both in terms of meeting the Russians' food needs and as a buffer zone on the border with Russia's Iravan Khanate and Ahalsikh Pasha during the wars with Qajar Iran and the Ottomans.

The second march of the Russians to the Iravan Khanate is already a test for the brilliance of other Azerbaijani generals Huseyngulu Khan and his brother Hasan Khan. In response to Gudovich's appeals for surrender, Hasan Khan said, "We are ready to fight with you not only inside the fort (it is not difficult), but also in the open field. Let it be known that the garrison of the fortress has already made its decision", his words clearly showed that he was determined not to give even an inch of the territory of the khanate to the enemy.

During the siege of the fortress, which lasted from October 3 to November 30, during the second march of the Russians to the Iravan Khanate, the bravery shown by the defenders of the fortress was a high example of the heroic struggle of the Azerbaijani people against the invaders. On the night of November 16-17, during the attempt of the Russians to attack the fortress, the brave defenders of Iravan killed the foreign invaders, the enemy was driven back with heavy losses, and this almost decided the fate of the entire march. The result of the third march of the Russians to Yerevan was also unsuccessful for the Russians.

Seversamidze, the head of Russian troops, wrote: "Armenians are more useful and loyal in peacetime" [11]. On July 16, Khan's troops counterattacked and entered Mirak (Shirak), and his brother Hasan Khan entered Shoragil. The Russian troops were forced to retreat after suffering heavy losses. "Ravan Sardar and his brother Hasan Khan freed the fortress of Abadan and put to the sword the Russians who escaped from there and took refuge in Garakilsa. Nomads from the region are moved to the Ravan side, and some villages of the Gyumru district are moved to the Ajam side. The princes are thinking of attacking Tiflis" [4]. Balığchay, Sadagachay, Garakilsa and other guard stations are destroyed. Hasan Khan's troops take control of the Gyumri road. Thus, Pembak and Shoragil are cleared of invaders for a short time.

At the end of 1826, the general staff developed two drafts of the next military campaign based on the opinion of Yermolov and Paskevich. According to the second project favored by Paskevich, the enemy was struck from an unexpected place, and the provinces of Yerevan and Nakhchivan were unexpectedly and completely separated from other provinces. The main blow was delivered to Tabriz. Yermolov demanded to be satisfied with occupying the Khanate of Iravan with the existing forces, to use Armenians in the fortresses, and to arm all Armenians in general. Then, passing through Meshkin province, Ardabil, Khalkhal and others were to be captured, thereby

bringing Talysh Khanate into submission [7]. Nikolay the first approved the project approved by Yermolov.

Paskeviçin İrəvan komendantı ilə görüşmək istəyinə cavab olaraq sərdar özü yazırdı: "Əgər söhbət qalanın təslim edilməsindən getmirsə icazə verirəm, əks halda bu mənasızdır. Mən qalanı heç vaxt təslim etmərəm". Qalanı ala bilməyəcəyinə əmin olan Paskeviç bu işdən vaz keçir. Şerbatova görə hətta qalanın mühasirəsi qoşunların qüvvəsi xaricində idi. Abbasabad və Sərdarabadda ələ keçirilən ərzaq və hərbi sursat rusları yarım il təmin etməyə imkan verirdi. Hətta Paskeviç bunsuz İrəvanın mühasirəsinin necə olacağını təsəvvür edə bilmədiyini bildirirdi [17].

İrəvanın alınması ilə bağlı Paskeviç I Nikolaya raportunda yazırdı: "...Mühasirə zamanı divarın altı qazılmış və artilleriya əla işləmişdir. Qurtuluş yolu tapmayanlar silahı atmış, digərləri müdafiə olunmaq istəmişlər. Lakin darvaza sındırıldıqdan sonra qala tam təslim olmuşdur" [3].

İrəvan müəllimlər seminariyasının müəllimi olan Şulgin bu məqaləni öz şagirdlərinin vasitəsilə ermənilərin yaşlı adamlarının verdiyi şifahi məlumatların əsasında yazılmışdır. Məqalədə XIX əsr rus tarixşünaslığına xas olan çar Rusiyasının Qafqazda apardığı əməliyyatların buradakı yerli xalqların İran və Türkiyənin əsrlər boyu biri-birini əvəz etməklə davam edən ağalığından, zülmündən azad etmək məqsədi daşıması xətti daim özünü göstərir. Müəllif rus ordusunun əzəmətindən, məğlubedilməzliyindən müəllif tərəfindən xüsusi vurğulanmaqla, İrəvanın alınmasında ermənilərin "xüsusi xidmətləri" də müəllif tərəfindən qeyd olunur.

Artıq 1827-ci ilin aprelində səhər əhalisi ailələri ilə birlikdə İrəvan qalasına köçür. Həsən xan isə süvarilərilə birgə Cəfərabadda mövqe tutmuşdu. Qalanın mühasirəsi 8 gün davam etmiş və oktyabrın 1-də ruslar tərəfindən alınır [19]. Paşkeviçlə əlaqəyə girən ermənilər qalanın müdafiəsindəki zəif yerləri ona bildirirlər.

On the 4th day of the siege, when Huseyin Khan wanted to leave the fortress in white clothes and attack the Russians on a white horse, he was dissuaded from this idea by some of the leaders of the fortress defense because he could be more easily hit by the enemy's bullets [19].

One year after the capture of Yerevan, Griboyedov's play "Gore ot uma" is staged for the first time in the hall of mirrors in the Sardar's palace [19].

The Sardar palace, two mosques, and several administrative buildings are located in the Iravan fortress. The castle is surrounded by a moat on three sides and two fairly high fences (walls). One side of the castle walls is steep and adjacent to Zangi river. On the right side of the river rises a mound called Mount Irakli, which was named after the Georgian Tsar Irakli's march to Yerevan. The castle walls are made of small stones and clay mixed with straw. Water was pumped underground to the castle from Zangi and Kirkhbulag rivers. There were 800 houses in the castle before it was occupied by Russia, most of which were destroyed during the occupation of the castle [15].

It was built by Huseyn Khan, located on the left bank of Araz with Sardarabad Castle, which is a little distance from Iravan Castle. Its 2-story castle walls are also designed for cannons with 10 bullets. There was a sardar's palace and up to 700 houses. There was 1 mosque, 16 mills, khan's garden, 1 dyehouse, 4 oil mills and 33 market places belonging to the Sardar [15].

On March 21, 1828, according to the decree issued by Nicholas I, the Nakhchivan and Iravan khanates were abolished, and in their place, the Armenian province was established in our ancient, ancestral lands. More than 40,000 Armenians were resettled here. The goal of the resettlement policy was to Armenianize the place. The Armenian province existed until 1850, and from that year it became the Iravan governorate.

Conclusion. To sup up, Irevan was given to Armenia when the Azerbaijan People's Republic was established, precisely by the Azerbaijan People's Republic. Most of the people living in the Iravan Khanate were Azerbaijanis. All the inhabitants of Zangezur district were Azerbaijanis. So, from the historical point of view, this is our land.

REFERENCES

1. Azərbaycan qəzeti. 31 mart 2001-ci il səh.3, 4
2. Azərbaycan qəzeti. 30 mart 2005-ci il səh.6
3. Azərb. MLTA, 288, siya.sax.7, v.2-2 arx. Osmanlı Devleti ilə…, II kitab, s.208-211
4. Bora Cevdet Hariciye, nz 5594 – Bax: Osmanlı devleti ilə..., I kitab, s.111-112
5. Çavçavadze İ.Q. "Erməni alimləri və fəryad edən daşlar" – Bakı, "Azərbaycan" nəşriyyatı, 1995, səh. 33 (80 səh.)
6. Dubrovin N.F. Zakavkaz"ye ot 1803-1806 goda. SPb.: 1866, 542 s.
7. Dubrovin N.F Istoriya voyny i vladychestva russkikh na Kavkaze, t.VI, Spb.: Sklad izdaniya u V.A.Berezovskogo, 1888, 756 s.
8. Ələkbərli Ə. Qədim Türk-Oğuz yurdu- "Ermənistan". Bakı – "Sabah", 1994, səh.18 (səh.208)
9. Xalq qəzeti. 1 dekabr 2010-cu il, №263 (26613)
10. Xalq qəzeti. 30 mart 2011-ci il, №65 (26704)
11. QAKA, VI cild, sənəd 1372
12. Qeybullayev Q. Qədim türklər və Ermənistan. B.: Azərnəşr, 1992, səh. 65 (140 səh.)
13. Məmmədov İ., Əsədov S. Ermənistan azərbaycanlıları və onların acı taleyi. – Bakı, "Azərbaycan" nəşriyyatı, 1992, səh. 8,13
14. Obozreniye rossiyskikh vladeniy za Kavkazom v statisticheskom, etnograficheskom, topograficheskom i finansovom otnosheniyakh, ch. I, SPB.: Tipografiya departamenta vneshney torgovli, 1836, s. 22;303.
15. Obozreniye Rossiyskikh vladeniy Zakavkaz'ya. T.4, Spb. 1836 g., str.290-292 (401 s.)
16. Ryumin V.A. Kratkiy istoricheskiy i etnograficheskiy ocherk Azerbaydzhana – Azerbaydzhanovedeniye, Baku, 1924, s.381. Shcherbatov. General-fel"dmarshal knyaz Paskevich, yego zhizn" i deyatel"nost'. T. II, SPb.: 1890
17. Shopen I. Istoricheskiy pamyatnik sostoyaniya Armyanskoy oblasti v epokhu yeye prisoyedineniya k Rossiyskoy imperii. SPb., 1852, s.482-488
18. Shul'gina K. Vzyatiye g. Erivani. CMOMPK, t. IV. Tiflis: Tipografiya Glavnonachal'stvuyushego grazhdanskoyu chastiyu na Kavkaze,1884, s. 34-39
19. https://ilhamaliyev.preslib.az/docs/i09.pdf0

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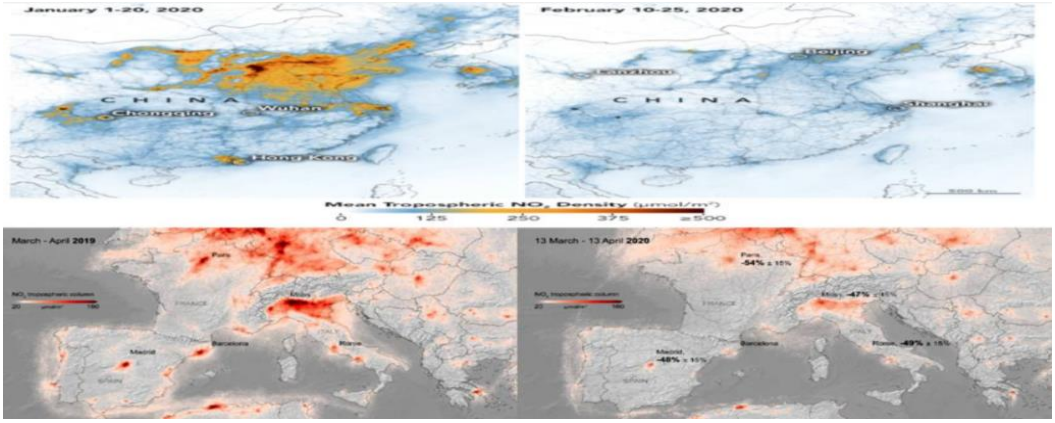

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3. Bahishti, "A New Multidisciplinary Journal; International Annals of Science", Int. Ann. Sci., vol. 1, no. 1, pp. 1.1-1.2, Feb. 2017. https://journals.aijr.in/index.php/ias/article/view/163
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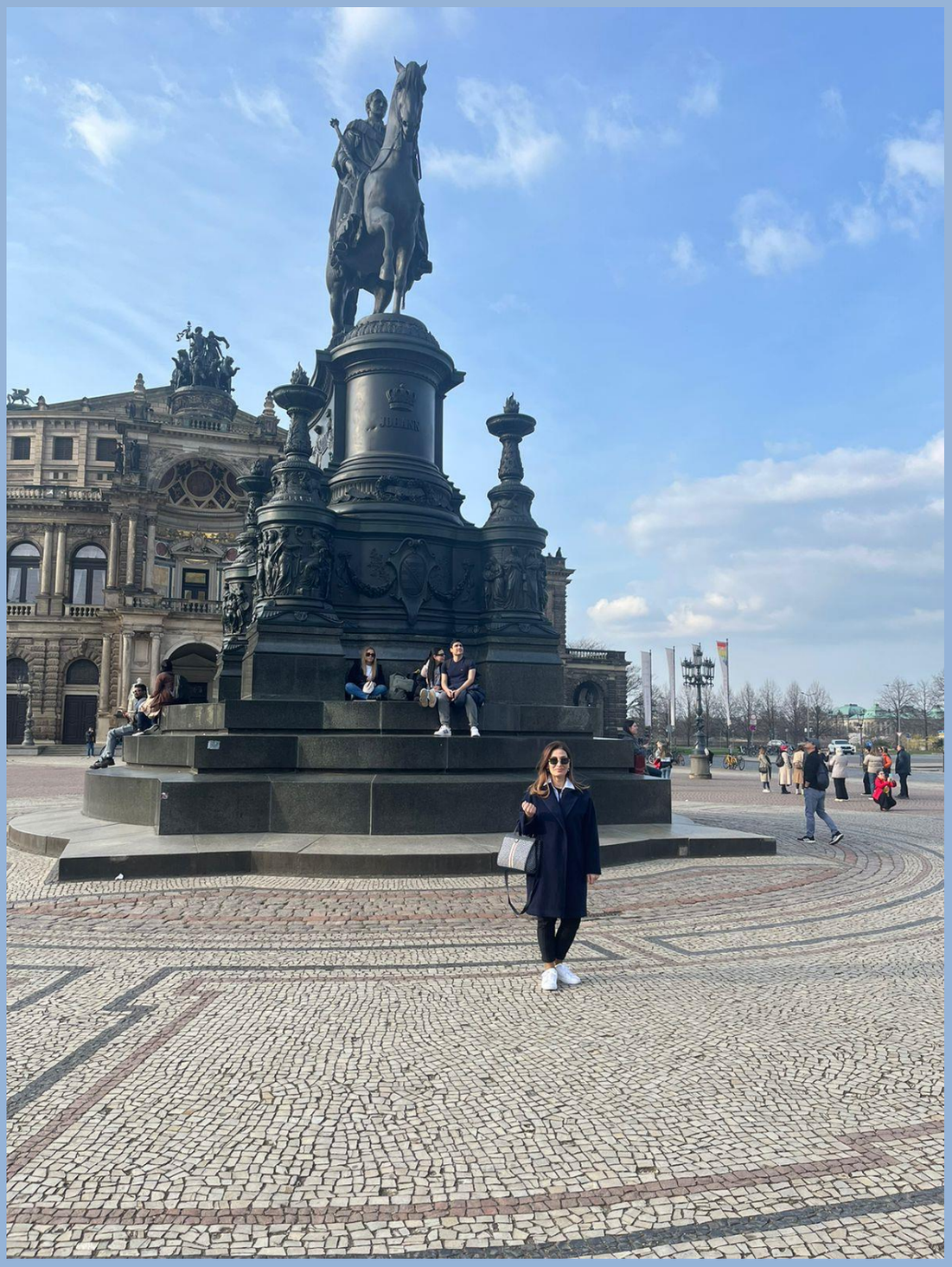

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