ТЕОРИЯ И ПРАКТИКА СОВРЕМЕННОЙ НАУКИ: ВЗГЛЯД МОЛОДЕЖИ

МАТЕРИАЛЫ III ВСЕРОССИЙСКОЙ НАУЧНО-ПРАКТИЧЕСКОЙ КОНФЕРЕНЦИИ НА АНГЛИЙСКОМ ЯЗЫКЕ

Научное издание

Часть I



Санкт-Петербург
2024

Министерство науки и высшего образования Российской Федерации
ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ОБРАЗОВАНИЯ
«Санкт-Петербургский государственный университет промышленных технологий и дизайна»
Высшая школа технологии и энергетики

МАТЕРИАЛЫ

III Всероссийской научно-практической конференции на английском языке «ТЕОРИЯ И ПРАКТИКА СОВРЕМЕННОЙ НАУКИ: ВЗГЛЯД МОЛОДЕЖИ»

Научное издание

2024 ● Часть I

Под общей редакцией заведующей кафедрой иностранных языков, кандидата филологических наук, доцента В. В. Кирилловой

Санкт-Петербург
2024

УДК 378.2.001
ББК 72
Т 338

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Т 338 Теория и практика современной науки: взгляд молодежи: материалы III Всероссийской научно-практической конференции на английском языке. В 2 ч. / Минобрнауки РФ; ФГБОУ ВО «С.-Петерб. гос. ун-т промышленных технологий и дизайна»; сост. М. А. Васильева, М. С. Липатов, Е. Н Лашина.; под общ. ред. В. В. Кирилловой. – СПб.: ВШТЭ СПбГУПТД, 2024. – Ч. I. – 356 с.
ISBN 978-5-91646-386-6

В настоящем сборнике представлены материалы III Всероссийской научно-практической конференции на английском языке «Теория и практика современной науки: взгляд молодежи», состоявшейся 30 ноября 2023 года в Санкт-Петербурге.

Материалы представлены в авторской редакции. Ответственность за аутентичность и точность цитат, имен, названий и иных сведений, а также за соблюдение законов об интеллектуальной собственности несут авторы публикуемых статей. Организаторы конференции не несут ответственность перед авторами и/или третьими лицами за возможный ущерб, вызванный публикацией статьи.

Материалы конференции размещены в научной электронной библиотеке elibrary.ru и зарегистрированы в наукометрической базе РИНЦ (Российский индекс научного цитирования).

УДК 378.2.001
ББК 72

ISBN 978-5-91646-386-6

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Ministry of Science and Higher Education of the Russian Federation

FEDERAL STATE BUDGETARY EDUCATIONAL INSTITUTION OF HIGHER EDUCATION

“Saint Petersburg State University of Industrial Technologies and Design”
Higher School of Technology and Energy

PROCEEDINGS

of the III All-Russian Scientific and Practical Conference in English “THEORY AND PRACTICE OF MODERN SCIENCE: THE VIEW OF YOUTH”

Scientific publication

2024 ● Part I

Under the general editorship of Head of the Department of Foreign Languages, PhD in Philology, Associate Professor
V. V. Kirillova

Saint Petersburg
2024

UDC 378.2.001
BBK 72
T 338

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T 338 Proceedings of the III All-Russian Scientific and Practical Conference in English “Theory and Practice of Modern Science: the View of Youth”. In 2 parts. / Ministry of Education and Science of the Russian Federation; FSBEI HE “Saint Petersburg State University of Industrial Technologies and Design”; compilers M. A. Vasilyeva, M. S. Lipatov, E. N. Lashina; under the general editorship of V. V. Kirillova. SPb.: HSTE SPbGUITD, 2024. Part I. 356 p.
ISBN 978-5-91646-386-6

This collection presents the proceedings of the III All-Russian Scientific and Practical Conference in English "Theory and Practice of Modern Science: the View of Youth", held on November 30, 2023 in St. Petersburg.

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The proceesings of the conference are posted in the Scientific Electronic Library elibrary.ru and are registered in the Scientometric Database of the RSCI (Russian Science Citation Index).

UDC 378.2.001
BBK 72

ISBN 978-5-91646-386-6

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TABLE OF CONTENT

Lisnyak A. V., Academic Advisor Cheremnykh V. Yu.
TO THE PROBLEM OF ACCOUNTING FOR LEASE TRANSACTIONS. 16

Vnukova Z. M., Academic Advisor Pitel T. S.
DIGITAL ECONOMY. 24

Moskalenko P. A., Academic Advisor Ignatieva T. Yu.
APPLICATION OF MACHINE LEARNING TO PREDICT ELECTRICITY CONSUMPTION. 29

Laputsky A. V., Academic Advisor Kozlov S. V.
USING MESSAGE BROKERS TO PROCESS REQUESTS ON THE EXAMPLE OF APACHE KAFKA. 33

Galimova E. Yu.
SOFTWARE TESTING METHODS OF INFORMATION RESOURCES OF THE HIGHER EDUCATIONAL INSTITUTION. 39

Fedoruk S. S., Lashina E. N.
NUCLEAR WASTE DISPOSAL. NUCLEAR WASTE DISPOSAL TECHNOLOGY IN RUSSIA AND THE USA. 45

Priymak A. A.
MARKETING PLACES AND DESTINATION BRANDING: FOREIGHN AND RUSSIAN EXPERIENCE. 51

Maksimov Ya. V., Ershov K. K.
EVOLUTION OF TRANSISTORS: FROM SILICON TO QUANTUM. 57

Pytiev N. N., Academic Advisor Yakovlev G. I.
FORMATION OF A KEY PERFORMANCE INDICATORS MONITORING SYSTEM FOR INDUSTRIAL ENTERPRISES. 62

Tangelov P. I.
TARGET AUDIENCE OF THE GRAPHIC NOVEL: SPECIFICS OF DEMAND FORMATION AND PECULIARITIES OF CONSUMPTION IN RUSSIAN FEDERATION AND THE REPUBLIC OF CRIMEA. 69

Kholamkhanova Ya. A., Academic Advisor Ivanenko A. I.
F. F. COPPOLA'S ''THE GODFATHER'' AS A SOCIOCULTURAL PHENOMENON. 78

Fedorova E. A., Academic Advisor Baranova E. G.
DEVELOPMENT PROSPECTS FOR CONTROL SYSTEMS DEBUGGING AND ADJUSTMENT. 88

Marshev D. V., Zheltova E. M., Academic Advisor Zheltova Ye. P.
METAVERSE POTENTIAL: STUDENTS' ASSESSMENT
FOR CAREER-RELATED TECHNOLOGICAL ADVANCEMENTS. 94

Kotova V. A., Academic Advisor Schevtsova I. V.
THE USE OF BIG DATA IN PUBLIC ADMINISTRATION. 101

Lutskaya E. V., Molikov P. A., Academic Advisor Korotkikh A. A.
ANALYSIS OF THE NEGATIVE IMPACT OF THE SMOLENSK
HYDROELECTRIC POWER PLANT ON THE ECOLOGICAL STATE
OF THE ENVIRONMENT. 106

Novikova V. I.
PROBLEMS AND PROSPECTS OF DIGITAL SERVICES BASED
ON BLOCKCHAIN. 112

Taktueva Yu. G.
FEATURES OF CHILD-PARENT RELATIONS AS A CAUSE OF DEVIANT
BEHAVIOR OF CHILDREN AND ADOLESCENTS. 117

Vnukova Z. M., Academic Advisor Pitel T. S.
CAUSES OF LOW-QUALITY ELECTRICITY. 122

Zhivotikova Yu. A., Academic Advisor Kuzurman V. A.
AEROSOL CONTAMINATION OF THE AIR BASIN, METHODS
OF ANALYSIS AND METHODS OF REMOVAL. 127

Kniazeva A. Iu., Academic Advisor Yanenko M. B.
EMOTIONAL INTELLIGENCE AS ONE OF THE COMPONENTS
OF QUALITY MANAGEMENT OF HOTEL SERVICES. 131

Novikova V. I.
CRYPTOCURRENCIES AS AN INVESTMENT OBJECT. 136

Zubets V. V., Shapkina I. A., Academic Advisor Lashina E. N.
CHRONIC SHORTAGE AND IMMINENT ABSOLUTE DEPLETION
OF MINERAL RESOURCES. WAYS TO SOLVE THE PROBLEM
OF EXHAUSTION. 141

Skrashchuk N. D., Khaliullina E. N., Academic Advisor Slassi Moutabir S. A.
ANALYSIS OF ESG STRATEGY IMPLEMENTATION BY BELARUSIAN
BANKS. 147

Protchenko O. V., Lashina E. N.
THE USE OF BLOCKCHAIN TECHNOLOGY IN THE ELECTRIC POWER
INDUSTRY. 151

Shentseva M. S., Molikov P. A., Academic Advisor Korotkikh A. A.
THE INFLUENCE OF A COOLING POND ON THE SAFE OPERATION OF A NUCLEAR POWER PLANT. 158

Nikeshin V. G., Academic Advisor Sidelnikov V. I.
PREDICTIVE CONTROL SYSTEM AS ONE OF THE APPROACHES TO ENSURING OPTIMAL PERFORMANCE OF PRODUCTION PROCESSES. 163

Nikolaeva E. S.
SPECIFIC FEATURES OF INTRODUCING BLENDED LEARNING “FLIPPED CLASSROOM” IN THE PROCESS OF LEARNING FOREIGN LANGUAGES AT UNIVERSITY. 169

Rubtsov K. D., Academic Advisor Krongauz D. E.
REDUCTION OF ELECTRICAL ENERGY LOSSES IN POWER TRANSFORMERS. 174

Zakharova V. D., Academic Advisor Kiriliuk O. M.
BASIC PRINCIPLES OF EDUCATIONAL TOURISM. 180

Khakimova K. I., Academic Advisor Tuguzbaev G. A.
CURRENT PROBLEMS OF PSYCHOLOGICAL AND PEDAGOGICAL SUPPORT FOR STUDENTS WITH LIMITED HEALTH CAPABILITIES. 185

Shevchuk V. V., Academic Advisor Yanchukovich S. G.
PROBLEMS OF WASTE RECYCLING AND WAYS TO SOLVE THEM. 191

Merzlaya D. M., Academic Advisor Zyatikov I. D.
PERMANENT MAGNET SYNCHRONOUS REACTIVE MOTOR. 197

Lyamkina V. A.
INCREASING THE EFFICIENCY OF MANAGEMENT OF HIGHER EDUCATIONAL INSTITUTIONS IN THE PROCESS OF DEVELOPING AN ENTREPRENEURSHIP UNIVERSITY. 202

Bozhenova M. V., Petrov V. S.
INTEGRATION OF ARTIFICIAL INTELLIGENCE INTO THE EDUCATIONAL PROCESS: DEVELOPMENT AND IMPLEMENTATION OF AN INNOVATIVE CHATBOT FOR PERSONALIZED LEARNING. 206

Maksimov Ya. V., Mazyarkin D. V., Academic Advisor Lashina E. N.
REVOLUTIONARY TRANSISTOR TECHNOLOGY: TRANSITION TO THE ERA OF ELECTRONICS OF THE FUTURE. 212

Maslenkov A. O., Nugaev I. I., Academic Advisor Shipshova O. A.
SHADOWIZATION OF ECONOMIC ACTIVITY AND ITS IMPACT ON ECONOMIC SECURITY. 217

Protchenko O. V., Academic Advisor Ilina O. V.
THE INFLUENCE OF GRAPHIC DESIGN ON THE BRAND. 223

Rzhevskaya N. V.
FROM CONCEPT TO CRYPTOGRAPHY: THE HISTORY OF HOMOMORPHIC ENCRYPTION AND ITS DEVELOPMENT. 228

Silchenko A. S., Domashchenko G. A.
DEMOGRAPHIC PROCESSES AND THE MECHANISM OF THEIR INFLUENCE ON THE LABOR MARKET. 236

Savenko A. V., Kryukov K. A.
COMPARATIVE ANALYSIS OF WATER PURIFICATION METHODS BY CHEMICAL AND ULTRASONIC TECHNIQUES. 241

Silchenko A. S., Domashchenko G. A.
EMOTIONAL LEADERSHIP STYLES. 246

Kascheev K. O., Academic Advisor Shiryaev A. D.
THE IMPACT OF RENEWABLE ENERGY SOURCES ON THE PROSPECTS FOR THE DEVELOPMENT OF THE OIL SECTOR. 251

Schegolkova A. A., Leshchenko K. D., Academic Advisor Savinskaya D. N.
CONTAINER VIRTUALIZATION: REVOLUTIONIZING SOFTWARE DEPLOYMENT AND MANAGEMENT. 257

Ivanova K. A., Putina Yu. V., Korableva S. A., Academic Advisor Korableva O. N.
ENERGY SAVING ISSUES IN THE CHEMICAL INDUSTRY. 262

Sivkova A. A., Skorobogatova D. I.
FINTECH AND BIGTECH: DEFINITIONS, FEATURES, DIFFERENCES. 268

Dergacheva D. A., Academic Advisor Perevertkina M. S.
DESIGNING AND USING WEBQUESTS TO SUPPORT TEACHING SPEAKING IN PRIMARY SCHOOL. 273

Piletskaya A. S., Academic Advisor Znamenskaya A. M.
THE IMPACT OF PLASTIC ON ECOSYSTEMS: PROBLEMS AND PROSPECTS FOR SOLUTIONS. 278

Kitaeva M. V., Academic Advisor Sergeeva E. V.
LINGVOCULTUROLOGICAL FEATURES OF ITALIAN TRAVEL VLOGS. 285

Gavrilina P. A., Academic Semchuk E. V.
USE OF LOW-POTENTIAL HEAT FOR SNOW UTILIZATION IN STATIONARY SNOW MELTING PLANTS. 290

Britanov D. E.
THEORETICAL ASPECTS OF CREATING AN ENABLING ENVIRONMENT FOR INNOVATION IN THE AGRICULTURAL SECTOR. 295

Demin E. A., Academic Advisor Baranova E. G.
THERMAL INSULATION MATERIALS IN AEROSPACE INDUSTRY. 299

Moskalenko P. A., Academic Advisor Slyuta M. O.
VARIABLE FREQUENCY ELECTRIC DRIVES AS A FOUNDATION FOR ENTERPRISE ENERGY SAVING. 304

Illarionov V. R., Lashina E. N.
FEATURES OF TRANSLATING LITERARY TEXTS FROM RUSSIAN INTO ENGLISH. 309

Chueva E. D., Academic Advisor Baranova E. G.
COMPARISON OF PIC, AVR AND ARM MICROCONTROLLERS. 314

Merzlaya D. M., Academic Advisor Ershov K. K.
COMPARISON OF SOFT-START METHODS FOR HIGH-VOLTAGE MOTORS. 320

Kascheev K. O., Academic Advisor Shiryaev A. D.
MODERN MONITORING SYSTEMS FOR REDUCING DOWNTIME OF PUMP STATIONS IN THE OIL INDUSTRY. 326

Savchenko V. M., Shavlovskaya O. K.
FEATURES OF MODERN IDIOMATIC EXPRESSIONS AND HOW NON-SPEAKERS NAVIGATE IDIOMS IN SOCIAL AND CULTURAL CONTEXTS. 332

Fedoruk S. S., Lashina E. N.
THE RELEVANCE OF THE PROBLEM OF OZONE HOLES IN THE ATMOSPHERE. 339

Egorova M. V., Academic Advisor Moreva Yu. L.
MARKET ANALYSIS OF DIGESTER PRODUCTION IN RUSSIA. 345

Kiselev A. A., Academic Advisor Leonova N. L.
APPLICATION OF THE PLOTLY LIBRARY OF THE PYTHON PROGRAMMING LANGUAGE IN DATA ANALYSIS. 351

СОДЕРЖАНИЕ

Лисняк А. В., науч. руководитель Черемных В. Ю.
К ПРОБЛЕМЕ УЧЕТА АРЕНДНЫХ ОПЕРАЦИЙ. 16

Внукова З. М., науч. руководитель Питель Т. С.
ЦИФРОВАЯ ЭКОНОМИКА. 24

Москаленко П. А., науч. руководитель Игнатьева Т. Ю.
ПРИМЕНЕНИЕ МАШИННОГО ОБУЧЕНИЯ ДЛЯ ПРОГНОЗИРОВАНИЯ ПОТРЕБЛЕНИЯ ЭЛЕКТРОЭНЕРГИИ. 29

Лапуцкий А. В., науч. руководитель Козлов С. В.
ИСПОЛЬЗОВАНИЕ БРОКЕРОВ СООБЩЕНИЙ ДЛЯ ОБРАБОТКИ ЗАПРОСОВ НА ПРИМЕРЕ APACHE KAFKA. 33

Галимова Е. Ю.
АНАЛИЗ МЕТОДОВ ТЕСТИРОВАНИЯ ИНФОРМАЦИОННЫХ РЕСУРСОВ ВЫСШЕГО УЧЕБНОГО ЗАВЕДЕНИЯ. 39

Федорук С. С., Лашина Е. Н.
УТИЛИЗАЦИЯ ЯДЕРНЫХ ОТХОДОВ. ТЕХНОЛОГИИ УТИЛИЗАЦИИ ЯДЕРНЫХ ОТХОДОВ В РОССИИ И США. 45

Приймак А. А.
МАРКЕТИНГ МЕСТ И ТЕРРИТОРИАЛЬНЫЙ БРЕНДИНГ: ЗАРУБЕЖНЫЙ И РОССИЙСКИЙ ОПЫТ. 51

Максимов Я. В., Ершов К. К.
ЭВОЛЮЦИЯ ТРАНЗИСТОРОВ: ОТ КРЕМНИЕВЫХ ДО КВАНТОВЫХ. 57

Пытьев Н. Н., науч. руководитель Яковлев Г. И.
ФОРМИРОВАНИЕ СИСТЕМЫ МОНИТОРИНГА КЛЮЧЕВЫХ ПОКАЗАТЕЛЕЙ РАБОТЫ ПРОМЫШЛЕННЫХ ПРЕДПРИЯТИЙ. 62

Тангелов П. И.
ЦЕЛЕВАЯ АУДИТОРИЯ ГРАФИЧЕСКОГО РОМАНА: СПЕЦИФИКА ОБРАЗОВАНИЯ СПРОСА И ОСОБЕННОСТИ ПОТРЕБЛЕНИЯ В РОССИЙСКОЙ ФЕДЕРАЦИИ И РЕСПУБЛИКЕ КРЫМ. 69

Холамханова Я. А., науч. руководитель Иваненко А. И.
«КРЕСТНЫЙ ОТЕЦ» Ф. Ф. КОППОЛЫ КАК СОЦИОКУЛЬТУРНЫЙ ФЕНОМЕН. 78

Федорова Е. А., науч. руководитель Баранова Е. Г.
ПЕРСПЕКТИВЫ РАЗВИТИЯ СИСТЕМ ОТЛАДКИ И РЕГУЛИРОВКИ СИСТЕМ УПРАВЛЕНИЯ. 88

Маршев Д. В., Желтова Е. М., науч. руководитель Желтова Е. П.
ПОТЕНЦИАЛ МЕТАВСЕЛЕННОЙ: ОЦЕНКА ВОЗМОЖНОСТЕЙ
ДЛЯ СТУДЕНТОВ ТЕХНИЧЕСКИХ ВУЗОВ РОССИИ. 94

Котова В. А., науч. руководитель Шевцова И. В.
ПРИМЕНЕНИЕ ТЕХНОЛОГИИ BIG DATA В ГОСУДАРСТВЕННОМ
УПРАВЛЕНИИ. 101

Луцкая Е. В., Моликов П. А., науч. руководитель Коротких А. А.
АНАЛИЗ НЕГАТИВНОГО ВОЗДЕЙСТВИЯ СМОЛЕНСКОЙ
ГИДРОЭЛЕКТРОСТАНЦИИ НА ЭКОЛОГИЧЕСКОЕ СОСТОЯНИЕ
ОКРУЖАЮЩЕЙ СРЕДЫ. 106

Новикова В. И.
ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ ЦИФРОВЫХ УСЛУГ НА ОСНОВЕ
БЛОКЧЕЙНА. 112

Тактуева Ю. Г.
ОСОБЕННОСТИ ДЕТСКО-РОДИТЕЛЬСКИХ ОТНОШЕНИЙ
КАК ПРИЧИНА ДЕВИАНТНОГО ПОВЕДЕНИЯ ДЕТЕЙ И ПОДРОСТКОВ. . . 117

Внукова З. М., науч. руководитель Питель Т. С.
ПРИЧИНЫ НЕКАЧЕСТВЕННОГО ЭЛЕКТРОСНАБЖЕНИЯ. 122

Животикова Ю. А., науч. руководитель Кузурман В. А.
АЭРОЗОЛЬНЫЕ ЗАГРЯЗНЕНИЯ ВОЗДУШНОГО БАССЕЙНА, МЕТОДЫ
АНАЛИЗА И СПОСОБЫ УДАЛЕНИЯ. 127

Князева А. Ю., науч. руководитель Яненко М. Б.
ЭМОЦИОНАЛЬНЫЙ ИНТЕЛЛЕКТ КАК ОДНА ИЗ СОСТАВЛЯЮЩИХ
УПРАВЛЕНИЯ КАЧЕСТВОМ ГОСТИНИЧНЫХ УСЛУГ. 131

Новикова В. И.
КРИПТОВАЛЮТЫ КАК ОБЪЕКТ ИНВЕСТИЦИЙ. 136

Зубец В. В., Шапкина И. А., науч. руководитель Лашина Е. Н.
ХРОНИЧЕСКИЙ ДЕФИЦИТ И НЕМИНУЕМОЕ АБСОЛЮТНОЕ
ИСТОЩЕНИЕ МИНЕРАЛЬНЫХ РЕСУРСОВ. СПОСОБЫ РЕШЕНИЯ
ПРОБЛЕМЫ ИСТОЩЕНИЯ. 141

Скращук Н. Д., Халиуллина Е. Н., науч. руководитель
Сласси Мутабир С. А.
АНАЛИЗ ВНЕДРЕНИЯ ESG-СТРАТЕГИИ БЕЛОРУССКИМИ БАНКАМИ. . . . 147

Протченко О. В., Лашина Е. Н.
ИСПОЛЬЗОВАНИЕ ТЕХНОЛОГИИ БЛОКЧЕЙН
В ЭЛЕКТРОЭНЕРГЕТИКЕ. 151

Шенцева М. С., Моликов П. А., науч. руководитель Коротких А. А.
ВЛИЯНИЕ ПРУДА-ОХЛАДИТЕЛЯ НА БЕЗОПАСНУЮ ЭКСПЛУАТАЦИЮ АТОМНОЙ ЭЛЕКТРОСТАНЦИИ. 158

Никешин В. Г., науч. руководитель Сидельников В. И.
СИСТЕМА ПРЕДИКТИВНОГО УПРАВЛЕНИЯ КАК ОДИН ИЗ ПОДХОДОВ К ОБЕСПЕЧЕНИЮ ОПТИМАЛЬНОГО ПРОТЕКАНИЯ ПРОИЗВОДСТВЕННЫХ ПРОЦЕССОВ. 163

Николаева Е. С.
ОСОБЕННОСТИ ВНЕДРЕНИЯ ТЕХНОЛОГИИ СМЕШАННОГО ОБУЧЕНИЯ «FLIPPED CLASSROOM» ПРИ ИЗУЧЕНИИ ИНОСТРАННОГО ЯЗЫКА В ВУЗЕ. 169

Рубцов К. Д., науч. руководитель Кронгауз Д. Э.
СНИЖЕНИЕ ПОТЕРЬ ЭЛЕКТРИЧЕСКОЙ ЭНЕРГИИ В СИЛОВЫХ ТРАНСФОРМАТОРАХ. 174

Захарова В. Д., науч. руководитель Кирилюк О. М.
ОСНОВНЫЕ ПРИНЦИПЫ ОБРАЗОВАТЕЛЬНОГО ТУРИЗМА. 180

Хакимова К. И., науч. руководитель Тугузбаев Г. А.
АКТУАЛЬНЫЕ ПРОБЛЕМЫ ПСИХОЛОГО-ПЕДАГОГИЧЕСКОГО СОПРОВОЖДЕНИЯ ОБУЧАЮЩИХСЯ С ОГРАНИЧЕННЫМИ ВОЗМОЖНОСТЯМИ ЗДОРОВЬЯ. 185

Шевчук В. В., науч. руководитель Янчукович С. Г.
ПРОБЛЕМЫ ПЕРЕРАБОТКИ МУСОРНЫХ ОТХОДОВ И ПУТИ ИХ РЕШЕНИЯ. 191

Мерзлая Д. М., науч. руководитель Зятиков И. Д.
СИНХРОННЫЙ РЕАКТИВНЫЙ ДВИГАТЕЛЬ С ПОСТОЯННЫМИ МАГНИТАМИ. 197

Лямкина В. А.
ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ УПРАВЛЕНИЯ ВЫСШИМИ УЧЕБНЫМИ ЗАВЕДЕНИЯМИ В ПРОЦЕССЕ РАЗВИТИЯ ПРЕДПРИНИМАТЕЛЬСКОГО УНИВЕРСИТЕТА. 202

Боженова М. В., Петров В. С.
ИНТЕГРАЦИЯ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ОБРАЗОВАТЕЛЬНЫЙ ПРОЦЕСС: РАЗРАБОТКА И ВНЕДРЕНИЕ ИННОВАЦИОННОГО ЧАТ-БОТА ДЛЯ ИНДИВИДУАЛИЗАЦИИ ОБУЧЕНИЯ. 206

Максимов Я. В., Мазяркин Д. В., науч. руководитель Лашина Е. Н.
РЕВОЛЮЦИОННАЯ ТЕХНОЛОГИЯ ТРАНЗИСТОРОВ: ПЕРЕХОД К ЭРЕ ЭЛЕКТРОНИКИ БУДУЩЕГО. 212

Масленков А. О., Нугаев И. И., науч. руководитель Шипшова О. А.
ТЕНЕВИЗАЦИЯ ЭКОНОМИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ И ЕЕ ВЛИЯНИЕ НА ЭКОНОМИЧЕСКУЮ БЕЗОПАСНОСТЬ. 217

Протченко О. В., науч. руководитель Ильина О. В.
ВЛИЯНИЕ ГРАФИЧЕСКОГО ДИЗАЙНА НА БРЕНД. 223

Ржевская Н. В.
ОТ КОНЦЕПЦИИ ДО КРИПТОГРАФИИ: ИСТОРИЯ ГОМОМОРФНОГО ШИФРОВАНИЯ И ЕГО РАЗВИТИЕ. 228

Сильченко А. С., Домащенко Г. А.
ДЕМОГРАФИЧЕСКИЕ ПРОЦЕССЫ И МЕХАНИЗМ ИХ ВЛИЯНИЯ НА РЫНОК ТРУДА. 236

Савенко А. В., науч. руководитель Крюков К. А.
СРАВНИТЕЛЬНЫЙ АНАЛИЗ МЕТОДОВ ОЧИСТКИ ВОДЫ ХИМИЧЕСКИМ И УЛЬТРАЗВУКОВЫМ СПОСОБОМ. 241

Сильченко А. С., Домащенко Г. А.
ЭМОЦИОНАЛЬНЫЕ СТИЛИ ЛИДЕРСТВА. 246

Кащеев К. О., науч. руководитель Ширяев А. Д.
ВЛИЯНИЕ ВОЗОБНОВЛЯЕМЫХ ИСТОЧНИКОВ ЭНЕРГИИ НА ПЕРСПЕКТИВЫ РАЗВИТИЯ НЕФТЯНОГО СЕКТОРА. 251

Щеголькова А. А., Лещенко К. Д., науч. руководитель Савинская Д. Н.
ВИРТУАЛИЗАЦИЯ КОНТЕЙНЕРОВ: РЕВОЛЮЦИЯ В РАЗВЕРТЫВАНИИ И УПРАВЛЕНИИ ПРОГРАММНЫМ ОБЕСПЕЧЕНИЕМ. 257

Иванова К. А., Путина Ю. В., Кораблева С. А., науч. руководитель Кораблева О. Н.
ВОПРОСЫ ЭНЕРГОСБЕРЕЖЕНИЯ В ХИМИЧЕСКОЙ ПРОМЫШЛЕННОСТИ. 262

Сивкова А. А., Скоробогатова Д. И.
FINTECH И BIGTECH: ОПРЕДЕЛЕНИЯ, ОСОБЕННОСТИ, ОТЛИЧИЯ. 268

Дергачева Д. А., науч. руководитель Перевёрткина М. С.
РАЗРАБОТКА И ИСПОЛЬЗОВАНИЕ ВЕБ-КВЕСТОВ ДЛЯ ОБУЧЕНИЯ УСТНОЙ РЕЧИ МЛАДШИХ ШКОЛЬНИКОВ. 273

Пилецкая А. С., науч. руководитель Знаменская А. М.
ВЛИЯНИЕ ПЛАСТИКА НА ЭКОСИСТЕМЫ: ПРОБЛЕМЫ
И ПЕРСПЕКТИВЫ РЕШЕНИЯ. 278

Китаева М. В., науч. руководитель Сергеева Е. В.
ЛИНГВОКУЛЬТУРОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ИТАЛЬЯНСКИХ
ВЛОГОВ О ПУТЕШЕСТВИЯХ. 285

Гаврилина П. А., науч. руководитель Семчук Е. В.
ИСПОЛЬЗОВАНИЕ НИЗКОПОТЕНЦИАЛЬНОЙ ТЕПЛОТЫ
ДЛЯ УТИЛИЗАЦИИ СНЕГА В СТАЦИОНАРНЫХ
СНЕГОПЛАВИТЕЛЬНЫХ УСТАНОВКАХ. 290

Британов Д. Е.
ТЕОРЕТИЧЕСКИЕ АСПЕКТЫ ФОРМИРОВАНИЯ БЛАГОПРИЯТНЫХ
УСЛОВИЙ ОСУЩЕСТВЛЕНИЯ ИННОВАЦИОННОЙ ДЕЯТЕЛЬНОСТИ
В СЕЛЬСКОХОЗЯЙСТВЕННОМ СЕКТОРЕ. 295

Дёмин Е. А., науч. руководитель Баранова Е. Г.
ТЕПЛОИЗОЛЯЦИОННЫЕ МАТЕРИАЛЫ В АЭРОКОСМИЧЕСКОЙ
ОТРАСЛИ 299

Москаленко П. А., науч. руководитель Слюта М. О.
ЧАСТОТНО-РЕГУЛИРУЕМЫЕ ЭЛЕКТРОПРИВОДЫ КАК ФУНДАМЕНТ
ЭНЕРГОСБЕРЕЖЕНИЯ ПРЕДПРИЯТИЯ. 304

Илларионов В. Р., Лашина Е. Н.
ОСОБЕННОСТИ ПЕРЕВОДА ХУДОЖЕСТВЕННЫХ ТЕКСТОВ
С РУССКОГО ЯЗЫКА НА АНГЛИЙСКИЙ. 309

Чуева Е. Д., науч. руководитель Баранова Е. Г.
СРАВНЕНИЕ МИКРОКОНТРОЛЛЕРОВ PIC, AVR И ARM. 314

Мерзлая Д. М., науч. руководитель Ершов К. К.
СРАВНЕНИЕ СПОСОБОВ ПЛАВНОГО ПУСКА ВЫСОКОВОЛЬТНЫХ
ДВИГАТЕЛЕЙ. 320

Кащеев К. О., науч. руководитель Ширяев А. Д.
СОВРЕМЕННЫЕ СИСТЕМЫ МОНИТОРИНГА ДЛЯ СОКРАЩЕНИЯ
ПРОСТОЕВ НАСОСНЫХ СТАНЦИЙ В НЕФТЯНОЙ
ПРОМЫШЛЕННОСТИ. 326

Савченко В. М., Шавловская О. К.
ХАРАКТЕРИСТИКИ СОВРЕМЕННЫХ ИДИОМАТИЧЕСКИХ
ВЫРАЖЕНИЙ И ПРИМЕНЕНИЕ ИХ В СОЦИАЛЬНО-КУЛЬТУРНЫХ
СИТУАЦИЯХ НОСИТЕЛЯМИ ДРУГИХ ЯЗЫКОВ. 332

Федорук С. С., Лашина Е. Н.
АКТУАЛЬНОСТЬ ПРОБЛЕМЫ ОЗОНОВЫХ ДЫР В АТМОСФЕРЕ. 339

Егорова М. В., науч. руководитель Морева Ю. Л.
АНАЛИЗ РЫНКА ПО ПРОИЗВОДСТВУ МЕТАНТЕНКОВ В РОССИИ. 345

Киселёв А. А., науч. руководитель Леонова Н. Л.
ПРИМЕНЕНИЕ БИБЛИОТЕКИ PLOTLY ЯЗЫКА ПРОГРАММИРОВАНИЯ PYTHON В АНАЛИЗЕ ДАННЫХ. 351

УДК 338.24

TO THE PROBLEM OF ACCOUNTING FOR LEASE TRANSACTIONS

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Abstract. The article is devoted to the identification and analysis of problematic aspects of accounting for lease transactions according to Russian and international accounting standards. The accounting aspects of the implementation of lease operations in the system of economic relations are determined and justified. Recommendations on building an effective system of accounting for lease transactions based on the provisions of the current Russian and international accounting standards are formulated.

Keywords: accounting, lease operations, lease agreement, finance lease, operating lease.

К ПРОБЛЕМЕ УЧЕТА АРЕНДНЫХ ОПЕРАЦИЙ

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Аннотация. Статья посвящена идентификации и анализу проблемных аспектов учета арендных операций согласно российским, а также международным учетным стандартам.

Определены и обоснованы учетные аспекты осуществления арендных операций в системе экономических отношений.

Сформулированы рекомендации по построению эффективной системы учета арендных операций на основе положений действующих российских и международных стандартов учета.

Ключевые слова: бухгалтерский учет, арендные операции, арендный договор, финансовая аренда, операционная аренда.

The current stage of economic development, characterized by constant instability due to the significant impact of crisis phenomena, presents enterprises with the problem of finding financial resources to ensure their sustainable development and implement various strategic initiatives.

This problem is particularly relevant in the context of research on the acquisition of new equipment and the introduction of new technologies. This is justified, first of

all, by the extreme wear and tear of fixed assets of domestic business entities, as a result of which there is a need to update them, which, in turn, requires capital investments.

Given the current situation, as well as constant fluctuations in the exchange rate, one of the priority ways to update and replace non-current assets with more modern and productive analogues is not to purchase them, but to lease them. Under such conditions, special attention should be paid to accounting for lease transactions and the specifics of reflecting their consequences in the financial statements of enterprises that use federal and international accounting standards.

Thus, the article defines the following scientific tasks: to reveal the essence of lease operations; to determine the place of lease operations in the enterprise's activities; to disclose and analyze the accounting procedure for business operations on lease operations at the enterprise; to provide recommendations for building an effective accounting system for lease operations at the enterprise based on the provisions of current federal and international accounting standards.

The following methods were used to solve these problems: analysis, synthesis, generalization, induction, analogy, modeling, and a systematic approach.

To build an effective accounting system for lease transactions, it is necessary to identify and consider the main features of their individual types and forms, since quite often the external similarity of property and legal relations leads to terminological disagreements, inconsistencies in legislation, identification of their individual types, which generally affects the process of accounting for these types of relations and leads to the formation of distorted accounting statements.

As S. V. Pankova notes, understanding their essence from an economic and legal point of view plays a decisive role in building an effective methodology for lease operations.

According to the author, lease operations from the point of view of the owner of the rental object should be considered as one of the forms of economic relations, which is the process of temporary transfer of the right to use and dispose of the property object (land, property complexes, fixed assets, intangible assets and other property) to the amount of rent equivalent to its value (Figure 1) [1, p. 20-21].

The basis for performing lease operations is a lease agreement, which defines the lease object (fixed assets, intangible assets, other non-current tangible assets, etc.), and which is concluded between two subjects of lease relations – the lessor and the lessee. Based on the legal nature of this agreement, the leased object should be considered in the context of a "triad" of property rights (ownership, disposal, use), some of which (use and partial disposal of property) passes from the lessor to the lessee.

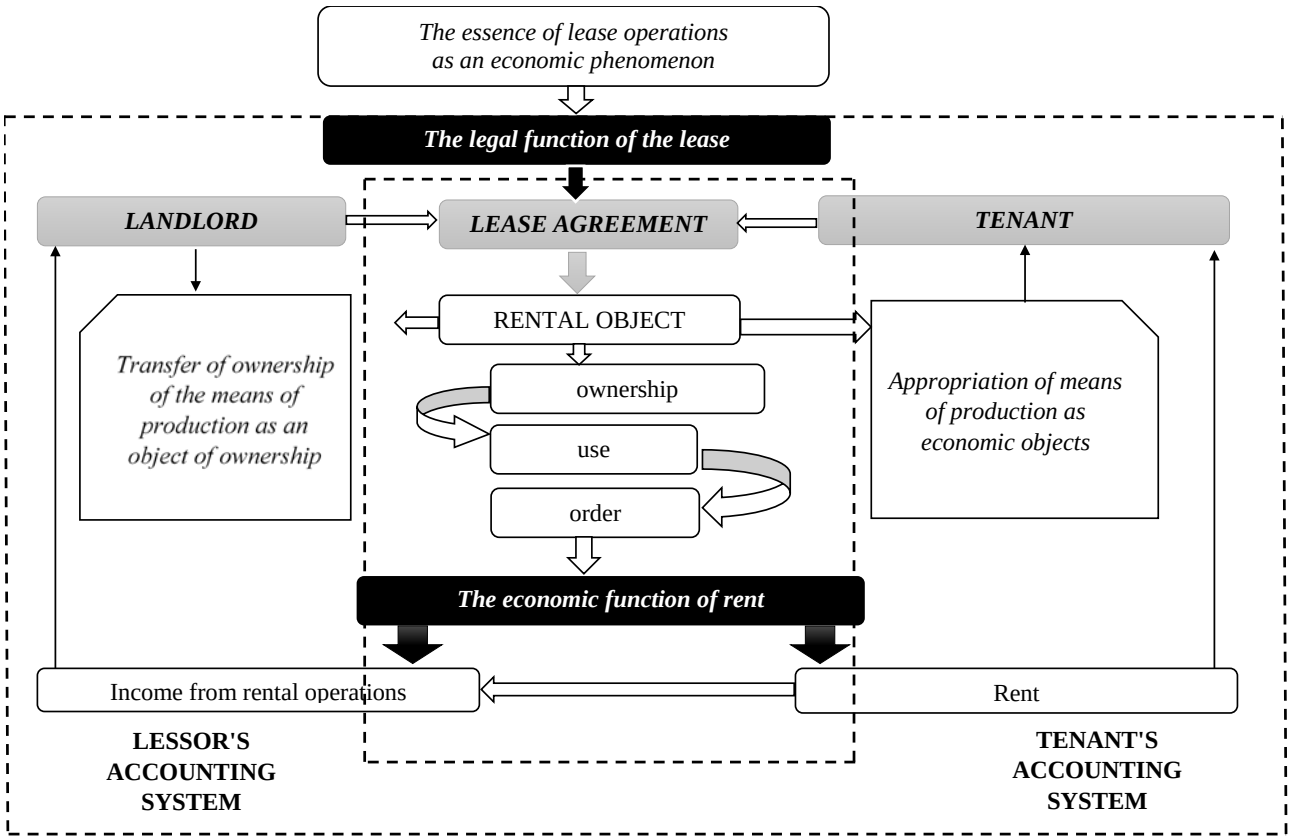


Figure 1. Rental operations in the system of economic relations

Thus, the economic function of a lease assumes that as a result of entering into a lease agreement, the lessor receives income from lease operations, and the lessee pays rent. The above processes should be clearly identified by the accounting systems of the two data subjects of lease relations and reflected in the accounting statements [1, p. 24].

As noted by U. Y. Blinova, the Federal Accounting Standard “Leases” (approved by Order No. 258n of the Ministry of Finance of the Russian Federation dated 31.12.2016), as well as the International Financial Reporting Standard 16 “Leases” (as amended on 20.08.2021) define two main types of leases – finance and operating leases.

Based on these standards, a finance lease is a lease that transfers to the lessee all the risks and rewards associated with the right to use and own an asset.

Operating leases include all other types of transactions that cannot be classified as finance leases. Accordingly, according to the author, the main difference between operating and finance leases is in the amount of risk and benefits transferred from one entity to another, as well as in the transfer of ownership of the leased object, in particular, if the operating lease ownership remains with the lessee, in case with the finance one it is transferred to the lessor at the end of the contract [2, p. 44].

In addition to the above classification, S. V. Kamysovskaya offers more detailed and expanded classification characteristics of lease operations for accounting purposes. So, in addition to the traditional approach, the author suggests considering the types of rental operations based on: service volume of lease operations; types of lease payments; rental payment distribution schemes.

The use of such a classification and the corresponding selected types of lease transactions allows you to build such an accounting system that will be as close as possible to the needs of interested users of accounting information. In addition, it should be taken into account that specialized types of classification of lease transactions can be developed to meet the goals of various types of accounting, in particular managerial, strategic, etc. (Figure 2).

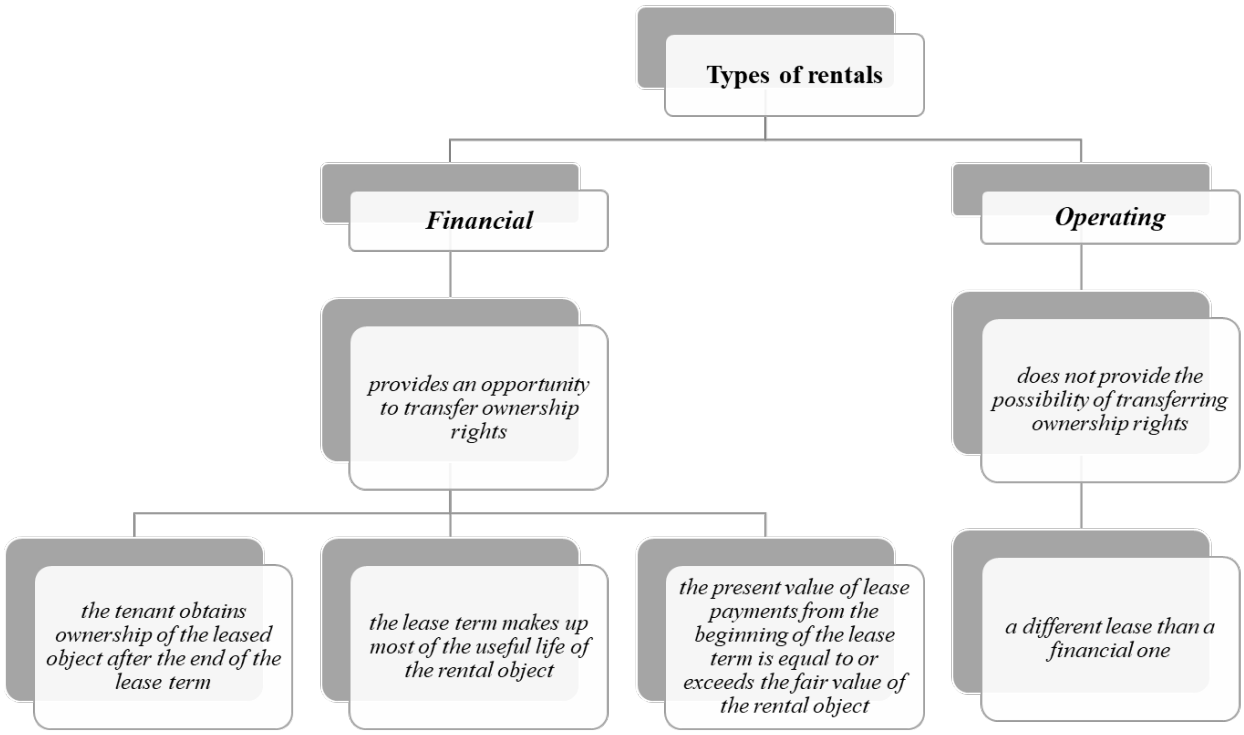


Figure 2. Types of leases

In general, S. V. Kamysovskaya states that International Financial Reporting Standard 16 “Leases” (hereinafter – IFRS 16) is a more detailed accounting standard that provides guidelines for accounting for lease transactions in comparison with the Federal Accounting Standard “Leases” (hereinafter – FAS “Leases”). However, it should be borne in mind that IFRS does not disclose the legal aspects of lease relations at all, since there are significant differences in international accounting systems based on the Anglo-Saxon or Romano-Germanic legal systems [3, p. 77-78].

At the same time, the basic provisions of accounting for lease transactions proposed in the above standards are sometimes criticized, which can be considered in the context of the following areas:

1. Capitalization of the consequences of lease operations. For example, international financial reporting standards adopt the following model for capitalizing lease transactions (Figure 3).

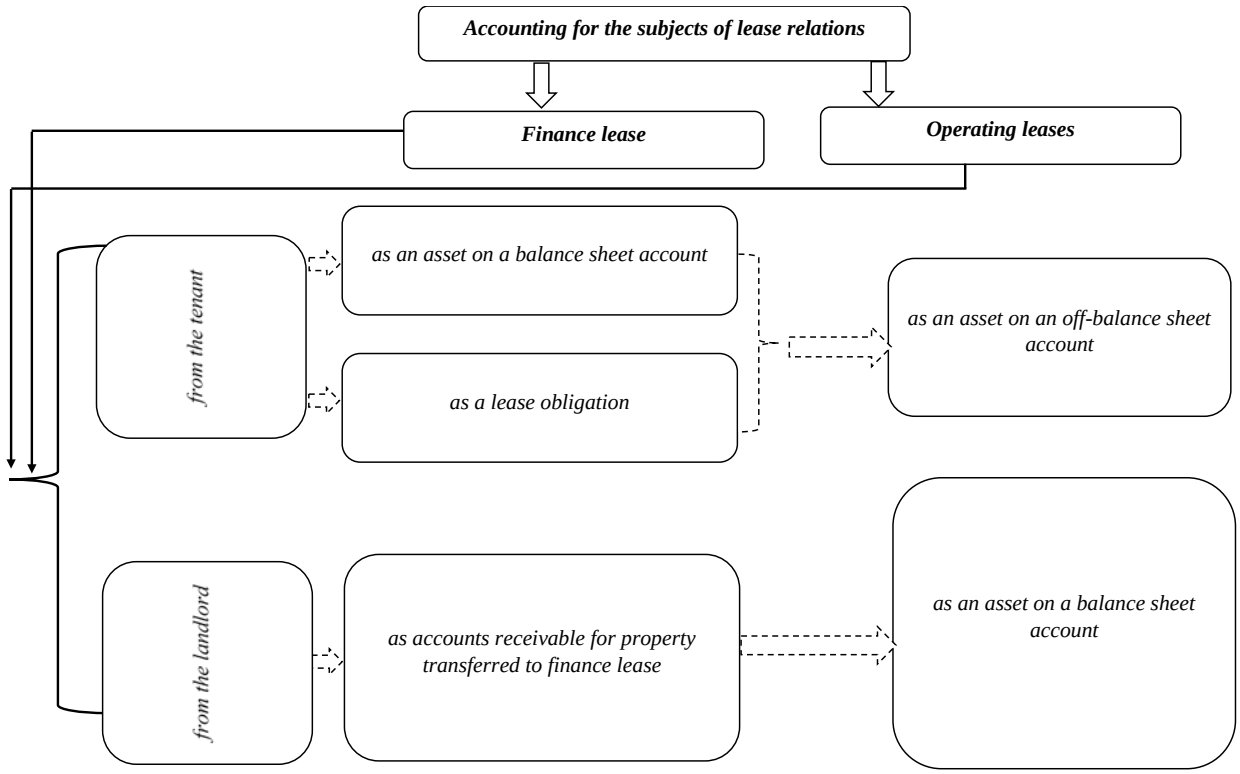


Figure 3. Capitalization of rental operations

The above model reflects current practice regarding the possibility of capitalizing a finance lease item as an asset from a lessee, provided that the essence of the lease operation meets the criteria for its classification as a finance lease.

Regarding this statement, O. E. Kachkova considers two main problematic issues.

First, why should all types of lease transactions related to finance leases be capitalized? Thus, according to the author, the existing views of researchers on this issue can be grouped into the following groups, for which a number of suggestions are given:

- there is no need to take into account (capitalize) any leased assets in the balance sheet, since the lessee does not own the ownership right to the property, capitalization is considered as unjustified;

- it is necessary to capitalize only those rental transactions that have signs of purchase in installments.

- all long-term agreements should be capitalized – in this approach, the natural condition for capitalization will be a long-term right to use the property.

Accordingly, critics of this statement, implemented in the vast majority of accounting standards of the world, according to O. E. Kachkova, justify the need for either its complete replacement due to the lack of ownership of the rental object by the lessee, or they suggest significantly narrowing the lease agreement depending on the specific circumstances.

According to O. E. Kachkova, the existence of such a statement in accounting standards is justified by the current interpretation of an asset as a resource that brings

future economic benefits, and the ability of accounting to provide reliable reflection of such operations, in turn, is one of the important factors for its further development.

Second, why shouldn't operating leases be capitalized along with the lessee's financial assets? The main argument regarding this position of the standard-setters is the difference in the economic nature of financial and operational lease operations, in particular in terms of risks and benefits transferred from one entity to another. This statement has also actually been refuted, since, according to IFRS 16, operating leases from lessees are also reflected in the balance sheet [4, p. 29-30].

2. A system of accounts for recording rental transactions. Under IFRS 16, the lessee's expenses consist of two parts: finance costs (interest) and a reduction in the unpaid finance lease liability. Finance costs should be allocated to periods over the lease term so that a constant periodic rate of interest is applied to the remaining balance of the liability. The less the tenant's debt becomes, the lower the interest will also be. Thus, the principle of correlation of income and expenses is observed, as a result, the discounted amount of debt is included in the balance sheet – the fair value of property without taking into account the amount of interest payments required (interest will be recorded as expenses in the profit and loss statement).

In Russian accounting, interest expenses are not shown separately – they are part of the rental payment. As a result, certain sections of the balance sheet and the profit and loss statement will be subject to significant adjustments during the transformation of financial statements.

According to International Financial Reporting Standards (IFRS), the lessee must amortize leased assets according to the rules applicable for similar own property (IFRS 16 "Fixed Assets"; IFRS 38 "Intangible Assets"). If the lessee is not sure that it will acquire ownership of the asset, the amortization period is set as the lowest based on the lease term or the asset's useful life. In addition, the business entity applies the procedures of IFRS 36 "Impairment of assets to leased assets" in the same way as to its own [4, p. 38].

In the Russian accounting standards, according to Article 31 of the Federal Law "On Financial Lease (Leasing)", the parties to the agreement under the agreement can apply accelerated depreciation of leased property [2, p. 52].

In order to improve the accounting system for accounting for rental transactions, scientists propose clarifications and improvements in terms of the above accounts, in particular, to clarify analytical accounts or sub-accounts that can be opened to these accounts.

Thus, E. A. Fedchenko suggests introducing an account "Non-current tangible assets under lease", which, in the author's opinion, will ensure adequate reflection of operations on accounting for leased property in accordance with business conditions, and facilitate timely receipt and analysis of the necessary information by management.

However, given that under current legislation intangible assets can also be leased, it is necessary to introduce in the context of this proposal an appropriate account for accounting for intangible assets under lease [5, p. 173].

Another area of improvement in the accounting system for accounting for lease transactions is the allocation of separate analytical accounts to account 76 "Settlements with various debtors and creditors" (sub-account "Leasing obligations") in the context

of types of non-current assets that were purchased for leasing, and for those non-current assets that are already under lease. Such proposals will help to distinguish among all non-current assets of the enterprise the share that will be leased, and in general will allow analyzing the value of the total rental pool of assets of the enterprise.

One of the promising areas of development of the system of accounts for accounting for lease transactions is also their improvement based on accounting for changes resulting from the introduction of the main provisions of IFRS 16 “Leases” into Russian accounting standards. One of the cardinal features of this standard, in comparison with the current FSBU “Leases”, is the same procedure for reflecting operations under finance and operational leases, following the example of finance.

3. Strategic unreasonableness of applying the principle of the predominance of essence over form. In the context of accounting for lease transactions, this principle should be understood as a certain rule that should be followed in the process of accounting for lease relationships, which provides for the following: lease transactions should be accounted for in accordance with their essence, and not only based on the legal form, i.e. the process of reflecting lease relationships in accounting accounts is affected not only by lease agreement, but also the type of lease determined by such agreement. As a result, today in the current international and domestic practice of accounting for lease transactions, there are two separate methods of accounting for operations for operating and finance leases.

Accordingly, accounting for the display of financial lease items as assets by the lessee is one of the most striking examples of the principle of essence prevailing over form. Thus, despite the absence of transfer of all ownership rights to this object to the lessee, it is reflected as a full-fledged asset of the enterprise.

At the same time, some researchers criticizing this principle, for example O. E. Kachkova, T. I. Krishtaleva, M. F. Ovsiychuk, tend to believe that such introduction of accounting principles for specific situations, reliable reflection of which cannot be provided by the current accounting system, indicates the lack of an effective strategy for further development of accounting. In order to avoid the occurrence of such problems in the future, it is necessary to take a more critical approach to the theoretical and methodological foundations of accounting and suggest possible directions for their improvement, taking into account global economic transformations [4, p. 60-61].

When constructing an effective methodology for lease operations, it is necessary to take into account the peculiarities of understanding their essence from an economic and legal point of view.

Based on the legal nature of the lease agreement, the leased object should be considered in the context of a set of property rights (ownership, disposal, use), part of which (use and partial disposal of property) passes from the lessor to the lessee.

The economic function of a lease assumes that as a result of entering into a lease agreement, the lessor receives income from lease operations, and the lessee pays rent.

The main areas of criticism of the basic provisions of accounting for lease transactions, given in domestic and international standards on lease accounting, are the following:

- capitalization of the consequences of lease operations;
- a system of accounts for recording rental transactions;

- strategic unreasonableness of applying the principle of the predominance of essence over form.

The formation of effective proposals for improving the accounting methodology for lease transactions in each of the selected areas will contribute to the creation of effective information support for the lease relationship management system at the enterprise.

Taking into account the process of harmonization of Russian accounting standards with international accounting doctrines, one of the promising areas of development of the methodology for accounting for lease transactions is to improve the theoretical and methodological aspects of their accounting by taking into account the changes laid down in the basis of IFRS 16 “Leases”.

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УДК 300.342

DIGITAL ECONOMY

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Abstract. The paper examines the definition of the digital economy, its pros and cons, as well as its importance in Russia and other countries. At the beginning of the XXI century, a stage of intensive development of digital technologies began, accompanied by a revolution in the information space and the acceleration of the processes of globalization of the world economy.

Keywords: economy, labor market, Internet, business, information technology.

ЦИФРОВАЯ ЭКОНОМИКА

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Аннотация. В работе рассматривается определение цифровой экономики, ее плюсы и минусы, а также ее значение в России и других странах. В начале XXI века начался этап интенсивного развития цифровых технологий, сопровождающийся революцией в пространстве информации и ускорением процессов глобализации мировой экономики.

Ключевые слова: экономика, рынок труда, интернет, бизнес, информационные технологии.

Digital Economy is an economic activity focused on digital and electronic technologies.

This includes e-business and commerce, as well as the goods and services they produce. In fact, this definition covers all business, cultural, economic and social transactions carried out on the Internet and with the help of digital communication technologies.

In other words, the digital economy is an activity directly related to the development of digital computer technologies, which includes services for the provision of online services, electronic payments, online trading, crowdfunding, etc.

Over the past 15 years, we have seen a huge growth of digital platforms and their impact on our lives. Instagram, Facebook, Twitter and other popular websites like YouTube, etc., are now influencing consumers (*Social networks whose activities are prohibited on the territory of the Russian Federation are mentioned*).

The driving force of the growing digital economy is digital data. The digital economy continues to develop at an incredible rate due to its ability to collect, use and analyze huge amounts of machine-readable information (digital data) about almost everything.

Such digital data is collected based on the analysis of “digital traces” that remain on various digital platforms as a result of the activity of individuals, social groups or enterprises [1, p. 170].

The new opportunities that are opening up to a person thanks to the development of the digital economy are certainly positive changes that open up new opportunities in almost every field of activity.

With the development of digital technologies, the consumer can receive the ordered services much faster, as well as save money, since prices on the Internet are often lower than those offered by an offline business.

But there are also disadvantages – these are threats from hackers. In order to protect the personal data of their customers, it is necessary to carefully build a security system, but not every business has such an opportunity.

Unemployment is rising. In the labor market, with the advent of new online services, some professions or even entire industries will gradually begin to disappear.

The digital economy in Russia lags far behind most European countries: the USA, Japan and China. An illustrative example is that the Russian Federation accounts for 1.8 % of global GDP, while the performance of supercomputers is only 0.32 %.

In 2016, Vladimir Putin instructed the Federal Assembly to develop a plan for the development of the electronic economy. Business representatives, experts from various ministries and economists were involved in this process.

In the summer of 2017, the government approved an Economic Development Program, the main idea of which is the integration of the domestic virtual environment with the digital economy of the Eurasian Union.

Significant financial and technical resources have been allocated at the State level for this purpose.

Special attention is paid to the development and implementation of telecommunications equipment and antivirus programs.

The plan of the Ministry of Communications involves the introduction of electronic technologies in all industries [2-5]:

- management of energy, water and fuel resources;
- creating smart cities;
- reduction of transaction costs;
- changing the division of labor system;
- opening of high-tech medical centers.

Instrumentally, these technologies are very similar, the key difference is in the purpose: if the main task of the Internet of Things is to collect all kinds of data (which will be used primarily to build models and forecasts), then the purpose of the industrial Internet of Things is to automate production (through remote management of resources and capacities according to sensor readings).

According to the forecasts of analysts at Ovum, Machina Research and Nokia, the number of industrial connected devices by 2019 will exceed 530 million units, and by 2025 their number will be from 20 to 200 billion units.

In many countries, the development of technologies for managing production resources, including in the interests of their virtual use, is carried out within the framework of state programs for transformation and the creation of a “Digital” economy: Industrie in Germany, Advanced Manufacturing Technology in the USA, a strategic concept for the development of production in China, betting on quality, innovation and the introduction of advanced technologies, Innovate UK in the UK, National Digital Economy in Australia.

In 2001 Thomas Mesenburg identified three key components of the digital economy:

- e-business infrastructure (hardware, software, telecommunications, networks, human capital, etc.);
- e-business itself (business management and any business processes carried out using computer networks);
- e-commerce.

In Russia, the main tasks of the digital economy in official circles are the end-to-end automation of key production and economic mechanisms and processes, the development of a personalized consumer market, the cumulative increase in the efficiency of economic entities, the mobilization of knowledge, the creation of new jobs in high-tech industries [6].

By comparison, the United States focuses on open and unrestricted access to the Internet, while China focuses on data exchange between government and commercial organizations.

An example of a digital economy is any economic activity carried out via the Internet.

Any company that seeks to fully or partially transfer its activities online can be called digital.

For example, Uber or Yandex Taxi are certainly technology companies whose activities are based on advanced customer interaction technologies.

As a result, the consumer received a radically new type of service provision with lower organization costs, which led to cheaper taxi fares. It also happens that a quite traditional company is switching to the digital economy.

In particular, this was the case with the Pyaterochka supermarket chain. When the administration realized that almost 70 % of the resources were spent on maintenance, it launched a digital transformation with an IBS partner and switched to new technologies, which made it possible to improve the business model.

According to IDC estimates, the global cognitive technology market will grow by an average of 55 % annually in the coming years, and will reach $31.3 billion by 2019.

At the same time, more than 40 % of the market will be occupied by software tools: applications for analyzing texts and other materials, search, machine learning, categorization, hypothesis generation, navigation, as well as cognitive platforms designed for the development of intelligent programs.

The main advantage of the digital economy is the expansion of trade.

On the Internet, small businesses can find a customer base, compete with large manufacturers and gain a place in international trade.

The spread of the digital economy has led to the development of new business models [6-9].

- Digital platforms that allow direct interaction between sellers, buyers and delivery partners, reducing transaction costs and expanding opportunities for the exchange of goods or services. Based on the specifics of the product and market segment, the platform can be a communication, social, media, search, operational, control, service, support, product, transactional platform, etc.
- Service business models based on the use of resources in exchange for their ownership. Today, new service models are emerging that facilitate the personalization of a product or service, allowing the customer to consume the right product in the right amount to achieve the desired result.
- Business models, pricing based on achieving results and efficiency from the customer's point of view, including the consumption of complex products and services.
- Crowdsourcing models based on obtaining external financial, human and intellectual resources. Such models are used in innovation or in the development, production, sale and marketing of products.
- Business models that monetize customers' personal data when a service that is free for the user sells them to another consumer segment.

The scale of the development of the digital economy in the world is difficult to assess accurately. This also causes a lot of controversy, since some experts divide e-commerce into "pure" and "mixed" one.

As of 2010, the digital economy was estimated by the Boston Consulting Group at $2.3 trillion. For a group of 20 countries, it was 4.1 % of the total GDP.

In 2013, Oxford Economics estimated digital commerce at $20.4 billion, accounting for approximately 13.8 % of global sales.

Projects on the creation and implementation of IoT platforms, the development of application services are also underway in Russia.

The Foundation for the Development of Internet Initiatives (FII) has developed a roadmap for the development of the Internet of Things and established the Internet of Things Association.

As part of the activities of the new technical committee for standardization "Cyber-physical Systems", functioning within the framework of Rosstandart, it is planned to develop and adopt standards in the field of the Internet of Things.

The digital economy can be perceived as an economic activity where digital information is used as a key factor of production, as well as processing large amounts of data, after which they are used for analysis.

If compared with more familiar forms of management, in this way it is possible to influence the efficiency of certain types of production, technologies and equipment.

The concept of the digital economy has many interpretations and interpretations.

Many scientific articles position it as the only course in development, others believe that the traditional economy will not change dramatically.

Despite the myths and illusions that have overgrown this term, it is obvious that changes are in full swing and it is not necessary to ignore the new stage of economic development based on the technological revolution.

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УДК 004.896

APPLICATION OF MACHINE LEARNING TO PREDICT ELECTRICITY CONSUMPTION

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Abstract. The article discusses the use of machine learning to predict electricity consumption. Algorithms such as linear regression, decision trees, random forest and neural networks are analyzed. The advantages and disadvantages of the algorithms are discussed, and recommendations for their use are offered.

Keywords: machine learning, electricity consumption forecasting, linear regression, energy systems.

ПРИМЕНЕНИЕ МАШИННОГО ОБУЧЕНИЯ ДЛЯ ПРОГНОЗИРОВАНИЯ ПОТРЕБЛЕНИЯ ЭЛЕКТРОЭНЕРГИИ

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Аннотация. В статье рассматривается использование машинного обучения для прогнозирования потребления электроэнергии. Анализируются такие алгоритмы, как: линейная регрессия, решающие деревья, случайный лес и нейронные сети. Обсуждаются преимущества и недостатки данных алгоритмов, а также даются рекомендации по их применению.

Ключевые слова: машинное обучение, прогнозирование потребления электроэнергии, линейная регрессия, энергетические системы.

Forecasting electricity consumption is an important aspect of effective management and planning of power systems. The accuracy of forecasts affects the economic efficiency and reliability of energy supply. Recently, machine learning has been actively used to predict electricity consumption due to its ability to process large volumes of data and identify complex patterns.

There are several machine learning approaches that can be applied to predict electricity consumption:

1. Linear regression. This is a statistical method that builds a linear model of the relationship between a dependent variable (electricity consumption) and one or more

independent variables (temperature, time of day, day of the week, etc.) [1]. Linear regression is a simple and fast forecasting method; however, its accuracy may be limited due to the linear nature of the model.

2. Decision trees and random forest. Decision trees build a hierarchical structure that divides data into subsets based on the values of the input variables. A random forest is an ensemble of decision trees that are trained on different subsets of data and combine their predictions to improve accuracy. These methods can account for nonlinear relationships and interactions between variables, making them more accurate than linear regression [2].

3. Neural networks. Neural networks are made up of layers of artificial neurons that can process and model complex dependencies in data. Deep learning based on neural networks allows models to be trained with more layers and neurons, which can improve prediction accuracy. However, neural networks require a large amount of data and computing resources to train.

4. Time series methods. Time series methods such as autoregressive integrated moving averages (ARIMA), exponential smoothing, and GARCH models use statistical properties of the original data to predict future values. They can be effective in forecasting electricity consumption, especially when there is seasonality or trends.

Implementing machine learning to predict electricity consumption can bring a number of benefits:

1. Improving forecast accuracy. Machine learning can provide more accurate forecasts of electricity consumption compared to traditional methods such as statistical models or expert judgment [3].

2. Optimization of the planning process. More accurate forecasts of electricity consumption allow energy companies to better plan the production and distribution of electricity, which in turn reduces costs and increases efficiency.

3. Integration of renewable energy sources. Machine learning can help predict electricity consumption based on factors such as weather, solar radiation and wind speed, allowing for better integration of renewable energy into the grid [4].

4. Energy demand management. Machine learning can be used to analyze and predict consumer behavior, allowing energy companies to develop demand management strategies such as dynamic pricing or energy conservation incentive programs.

The benefits of using machine learning to predict electricity consumption include:

- Higher forecast accuracy compared to traditional methods.
- Ability to take into account a large number of factors and their relationships.
- Flexibility and adaptability to changing conditions.

Disadvantages may include:

- High demands on computing resources, especially for complex models and large volumes of data.
- The need to collect and process large amounts of data to train models.
- Risk of overtraining models if they are too complex or the data is not representative enough.

Let’s look at the process of using machine learning to predict electricity consumption using a random forest as an example [5].

Stage 1: Data collection and preparation. The first step is to collect electricity consumption data, which may include historical consumption data, weather conditions, calendar events, population data and other socio-economic indicators. After collecting data, it must be preprocessed by filling in gaps, removing outliers, and normalizing feature values.

Stage 2: Dividing the data into training and test sets. The data is divided into training and test sets to train the model on one part of the data and test its performance on another, independent part. Typically, a ratio of 70:30 or 80:20 is used for the training and test sets, respectively.

Stage 3: Model selection and training. At this stage, a machine learning algorithm is selected that will be used to predict electricity consumption. In our example, we use random forest, which is an ensemble method that combines multiple decision trees. The model is trained on a training set using historical electricity consumption data and corresponding features.

Step 4: Evaluating model performance. After training the model, its performance is evaluated on the test set using various metrics such as mean absolute error (MAE), mean squared error (MSE) or coefficient of determination (R^2) [6]. This helps determine how well the model can predict energy consumption using new data.

Stage 5: Optimizing the model and checking for overfitting. Based on the model performance results, you can determine whether the model requires optimization (such as hyperparameter tuning) or testing for overfitting. Overfitting can be detected using cross-validation, where the model is trained and tested on different subsets of the data.

Stage 6: Implementation of the model. Once the model has been optimized and tested for overfitting, it can be implemented in a real energy management system to predict future energy consumption values. This will enable grid operators to optimize planning processes, integrate renewable energy sources and develop demand management strategies.

Many companies and organizations have already successfully implemented machine learning to predict energy consumption. For example, Google DeepMind used machine learning to optimize energy consumption in its data centers, reducing cooling costs by 40 %. The graph in Figure shows a typical day of testing using the DeepMind algorithm to recommend the most efficient power consumption. The graph shows when machine learning recommendations were turned on and off. It is also worth noting the experience of EDP (Energias de Portugal), which used machine learning to predict electricity consumption based on weather data, which improved the accuracy of forecasts and optimized the planning process.

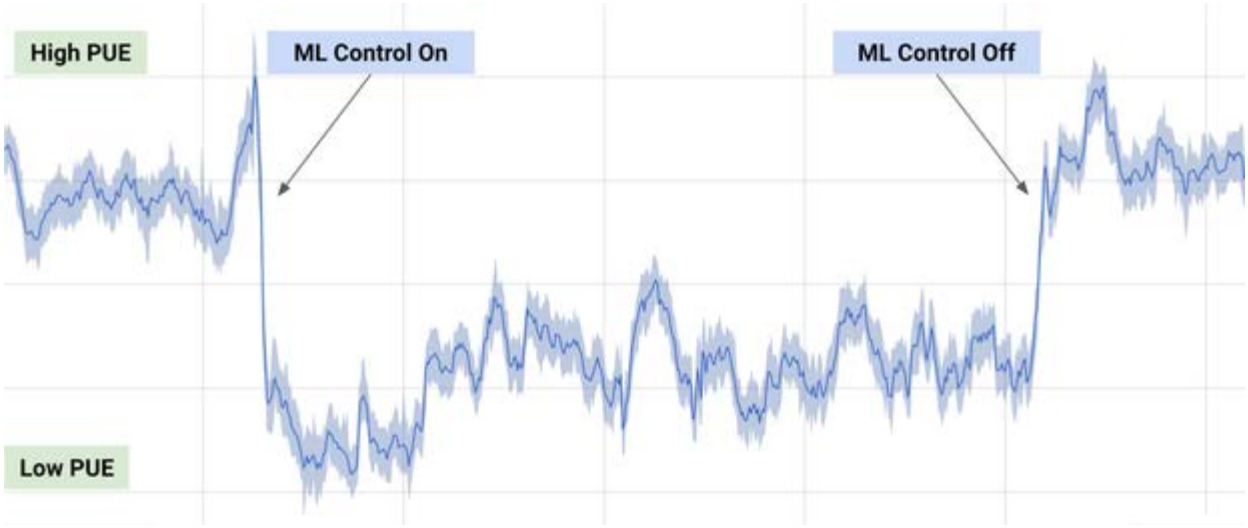


Figure. Testing using the DeepMind algorithm

The use of machine learning to predict electricity consumption is a promising area that can significantly improve the accuracy of forecasts and the efficiency of energy system management. Various machine learning methods, such as linear regression, decision trees, neural networks, and time series methods, can be used depending on the specifics of the problem and the available data. However, for the successful application of machine learning, it is important to conduct careful data analysis, select appropriate models and techniques, and consider possible limitations associated with computing resources and data volume.

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УДК 004.42:004.62

USING MESSAGE BROKERS TO PROCESS REQUESTS ON THE EXAMPLE OF APACHE KAFKA

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Abstract. The article discusses the technology of using message brokers when processing requests. Aspects of its historical emergence and development are analyzed. The relevance of the use of message broker technology as a tool for working with databases in modern information systems is determined. An example of designing a web application shows how to implement sending and reading messages using the Apache Kafka software broker and the Java programming language.

Keywords: information systems, data processing, queries, message brokers, Apache Kafka, Java.

ИСПОЛЬЗОВАНИЕ БРОКЕРОВ СООБЩЕНИЙ ДЛЯ ОБРАБОТКИ ЗАПРОСОВ НА ПРИМЕРЕ APACHE KAFKA

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Аннотация. В статье рассматривается технология использования брокеров сообщений при обработке запросов. Анализируются аспекты ее исторического возникновения и развития. Определяется актуальность применения технологии брокеров сообщений как инструмента работы с базами данных в современных информационных системах. На примере проектирования web-приложения показано, как реализовать отправку и чтение сообщений с помощью программного брокера Apache Kafka и языка программирования Java.

Ключевые слова: информационные системы, обработка данных, запросы, брокеры сообщений, Apache Kafka, Java.

The growing amount of equipment connected to global computer networks has led to a new term for the Internet of Things. It has come to machine communication and a set of devices that can interact with each other. The need to improve system integration has led to the development of message brokers, which is especially important for data analysis and business intelligence [1, 2]. A message broker is software that allows applications, systems, and services to communicate and share data. This is achieved by the broker by translating messages between formal protocols of their exchange, which allows interdependent services to “communicate” with each

other directly. In this case, such data exchange can be carried out even if they are written in different languages or work on different platforms.

Message brokers appeared due to the following factors. Currently, about 12 billion smart machines are connected to the Internet. Given that there are about 7 billion people on the planet, we have almost one and a half devices per person. By 2030, their number will significantly increase to 200 billion, or even more. With the development of technology, the construction of smart homes and other automatic systems, our daily life is becoming more and more consistent with the concept of digital space.

Let's dwell in more detail on the use of a message broker, which is based on Apache Kafka [3]. In 2010, LinkedIn engineers faced the challenge of integrating vast amounts of data from their infrastructure into a lambda architecture [4, 5]. It also included Hadoop and real-time event processing systems [6]. As for traditional message brokers, they did not meet the needs of LinkedIn. These decisions were too heavy and slow. In this regard, a team of engineers has developed a scalable and fault-tolerant messaging system without unnecessary functions. The new queue manager quickly evolved into a full-fledged event streaming platform.

The technology became popular largely due to its compatibility. Apache Kafka message broker can be used with a wide range of systems:

- user web and desktop applications;
- microservices, monitoring and analytics systems;
- data processing systems NoSQL, Oracle, Hadoop, SFDC.

With the help of the Apache Kafka message broker, it is easy to create applications for data processing and manage complex internal systems, optimizing search queries [7]. Figure 1 shows the three main features of this queue manager.



Figure 1. Apache Kafka Messaging Broker Capabilities

As you can see, Apache Kafka makes it possible to:

- publish and subscribe to record streams with excellent scalability and performance, making it suitable for use throughout the company;
- store streams securely, distributing data across multiple sites for highly available deployment;
- process data streams as they arrive, allowing aggregation, window control parameters, data merging in the stream, etc. [8].

Consider an example that will send a message to Apache Kafka and then read it. We will implement the software implementation in the Java programming language [9, 10].

First, set up ExampleProducer, the “publisher” that sends the message.

```
ExampleProducer()
{
    Properties props = new Properties();
    props.put("bootstrap.servers", "localhost:9092");
    props.put("key.serializer",
"org.apache.kafka.common.serialization.StringSerializer");
    props.put("value.serializer",
"org.apache.kafka.common.serialization.StringSerializer");
    producer = new KafkaProducer<>(props);
}

  public void sendMessage(String topic, String key, String value)
  {
    System.out.printf("Sending message topic: %s, key: %s, value: %s%n", topic, key,
value);
    producer.send(new ProducerRecord<>(topic, key, value));
  }
```

Here bootstrap.servers connects to the message broker, and key.serializer and value.serializer inform Apache Kafka that they are poisoning data that is of the String data type.

Next, set up ExampleConsumer (“Subscribers” consumer of messages).

```
  public ExampleConsumer(String topic, BiFunction<String, String, Boolean>
biFunction)
  {
    Properties props = new Properties();
    props.setProperty("bootstrap.servers", "localhost:9092");
    props.setProperty("group.id", "test");
    props.setProperty("key.deserializer",
"org.apache.kafka.common.serialization.StringDeserializer");
    props.setProperty("value.deserializer",
"org.apache.kafka.common.serialization.StringDeserializer");
    KafkaConsumer<String, String> consumer = new KafkaConsumer<>(props);
    consumer.subscribe(Arrays.asList(topic));
    out: while (true)
     {
      ConsumerRecords<String, String> records =
consumer.poll(Duration.ofSeconds(30));
      for (ConsumerRecord<String, String> record: records)
       {
       if (biFunction.apply(record.key(), record.value())){
         break out;
       }
```

```
        }
    }
```

Here group.id is the identifier of the consumer group.
KafkaExampleMain is the main class where the main method is implemented.

```
public static void main(String[] args) throws InterruptedException
 {
  final String topic = "my-test-topic";
  int count = 3;
  AtomicInteger atomicInteger = new AtomicInteger(0);
  ExecutorService executorService = Executors.newFixedThreadPool(2);
  //start consumer
  executorService.execute(() ->
 {
  new ExampleConsumer(topic, (key, value) ->
   {
    System.out.printf("consumed: key = %s, value = %s%n", key, value);
    return atomicInteger.incrementAndGet() == count;
    });
 });
   //start producer
  executorService.execute(() ->
   {
    ExampleProducer exampleProducer = new ExampleProducer();
    for (int i = 0; i < count; i++)
     {
      exampleProducer.sendMessage(topic, Integer.toString(i), "message - " + i);
      }
  });
    executorService.shutdown();
    executorService.awaitTermination(3, TimeUnit.MINUTES);
 }
```

The results of the program are shown in Figure 2:
Sending message topic:

- my-test-topic;
- key: 0;
- value: message – 0.

Sending message topic:

- my-test-topic;
- key: 1;
- value: message – 1.

Sending message topic:

- my-test-topic;
- key: 2;
- value: message – 2.

consumed:

- key = 0;

- value = message – 0.
  consumed:
- key = 1;
- value = message – 1.
  consumed:
- key = 2;
- value = message – 2.

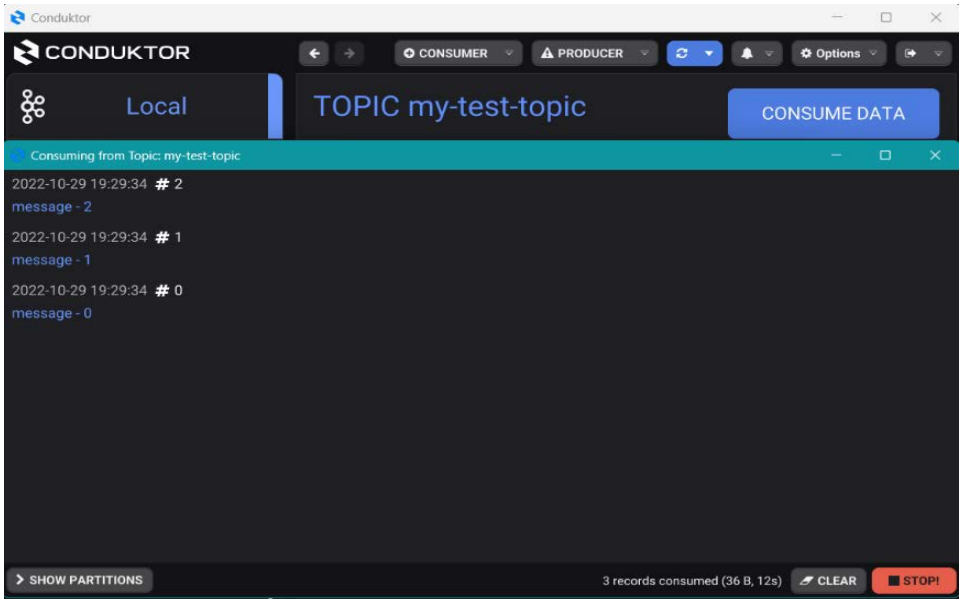


Figure 2. Displaying the results of the program using Apache Kafka

Thus, the ability to efficiently exchange messages between multiple unrelated software components is vital for each distributed ecosystem. Message brokers provide simple, scalable and reliable means to achieve this goal, and Apache Kafka message broker is one of the most complete and effective tools that exist today. At the same time, it is much more than just a messaging system. Its distributed architecture and real-time data processing make the Apache Kafka message broker adaptable to a wide variety of scenarios and use cases in an infinite space of digital information.

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УДК 004.415.53

SOFTWARE TESTING METHODS OF INFORMATION RESOURCES OF THE HIGHER EDUCATIONAL INSTITUTION

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Abstract. The relevance of this research topic is determined by the fact that improving the quality of information resources of a higher educational institution contributes to an increase in the influx of applicants. Particular attention is paid to the quality of User Experience design, as it directly affects the attractiveness of the site for the end user. The main methods of software testing are discussed, recommendations for their application are given.

Keywords: software testing, user experience design, A/B testing, equivalence class, analysis of boundary values.

АНАЛИЗ МЕТОДОВ ТЕСТИРОВАНИЯ ИНФОРМАЦИОННЫХ РЕСУРСОВ ВЫСШЕГО УЧЕБНОГО ЗАВЕДЕНИЯ

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Аннотация. Актуальность данной темы исследования обусловлена тем, что повышение качества информационных ресурсов высшего учебного заведения способствует увеличению притока поступающих. Особое внимание уделяется качеству UX-дизайна, так как он напрямую влияет на привлекательность сайта для конечного пользователя. В статье обсуждаются основные методы тестирования программного обеспечения, даются рекомендации по их применению.

Ключевые слова: тестирование программного обеспечения, UX-дизайн, A/B тестирование, классы эквивалентности, анализ граничных значений, устойчивое развитие.

Quality testing is crucial in the process of creating a successful information resource. Often more attention is paid to the cost of the information resource development process. However, at the end of the last century, G. Myers wrote that from

30 to 60 % of the total resources of the project to create a information resource are spent on testing [1, p. 7].

In order to comply with quality, a well-coordinated organization of the entire process of creating an information resource, that is, a quality system is important. In this context, an organization is considered as a set of managed processes. Variations in the characteristics of the manufactured product are the result of these processes. Creating software is a long, time-consuming, complex process, so it is important to apply various testing methods to ensure the quality of information resources.

In this article, by UX design (User Experience design) we will understand the process of creating an information resource that provides a user-friendly interface for the user. The university's website is an important tool for promoting educational services. After hearing about the university for the first time, the applicant and his parents usually turn to the university's website. Websites are often viewed using mobile devices, so it is important to create a high-quality mobile version of the university portal. The location of the menu at the top of the screen is inconvenient. To use it, you will need to use your other hand or stretch your thumb on the hand holding the phone. This menu arrangement is inherited from desktop computers.

Text is an integral part of the content of the website. It is present at the main points of contact. The point of contact is the interface between the user and the educational product. When creating a point of contact, the system architect chooses the degree of generalization himself. For a more effective service design, it is recommended to break the contact points into fairly small elements.

There may be situations when the user's interaction with the site will go according to an unplanned scenario. In this case, the most informative error message should appear. A window with the text "Error" gives the user information that something went wrong, but does not suggest how to fix the situation. The message "Unknown error" may spoil the user's impression of the site. An informative error message will help maintain the client's trust in the web resource. Messages with little meaning, such as "Done", are recommended to be replaced with more informative ones, for example, "Document added". If an incomprehensible situation has arisen on the site that does not affect the user's work, it makes no sense to display a warning message. It will only distract and annoy.

It is important that the site communicates with the user in a modern and simple language. Jargon and complex abbreviations should not be used. The "voice of the product" can both attract and interest, and alienate the user.

An iterative organization of work is recommended, which is prescribed in the guideline. Instead of the term guidelines, the word "guide" is often used in Russia. For example, "Corporate Identity Guide". The guidelines describe graphic elements as brand constants, prescribe rules for their use. The guideline is a specialized document intended primarily for designers. It helps to maintain uniformity in the branded products of the organization, makes it recognizable. The use of the guideline helps to ensure the correct application of corporate identity elements in all branches of the organization.

When creating a text on the university's website, personal assessments and "creative" formulations should be avoided. Working openly, consulting with colleagues and evaluating the results after each short iteration, you can avoid major alterations. The text should not be added to the site just for the sake of filling in the voids.

Minimalism in the interface may not be the right solution. Before removing interface elements, we should think about and check whether we are removing semantic elements that are important to the user. The "beautiful" emptiness on the screen leaves many user questions unanswered. A single button can "grow" additional text and several hints. As a result, the user will be able to find answers to a number of their questions without contacting the support service. It is important to provide for the maximum number of possible user situations.

When designing a new section, first of all you need to ask yourself the question: "Why?". Why is this section needed as a separate element; why do we want to collect this information in it; why is it impossible to disband this information for other sections? Answers to the above and similar questions will help form the content of the section and its title. A "random" search for the name of a section, for example, using a survey of your colleagues, rarely gives good results. Of course, among the large list of names generated on the principle of "I just like it", there may be interesting options. However, in most cases, this approach is not very effective [2, p. 35].

A/B testing will help to improve the quality and effectiveness of the university's website. If there are innovations and you need to check their effectiveness, this type of testing comes to the rescue. The users of the site are randomly divided into groups. The control group "A" works with the old version of the site, and the second group ("B") works with the updated one. To ensure that the user always belongs to the same group during testing, a special label is recorded in the browser cookies. To reduce the influence of external factors (day of the week, time of the year, weather, advertising company, etc.), measurements in groups are carried out in parallel. The use of special filters in Google Analytics (filter by IP address, clearing data from spam, separating information and advertising traffic, etc.) will help to eliminate the impact of internal factors.

It is not always possible to achieve the same number of users in groups, so it is recommended to use relative metrics. Next, rationing is performed for the number of page views or for the number of users.

One of the basic concepts of testing theory is the equivalence class [3, p. 32]. It includes a group of tests that are designed to detect the same error. At the same time, it is assumed that if one of the tests reveals an error, then the others will most likely do it too. The opposite assumption is also put forward. The method of equivalent partitioning is based on the construction of equivalence classes. The search for equivalence classes is a subjective process. Two testers analyzing the same program will compile different lists of classes.

As a rule, most of the errors occur at the borders of the input area, and not in the center. The method of analyzing boundary values is to obtain test variants that analyze

boundary values. This testing method complements the Equivalent Partitioning method. The main difference between boundary value analysis and equivalence partitioning is that test cases are created to test only the edges of equivalence classes. At the same time, in the process of creating test variants, not only the input conditions are taken into account, but also the output area. When using this testing method, a certain degree of specialization in the problem under consideration is required. Compliance with a number of rules will help in solving this problem:

1. When testing a range of input values, tests are required for the minimum and maximum boundaries of the range and for the situation of a slight outflow from the boundaries of the range of values. That is, if the data entry condition is a range from variable ‘a’ to variable ‘b’, then the test options should be for options ‘a’ and ‘b’, as well as for options slightly to the left of a and slightly to the right of b on the numeric axis. For example, the range is [-100; 100], then we check -100; 100; -100.0001, 100.0001.

2. If the input condition specifies a discrete set of values, then test cases are created to check the minimum and maximum of the values and for values slightly less than the minimum and slightly more than the maximum.

3. If the input data of the program are ordered sets (for example, a linear list or a table), then it is necessary to test the processing of the first and last elements of these sets.

4. The first three rules also apply to the conditions of the output area.

5. If the internal data structures of the program have prescribed boundaries, then test variants are developed that repeat these structures at their boundaries.

6. If the input or output data of the program are ordered sets (for example, a linear list or a table), then it is necessary to test the processing of the first and last elements of these sets.

The analysis of boundary values, when applied correctly, is one of the most effective methods, since it also allows you to identify common errors that were made during the development of the program. However, it should be understood that the boundary values may be barely perceptible and, therefore, difficult to determine.

The methods of equivalent partitioning and analysis of boundary values do not allow us to sufficiently test the business logic that is deeper than the user interface. To test it, the alternative table method is often used. There are situations for which the input data that exists at a certain point in time for a particular transaction is sufficient in itself to determine the action that the system should perform. Such situations are called transactional. Alternative tables reflect the rules governing the handling of transactional situations. Less often, a boolean graph is used instead of tables, then such a technique is called a causal relationship diagram. Any table of alternatives can be transformed into a causal relationship diagram and vice versa. This article discusses the alternative table method. In most cases, it is more convenient due to its simple and concise structure.

Using the alternatives table, two types of defects are found. The first is when the system performs an action that should not be performed under a given combination of

conditions. The second is when the system does not perform an action that it should perform under a given combination of conditions. When writing tests, the input test data must meet the specified conditions from the alternatives table. The output test data is actions under a given combination of conditions. Each combination of conditions must be covered by at least one test scenario. To achieve this, you need to write at least one test for each column in the table.

If the tester looks for errors without any methodology, then he subconsciously uses the method of error assumption. This method is largely based on intuition, so its procedure is quite difficult to describe. The basic idea is to make a list that lists possible errors and situations in which these errors could manifest themselves. Then tests are compiled based on the list. This method can be used by a tester with practical experience.

The main criterion for the operation of the operator coverage method is the execution of each operator at least once. Such a criterion is usually insufficient, so the operator coverage method is used only in conjunction with other methods. The method of covering solutions (transitions) is based on the statement that each direction of transition must be implemented at least once. The result of passing each solution is the value true or false. In the condition coverage method, all results of all conditions must be met at least once. The method of covering solutions and conditions is a combination of the two previous ones. Both the results of each transition and each operator must be executed at least once.

Load testing checks the stability of the system while simultaneously working with a large number of users with significant amounts of data, it is a client-oriented type of testing. Automation tools include Jmeter, Locust, LoadRunner, Gatling and others.

In the process of functional testing, the compliance of the software implementation with the requirements specified in the terms of reference is checked, but data processing is not tested. This type of testing is more often carried out without access to the program code. User interaction with the system is simulated.

To assess the quality of the texts that are planned to be placed on the site, you can use close-tests (close-test). They were first proposed by Wilson Taylor in 1953 [4, p. 152]. The test helps to assess how much the context is understood by the user. For testing in the text under study, some words are replaced with spaces [3]. Next, the subjects are asked to fill in the gaps based on the context. If they manage to correctly recreate 60-70 % of the content, the text can be considered good and suitable for posting on the site.

If an Internet resource has many fields for data entry, it is recommended to use automated testing, in particular, the areas of acceptable values of the input data [5]. Automated testing is also convenient for login and password entry forms, for checking the correctness of access rights differentiation.

Effective UX-design of information resources of the university allows you to strengthen its brand, attract more motivated applicants. To ensure the quality of the site, it is recommended to test it using various methods.

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УДК 621.039

NUCLEAR WASTE DISPOSAL. NUCLEAR WASTE DISPOSAL TECHNOLOGY IN RUSSIA AND THE USA

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Abstract. The problem of nuclear waste disposal is very relevant today. Radiation safety requirements are constantly becoming more stringent. This article describes methods of nuclear waste disposal, and also discusses nuclear waste disposal technologies in Russia and the USA.

Keywords: nuclear waste, radiation, radioactive waste, disposal, safety, technology.

УТИЛИЗАЦИЯ ЯДЕРНЫХ ОТХОДОВ. ТЕХНОЛОГИИ УТИЛИЗАЦИИИ ЯДЕРНЫХ ОТХОДОВ В РОССИИ И США

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Аннотация. Проблема утилизации ядерных отходов очень актуальна на сегодняшний день. Требования к радиационной безопасности постоянно ужесточаются. В данной статье описываются способы утилизации ядерных отходов, а также обсуждаются технологии утилизации ядерных отходов в России и США.

Ключевые слова: ядерные отходы, радиация, радиоактивные отходы, утилизация, безопасность, технология.

Nowadays, the tension of the ecological situation is increasing very rapidly every day. With the development of the scientific industry, the economy and the standard of living of citizens, the state of the environment around the world is rapidly deteriorating. The main epicenters of pollution are large cities and industrial centers, as tons of harmful waste appear there every day. Hazardous waste is the garbage that remains after industrial production.

These are emissions with a chemical composition or various harmful properties that can cause the development of a disease, provoke a fatal outcome or cause any harm to the human body or other forms of life.

Until some time, radiation and radioactive substances were a natural part of the environment. However, at some point man took a big step forward and tamed the power of the atom. Since then, radioactive substances and radiation have been used in a wide variety of activities: from industry and energy production to medicine and agriculture. And as befits non-trivial human labor, all this activity leads to the formation of waste in various forms. And not just waste, but radioactive waste (RW) [1].

Radioactive waste is generated with different chemical and physical characteristics, forms, volume of radionuclides and at different types of enterprises, because of this there are many options for waste management. These substances cause great harm to human life, so their accumulation is the main problem. In case of improper handling of radioactive waste, the environmental situation worsens, since waste disposal occurs in the hydrosphere and lithosphere.

Radioactive waste is generated during the operation of nuclear fuel cycle facilities, nuclear power plants, research reactors, critical stands and assemblies, powerful sources of ionizing radiation, civil and naval vessels with nuclear power plants and other radiation sources.

At nuclear power plants, a nuclear fission reaction occurs, splitting an atomic nucleus into two, less often three nuclei with similar masses with a large release of energy. The fuel for the nuclear power plant is Uranium 235 nuclei. As a result of the reaction, about 100 different isotopes with mass numbers from 90 to 45 are formed. To start fission of the uranium nucleus, one neutron is needed, for example, a neutron from a plutonium nucleus. The fission products of uranium nuclei can be isotopes of barium, xenon, strontium, rubidium [2].

Radiation safety measures for waste are determined taking into account the properties of radiation and the degree of its danger. There are:

- alpha-emitting waste – contains heavy particles (positively charged), the penetrating ability is low, such radiation can be retained by a sheet of paper, 1 layer of clothing, it poses a danger to open mucous membranes (visual organs), but not to intact skin;

- beta-emitting waste – contains electrons (negatively charged), the penetrating ability is average, glass and aluminum are used for protection, clothing also protects the body well from radiation;

- gamma-emitting waste – has an electromagnetic nature similar to visible light, is characterized by high penetrating and damaging ability (spread over hundreds of meters), special screens are used for protection, indirect factors that increase the level of safety, time and distance, are considered.The first two groups include wastes that contain difficult-to-detect alpha- and beta-emitting radionuclides. For comparison, materials of the third type include easily detectable gamma-emitting radionuclides [3].

At the moment, the problem of radioactive waste disposal is very relevant. There are many rules and laws about the correct disposal system, as this type of waste has a

very high hazard class. One of such laws is Federal Law No. 190-FZ of 11.07.2011 “On Radioactive Waste Management and on Amendments to Certain Legislative Acts of the Russian Federation” (with amendments and additions coming into force from 16.07.2013) Article 12. Requirements for the disposal of radioactive waste:

1. Radioactive waste, with the exception of short-lived radioactive waste, the specific activity of which, as a result of the decay of radionuclides during storage, can be reduced to a level at which such waste ceases to be radioactive waste, is subject to mandatory disposal at radioactive waste disposal sites.

2. The disposal of solid highly active long-lived and solid medium-active long-lived radioactive waste is carried out in the deep burial sites of radioactive waste, ensuring the localization of such waste in accordance with the Law of the Russian Federation of February 21, 1992 N 2395-1 “On Subsoil”.

3. The disposal of solid low-active radioactive waste and solid medium-active short-lived radioactive waste may be carried out at the points of near-surface disposal of radioactive waste.

4. The disposal of radioactive waste generated during the extraction and processing of uranium ores and solid very low-active radioactive waste can be carried out without their conditioning in the near-surface disposal of radioactive waste.

Disposal of radioactive waste depends on the level of activity of the constituent elements. Disposal of radioactive waste does not reduce the level of radiation to zero, but only partially reduces the degree of radiation. The waste is treated before being transported to the disposal site to avoid harm to people and the environment, as the treatment reduces the level of danger of radioactive waste. Several methods are used for this:

1) Materials made of wood, textiles, paper, cardboard, rubber that have come into contact with low or medium level radioactive substances are burned. The recycling process takes place inside special chambers that prevent or minimize the ingress of hazardous particles into the environment. Heat treatment does not destroy the radiation level, but only reduces it. Therefore, the remains of the waste are mixed with a cement solution and poured into sealed containers. Their burial takes place in specially equipped mines, warehouses, salt stocks.

2) Compression is used for the treatment of low- and medium-level radioactive waste. Presses compact nuclear waste, reducing the volume up to ten times. The resulting material, which has a radiation background, is poured with cement mortar and buried as burnt hazardous waste. Cemented waste after compression, stored in special containers, does not pose a danger to the environment.

3) There is such a method of burial as glazing. Glass is capable of absorbing large volumes of hazardous substances. Radioactive waste of any level of activity is put inside special steel containers and filled with liquid glass. The material dissolves due to the use of an electric heating furnace. In order to give hardness to garbage, super calcinates, glass ceramics are used, after careful sealing of the resulting mixture, it is buried in equipped burial grounds [2].

Today, two types of nuclear waste burial grounds are being built:

1. Storage facilities located in shallow depressions or near the surface of the earth, designed for decades.

2. Deep RW burial grounds located in spent mines or on the ocean floor.

Employees of storage facilities and persons responsible for the selection and arrangement of a place for the disposal of radioactive waste must strictly follow the established rules:

1. The placement area should not be seismically unfavorable.

2. No construction should be carried out near the burial ground. This is fraught with damage to containers with nuclear contents.

3. The nearest settlement should be no closer than 20 km.

4. Another 1 km radius should be allocated to the sanitary zone that is not included in the exclusion zone.

5. All structures located at the RW landfill must be made of radiation-resistant materials.

6. The risk of landslides should be eliminated.

7. It is impossible to arrange burial grounds in areas of the presence of reservoirs and groundwater. The threat of flooding should be completely excluded.

8. The filled and preserved storage must be 100 % autonomous [4].

In modern Russia, measures are being taken to rehabilitate former burial grounds to reduce the danger, new burial sites are being developed taking into account water inaccessibility, seismic activity, and soil characteristics. Spent salt mines are better suited for these purposes. In 2016 The Government of the Russian Federation identified six burial sites on the territory of the Leningrad, Sverdlovsk, Chelyabinsk, Tomsk regions, and Krasnoyarsk Krai that comply with environmental safety standards. These are objects of deep and near-surface types for radioactive waste with different activity and decay periods. As it was indicated, the disposal of radioactive waste does not reduce the radiation level to zero, but only partially reduces the degree of radiation. New methods and burial sites are being sought, improved sealed containers are being produced to prevent dangerous substances from entering the air, water, and soil. New methods of processing, decontamination, and disposal of nuclear waste are being developed.

In Russia, several methods are used to neutralize radioactive waste before disposal:

- the use of sodium carbonate;
- dissolution in nitric acid;
- soil elution;
- treatment of liquid waste.

Each of the methods has its positive and negative sides, but without them it is not possible to reduce the level of garbage radiation [5].

The classification of radioactive waste in the United States has its own characteristics. For example, there is no category of medium-level radioactivity waste in the classification, but there are four additional subcategories of low-level waste. Typically, such waste is stored in a temporary radioactive waste storage facility in the

area where it was generated until sufficient quantities have accumulated for further transportation.

As of 2009, there are 104 nuclear power reactors in the USA, as well as a number of auxiliary reactor maintenance facilities. There was also one civilian recycling plant in West Valley (Figure), which was the largest waste generation site, currently closed. Spent nuclear fuel is stored in holding pools on the territory of the nuclear power plant itself. To increase the storage capacity, dry storage boxes are used, which are located in containers or in concrete bunkers. Spent fuel from research nuclear reactors, as well as from foreign reactors of the European Union, is stored in a dry temporary storage facility in the Savannah River area and at the Idaho National Laboratory.



Figure. The recycling plant in West Valley, US

The US government, which is in power, has assembled a Blue Ribbon Panel (BRP) expert commission to find new ways to handle waste and prepare reports on the work done.

High-level waste generated as a result of civil waste processing is sent to storage facilities in the same way as spent nuclear fuel. The storage facility has remained open for more than a hundred years since the beginning of the placement of radioactive waste in it – waste can be loaded for fifty years, and in the next fifty years the storage facility is in an open accessible state.

Spent nuclear fuel from research reactors, as well as from power reactors, is planned to be disposed of for burial in deep geological formations.

Waste with long-lived radionuclides is loaded into temporary waste storage facilities for an indefinite period of time, most often for a long time. Low-level radioactive waste is placed in near-surface storage facilities, which are located at a depth of 30-40 meters. Radioactive waste of a very low level of activity is sent to other places of storage of hazardous substances.

Currently, there are four near-surface storage facilities for low-level radioactive waste in the United States.

One of the main problems associated with the disposal of waste in the United States is that organizations in some states that produce waste are forced to organize long-term disposal of this waste themselves. One near-surface storage is in the licensing process. Prior to that, four such repositories were not licensed due to non-compliance with security requirements.

In the USA, radioactive waste from nuclear power plants and research reactors goes through all stages of processing, and then, mainly, is sent to long-term storage in order to reduce activity. There is also increasing interest in the disposal of waste in deep formations; waste of a very low level of activity is dumped into water bodies [6].

In general, nuclear waste is a serious problem that requires attention and measures taken for its safe treatment and disposal. It is necessary to develop and apply technologies that will minimize risks and protect us and future generations from the dangers associated with radioactive waste.

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УДК 332.1

MARKETING PLACES AND DESTINATION BRANDING: FOREIGHN AND RUSSIAN EXPERIENCE

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Abstract. In the Russian scientific discourse, the history of the emergence of marketing places and destination branding is considered quite indirectly. The article is devoted to the study of the prerequisites for the emergence and history of the formation of the theory of marketing places and destination branding. The author has studied the main stages of the emergence of the theory of marketing places and destination branding in foreign scientific discourse, as well as in the Soviet and Russian context. Based on the data obtained, we presented a detailed chronology of the emergence and formation of the theory of marketing places and destination branding.

Keywords: region, territory, place, marketing places, destination marketing, destination branding, place branding.

МАРКЕТИНГ МЕСТ И ТЕРРИТОРИАЛЬНЫЙ БРЕНДИНГ: ЗАРУБЕЖНЫЙ И РОССИЙСКИЙ ОПЫТ

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Аннотация. В российском научном дискурсе достаточно опосредованно рассмотрена история возникновения маркетинга мест и территориального брендинга. Статья посвящена исследованию предпосылок возникновения и истории становления теории маркетинга мест и территориального брендинга. Автором были изучены основные этапы возникновения теории маркетинга мест и территориального брендинга в зарубежном научном дискурсе, а также в советском и российском контексте. На основании полученных данных нами была представлена подробная хронология появления и становления теории маркетинга мест и территориального брендинга.

Ключевые слова: регион, территория, место, маркетинг мест, территориальный маркетинг, территориальный брендинг, брендинг мест.

Before the very emergence of the concept and methodological apparatus of destination branding, attempts were already made in some states to construct a positive image of the country.

The development of conceptual marketing models originated in Western American theoretical and applied discourse. Thus, the first work that affects destination marketing in any way is the article “Expanding the concept of marketing”, published in 1969 by researchers Philip Kotler and Sidney Levy [1]. In the 1970s, post-industrial processes led to a quite obvious understanding that marketing as an activity can be applied not only to goods or services, but also to various territories (places) [2].

So, in Russia, marketing as an activity officially appeared during the USSR period in connection with the signing in 1975 of the Final Act [3] of the Helsinki Conference on Security and Cooperation in Europe. This document regulated the introduction of marketing into government activities for the purpose of cooperation and mutual understanding with other states. However, the de facto development of marketing activities in the country did not occur properly due to the perception of marketing by the Soviet Union as another negative capitalist product [4].

The first specialized works on the topic of destination marketing appeared in the West in the early 1990s. So, in 1993, one of the first key works of F. Kotler and other authors was published under the title “Marketing Places: Attracting Investments, Industries and Tourism to Cities, States and Nations” [5]. In this study, Kotler and co-authors talk about marketing tools as the most comprehensive for solving problems related to any territorial units [6].

In the Russian discourse of the 1990s, after the collapse of the USSR, the marketing of places in modern Russia gets a second wind. Thus, marketing places of territories in the research and practical sphere was laid by the Russian scientist A. M. Lavrov in 1994 in his dissertation research “Regional marketing: issues of theory, methodology and practice”. This work was completely innovative for the Russian Federation and caused a resonance in the relevant circles [6].

The marketing places also implies the development of a positive image of the state. Thus, at the turn of the XX–XXI centuries, the directions for the formation of a positive business image of Russia were probably first identified at the turn of the century in the project “Concepts for the formation of a positive image of Russia”, prepared by the Public Relations Department of the Russian Center for Foreign Investment Promotion under the Ministry of Economy of the Russian Federation.

This document includes the following areas of formation of a positive business image:

1) development and presentation of investment projects;

2) preparation of an extensive database on legislative, regulatory, legal and economic conditions for foreign investors of the Russian economy;

3) the involvement of media resources in the face of state and foreign media to cover the advanced sectors of the Russian economy;

4) preparation of special publications, holding conferences for full-scale coverage of the conditions and advantages of the Russian investment market;

5) regulation of actions of state structures.

However, due to the inconsistency of the positions of the Russian government, as well as real practice, which is far from the approaches and tools of marketing communications, the project was not implemented [6].

Thus, we have consistently come to the next stage in the development of destination marketing, namely the emergence of destination branding. Destination branding is a newer term that is related to the term marketing places, but with its own specific features. The first attempts to introduce the term place branding and destination branding began to be undertaken by the British adviser on building the national brand image of the state, Simon Anholt, since 1998 in the magazine Place Branding and Public Diplomacy and a number of books [7]. The concept of destination branding received international publicity and consolidation in science in 2002 by Simon Anholt in a book called “Destination Branding: Creating the Unique Destination Proposition” [8].

Simon Anholt developed the concept of the so-called competitive identity, often shown in the form of a hexagon figure and consisting of six brand components, such as tourism, export brands, politics, business and investment, culture and humans (Figure) [9].

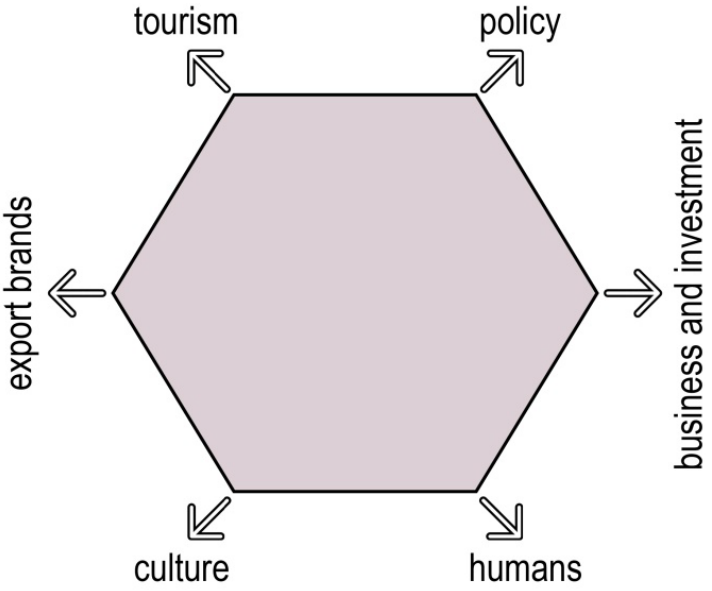


Figure. Conceptual model of S. Anholt, scheme (hexagon)

Based on this, we will attempt to define the concept of place branding. Therefore, based on the above, we can conclude that the brand of places is an image, an idea of the unique economic, geographical, socio-cultural components of a certain territory (place) that cause persistent associative connections [10].

Let’s turn to the theory of branding. So, one of the authoritative researchers in the field of destination branding Keith Dinnie in his famous book “City Branding: Theory and Cases” [11] asserts that the branding of places is an effective method by

which it is possible to work qualitatively with target audiences, that is, with local residents, tourists and investors.

He also observes the fact that there is now a massive desire to use the tools of destination branding in cities and regions around the world. However, the researcher also finds negative connotations in this, because some regions use territory branding only within a certain trend, etc., without understanding the problems of the region, which leads to ineffective results. According to the author, the key mistake of this is the presentation of the brand of a place simply as a selling visual and nothing more, to attract tourists [11].

A well-developed destination marketing for the state opens up a number of advantages and privileges in the face of attracting investments or everything related to the recreational potential of the state. That is why, at the end of the 2000s, a variety of states seriously thought about thinking through and designing their national brand, which will be able to strengthen their own reputation on the world stage. And at that time, place branding was a new phenomenon for Russia. The policy of the territorial and image component of the regions and Russia as a whole in the late 2000s was just being formed. For the first time, the concept of promoting national and regional brands of the country was approved by the Government of the Russian Federation in January 2008 [12].

A distinctive feature of the global case on the desired topic is that from 2005 to 2016, a tendency was revealed to shift research interest from the topic of marketing places to the topic of destination branding [13].

The trend towards increasing popularity of destination branding and marketing in the Russian Federation was noted in 2011-2012, which in turn caused a series of problematic moments due to the widespread demand and popularity of this area of development and promotion of the image of territories, as well as continued interest in scientific, professional discourse, as well as the public environment.

The problem is explained by the fact that different approaches to the place branding, the professional affiliation of the participants in the process to different areas of the intellectual services market exist within the framework of one, but not quite defined conceptual apparatus. This negative and undesirable process occurs due to the fact that, in fact, various content and semantic units are placed in the concept of destination branding, where this discrepancy often expresses itself in professional and expert discussion. Consequently, the problems with the designation and interpretation of the conceptual apparatus are applied in the field of destination branding. It can be voiced in this way: what kind of communicative, service or organizational product does the developer create, what does the customer of the place brand ultimately want to get [14].

Thus, having revealed the essence of the theory of destination marketing and branding, having identified the main features of the introduction of these theories in the XX–XXI centuries in the global context, in the USSR and in the Russian Federation, we can say that the place marketing appeared earlier and became the foundation for the development of the theory of destination branding. At the moment,

these two complementary, but not identical concepts are a tool for developing the economic opportunities of a certain territory, as well as creating unique identifiers of a particular locality.

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УДК 621.3

EVOLUTION OF TRANSISTORS: FROM SILICON TO QUANTUM

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Abstract. Transistors are one of the most important elements in electronics and computing. Silicon transistors were invented in the middle of the XX century and became the basis for the creation of the first computers and electronic devices. These transistors had high reliability and stability, which allowed them to be used in various devices. However, with the development of technology, it became clear that silicon transistors have their limitations. Therefore, scientists began to look for new materials and technologies to create more efficient transistors. In this article we will look at the evolution of transistors from silicon to quantum. This article discusses the methods of using various transistors and describes the principles of their operation and advantages. A comparative analysis of quantum and silicon transistors has been carried out in order to determine the most efficient transistor for future use in quantum computers.

Keywords: high technologies, transistors, silicon transistors, quantum dots, quantum computer.

ЭВОЛЮЦИЯ ТРАНЗИСТОРОВ: ОТ КРЕМНИЕВЫХ ДО КВАНТОВЫХ

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Аннотация. Транзисторы являются одним из самых важных элементов в электронике и вычислительной технике. Кремниевые транзисторы были изобретены в середине XX века и стали основой для создания первых компьютеров и электронных устройств. Эти транзисторы имели высокую надежность и стабильность, что позволило использовать их в различных устройствах. Однако с развитием технологий стало ясно, что кремниевые транзисторы имеют свои ограничения. Поэтому ученые начали искать новые материалы и технологии для создания более эффективных транзисторов. В данной статье рассмотрены методы использования различных транзисторов, описаны принципы их действия и преимущества. Проведен сравнительный анализ квантовых и кремниевых транзисторов с целью определения наиболее эффективного транзистора для будущего применения в квантовых компьютерах.

Ключевые слова: высокие технологии, транзисторы, кремниевые транзисторы, квантовые точки, квантовый компьютер.

In the modern world, an era is coming where the demands and needs of people are constantly increasing. Every year we face a growing volume of data, complex tasks in the field of science and technology, as well as the emergence of new challenges that require higher computing power. In such a situation, traditional silicon transistors are no longer able to meet our needs, and this is where quantum transistors come on the scene.

Today there is a growing need for the development of new technologies capable of providing higher computing power and information processing. Quantum transistors represent one of the key ways to achieve these ambitious goals. World leaders in the field of science and technology have already focused their attention on the development of quantum transistors, investing huge amounts of money and resources in research projects.

In this article, we will take a closer look at what quantum transistors are, how they are arranged and work, as well as what new possibilities can be opened with their help. Let’s figure out why the development of quantum transistors is a necessary step in the modern world, and which organizations and scientists are conducting research in this area [1].

Transistors are devices that play an important role in modern electronics. They serve as key building blocks in all electronic devices, including computers, mobile phones, televisions and many others. Over the past few decades, engineers and scientists have done considerable work in the development of transistors. In this article we will consider the evolution of transistors from silicon to quantum.

Silicon transistors were discovered in the 1950s and have since become the main elements of microelectronics. They are made of silicon, a semiconductor material with the ability to control the flow of electrons. Silicon transistors have three layers: emitter, base and collector, which control the electronic current and allow amplifying or switching signals. From them came the field and bipolar transistor.

A bipolar transistor is a semiconductor crystal of type p or n, which is called a base (Figure 1). Next to the base, areas with the opposite type of conductivity are created, which are called a collector and an emitter. The collector junction is between the collector and the base, and the emitter junction is between the emitter and the base.

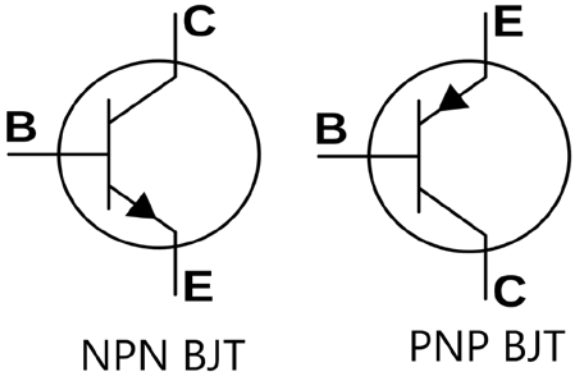


Figure 1. Example of a bipolar transistor with a p-n-p and an n-p-n junction

The bipolar transistor is controlled by current. That is, in order for current to flow between the collector and the emitter (in other words, for the transistor to open), current must flow between the emitter and the base (or between the collector and the base – for the inverse mode).

One of the features of bipolar transistors is the uneven concentration of charge carriers in the emitter, base and collector. In the emitter, the concentration of charge carriers is the highest, in the collector it is slightly less, and in the base, it is much less than in the emitter and collector.

When operating in the amplifying mode, the emitter junction is open and the collector junction is closed. A current will flow through the emitter caused by the transition of electrons from the emitter to the base and the transition of holes from the base to the emitter. Thus, the emitter current consists of electronic and hole components.

A field-effect transistor, unlike a bipolar one, works using the main charge carriers – electrons or holes. The device controls the flow of electrons (or electron holes) from the source to the drain, affecting the size and shape of the "conducting channel" created by the voltage (or lack thereof) supplied to the gate and source terminals. This conducting channel is a "stream" through which electrons flow from the source to the drain (Figure 2). For devices in the gain or depletion mode, at drain-source voltages much lower than the gate-source voltage, a change in the gate voltage will lead to a change in the channel resistance, and the drain current will be proportional to the drain voltage (tied to the source voltage). In this mode, the field effect transistor operates as a variable resistor.

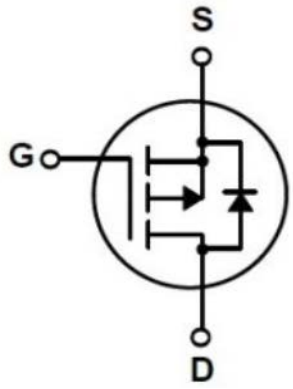


Figure 2. Example of a field-effect transistor

Field-effect transistors are divided into types p and n, depending on the channel conductivity, as well as transistors with a control p-n junction and transistors with an isolated gate, depending on the method of performing the gate [2].

The difference between a field-effect and bipolar transistor is that in bipolar transistors, the resistance between the emitter and the base is relatively low, which provides a fairly low input impedance. In field-effect transistors, the resistance between the source and drain is high, which ensures high input resistance. In general, bipolar and field-effect transistors have different operating principles and characteristics. The choice between them depends on the specific requirements and conditions of use.

With the advent of microprocessors and integrated circuits in the 1970s, transistors became so small that millions or even billions of transistors could fit on a single silicon chip. This made it possible to increase the performance and functionality of electronic devices.

However, with the development of technology, it became obvious that silicon transistors have their limitations. One of the key limitations is the physical limit of the minimum size of transistors. When the size is reduced to the nanometer level, phenomena such as quantum effects and charge leakage begin to occur, which negatively affects performance and energy efficiency [3].

In this regard, researchers began to look for alternative materials and technologies to create more efficient transistors. One of the most promising options is quantum transistors.

A quantum transistor is a semiconductor device in which electric current is controlled at the level of single electrons. Such a transistor includes nanostructures, such as quantum dots or quantum conductors, which act in accordance with quantum mechanical phenomena.

The operation of a quantum transistor is based on the phenomenon of quantum dots or quantum conductors, which have a quantum dimensional effect and energy levels, the quantum states of which can be changed when exposed to an external electric field. This makes it possible to control the current flowing through such a transistor with high accuracy in a variety of industries, for example, in electronics, quantum transistors can be used in the production of more powerful and energy-efficient microchips, which will lead to increased performance of computers and other electronic devices. Also, quantum transistors will affect sections of nanoelectronics. The use of such transistors in nanoelectronics can lead to the creation of new types of sensors, devices for data storage and processing, and other innovative technologies [4].

Thanks to the new technology, they promise a significant improvement in the performance and energy efficiency of electronic devices. They are capable of operating on incredibly small scales and can be used in quantum computers, which have the potential to process huge amounts of data and solve complex problems.

But, unfortunately, quantum transistors also have a number of disadvantages, such as: difficulty in production, high sensitivity to external influences, vulnerability to errors, limited use. Their effectiveness and applicability in various fields are still to be determined [5].

Summing up the above, I would like to say that quantum transistors represent a promising development in the field of nanotechnology, which can lead to significant changes in computing and electronics. However, at the moment this technology does not yet exist, and research in this area is at the development stage.

Despite the fact that some progress has already been made in the creation of quantum transistors, such as the demonstration of qubits with high stability and quantum interference effects, there are still many problems and challenges that need to be overcome to create an efficient and scalable quantum computing system.

One of the key obstacles is the development of materials and structures capable of maintaining the coherence of quantum states for a long time at room temperature. In addition, the creation of efficient interfaces between quantum and classical elements is

also an important task that must be solved in order to realize the full potential of quantum computing.

However, with constant progress in the field of quantum technology, it can be expected that quantum transistors will become a reality in the near future. This can lead to revolutionary changes in the computing and communications industry, providing exponential increases in productivity and reduced power consumption compared to classical technologies.

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УДК 338.31

FORMATION OF A KEY PERFORMANCE INDICATORS MONITORING SYSTEM FOR INDUSTRIAL ENTERPRISES

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Abstract. This paper discusses an importance of the key performance indicators monitoring system for modern industrial enterprises. It also proposes an approach for the formation of a key performance indicators monitoring system which focuses on such elements as Safety, Personnel, Quality, Logistics and Cost.

Keywords: industrial production, key performance indicators, monitoring.

ФОРМИРОВАНИЕ СИСТЕМЫ МОНИТОРИНГА КЛЮЧЕВЫХ ПОКАЗАТЕЛЕЙ РАБОТЫ ПРОМЫШЛЕННЫХ ПРЕДПРИЯТИЙ

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Аннотация. В работе обсуждается важность мониторинга ключевых показателей деятельности промышленных предприятий. В статье обоснована также структура составляющих элементов мониторинга и предложен подход к формированию результативной системы мониторинга ключевых показателей.

Ключевые слова: промышленное производство, ключевые показатели деятельности, мониторинг.

In today’s environment of high uncertainty, special business conditions and unstable economic and geopolitical situation, industrial enterprises are searching for the ways to improve their operations and obtain competitive market advantages in Russia and abroad.

In such a situation the level of operational effectiveness of the enterprises and their key business sections is becoming of crucial importance.

The article holds relevance and scientific novelty. By exploring the relation between key performance monitoring system and industrial enterprises business performance, the article sheds light on an underexplored area of research, offering new insights and perspectives on the subject.

The higher the operational effectiveness, the greater the probability of the further systematic development of the enterprise and stable long-term operations.

At present there are many modern programs and techniques aimed at achieving high results in business performance and operational effectiveness.

These include such concepts as Lean Manufacturing, Six sigma, Total Quality Management, Agile, Business process reengineering, Theory of constraints etc.

Lean manufacturing is a methodology which prescribes detection, analysis and elimination of various losses in business processes. One of the key constructs in Lean is the concept of "value" in the form it is understood by the customer. Lean manufacturing presumes an investigation of business process in search of any kind of the following types of losses – losses due to the transportation (time spent on transportation), losses on inventory (frozen resources), losses on ineffective motions (for example, imperfect layouts or ergonomics), waiting for something, overproduction (producing what is not required), overprocessing, defects and skills of personnel which might not be efficiently utilized [1, p. 61].

Six sigma is a business process improvement concept which requires process variability identification and reduction to keep it under control in order to eliminate the deviations that might go beyond the specification [2, p. 27].

Total quality management is a concept aimed at a certain style of business process management – the one that ensures the high-quality products or services.

Agile methodology suggests continuous improvement of business processes that involves the constant feedback which reveals the level of effectiveness reached on the particular processes [3, p. 38].

The Theory of constraints states that having considered a business process as a whole, it is possible to identify individual limiting elements, or factors that determine the effectiveness of the entire business process. According to this approach, only the removal of these restrictions can improve business performance [4, p. 5].

Business process reengineering is applied when there is a decrease in business profitability. Its goal is to improve the company's key performance indicators (KPIs) [5, p. 127], and its method is a step-by-step transformation in order to achieve a high level of operational effectiveness.

All the concepts described have been developed to drive business performance, even though they act somewhat differently.

Depending on the specific business case, one of the above-mentioned methodologies might be more or less appropriate, but effective implementation any of them will definitely help to make a step in business performance.

A comparative analysis of the key business performance improvement concepts is presented in Table.

Table – Comparative analysis of the key business performance improvement concepts.

Concept	Aspects
Lean	– Identify and eliminate 7 (+1) types of waste – Implement continuous improvement practices – Emphasize standardization and visual management
Six sigma	– Reduce process variation – Utilize statistical tools and methods for data analysis – Exploit DMAIC (Define, Measure, Analyze, Improve, Control) methodology
TQM	– Promote employee involvement and empowerment – Involve top management in quality initiatives – Integrate quality throughout all processes and departments
Agile	– Emphasize adaptive planning and flexibility – Encourage collaboration and self-organizing teams – Utilize short development cycles, known as sprints
Business process reengineering	– Redesign and improve business processes – Focus on fundamental changes rather than small improvements – Utilize technology to automate processes
Theory of constraints	– Identify and manage bottlenecks or constraints in processes – Focus on optimizing the overall system rather than individual components – Utilize the Five Focusing Steps: identify, exploit, subordinate, elevate, and repeat

In the same time, whichever concept is chosen, a clear understanding of the certain indicators status is a key factor that may allow to create conditions not only for the dynamic development of the processes under focus in predetermined directions, but also to prevent their degradation and losses of the results already achieved.

This can be realized by a clear key performance indicators monitoring system. This system is an effectively organized process which includes collection, visualization and timely analysis of the certain data within a number of prioritized business sections. The monitoring system should demonstrate the level of effectiveness over time of both individual processes and the entire enterprise as a whole.

Key business processes monitoring of the kind is often crucial and allows one to achieve the results that would otherwise be impossible.

Among the advantages that can be achieved by using the key performance indicators monitoring system it is possible to single out an assessment of the effectiveness of a particular process. This information shows a clear status of the particular process, including dynamics and trends, which is, in turn, allows one to take timely measures to correct the situation if necessary.

This monitoring also makes it possible to see the whole picture and assess the possibility to achieve strategic goals and objectives established by the company.

Another advantage of using reliable data of the business processes key performance indicators monitoring system is that it gives the basis for the analysis to make informed management decisions.

It should be noticed as well that these data can not only allow one to see the trends and potential risks, but also to take timely measures for the business system stabilization.

One more benefit of the effective business processes key performance indicators monitoring system is the visualization of the relationship between the goals of the entire enterprise and the goals and results of individual processes. Besides understanding the relevant contribution of an employee to the overall company's result brings meaningfulness to the work and, consequently, greater effectiveness.

Depending on the key performance indicators monitoring frequency, the total structure can be divided into operational, tactical and strategic levels.

Operational monitoring can be carried out on an hourly basis. The fundamental importance of operational monitoring is the possibility of a quick reaction in the case of deviation of the process from the targeted state. This type of monitoring and related response measures may help to reduce the risks of not achieving goals at the end of a relatively short working period, for example, at the end of the shift.

The second type of monitoring is tactical. An example of the monitoring type is daily monitoring. It allows one to see the difference and compare the results from day to day, and between different shifts in order to analyze the performance of the work.

The third type of monitoring is strategic monitoring. It involves analyzing the data on key performance indicators for longer periods of time, such as weeks and months. The advantage of this type of monitoring is the opportunity to see the trends in the dynamics of the indicators and to make appropriate management decisions based on the reliable data.

The system for key performance indicators monitoring distributed by the main types is shown in Figure 1.

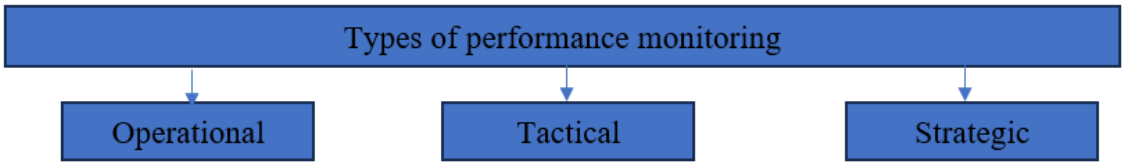


Figure 1. Company's performance monitoring levels

An important factor for the organization of effective monitoring of the company's key performance indicators is visualization and the ability to see the status quickly and accurately.

To do this, a visual identification of the statuses can be applied according to a "traffic light" scheme – that is, if the target for the metric is reached, the status is shown in green, if not reached – in red (See Figure 2).

With the visual identification of the kind, it becomes possible to quickly and accurately see the status of the process or indicator, which is, in turn, allows for prompt

response measures in case of deviations of the processes or indicators from the targeted state (red status of visual identification).

In addition to the systematization of the key performance indicators by the type of control (operational, tactical, strategic), they can also be classified depending on the business section they belong to.

One of such sections can be Safety section.

The safe work of personnel is an absolute priority in the work of companies and, along with the preservation of the life and health of employees, it makes it possible to prevent the risks of company's activities interruptions due to unforeseen cases of injuries (risks to stop company's operations by competent authorities) [6, p. 17].

Another business section which can be monitored by the key performance indicators is related to Personnel.

Regardless of the production automation level, personnel remain one of the key factors and a necessary element of companies' business processes, since almost any activity, including automated, presumes human involvement at least to control the operation of equipment, and most often into direct work, both physical and intellectual.

The cornerstone of the entire business system is the Quality System, without which a stable business is impossible. The quality level reflects the degree of compliance of the products with the requirements set by the customers. There is so-called "internal" quality level, i.e., the level of defects after the production process and before the product is shipped to the customers, and "external" level, i.e., the level of quality at which products are shipped to the consumer. It is obvious that the level of "external" quality should be maximum, and the number of defects of the shipped products should tend to zero. In turn, this can be achieved by increasing the "internal" quality level.

Another important section in the company's operations is Logistics processes. These processes are absolutely necessary and reflect the state of production, storage and delivery of goods with minimal costs and maximum profit.

These processes can be related both with production planning and the degree of compliance between facts and plans, as well as with storage and shipment of products to customers. At the same time, it is reasonable to keep under control those key performance indicators of business processes that reflect the discipline of production and supply, inventory turnover, etc.

From the customer's point of view, these two last sections of the company's activities (Quality and Logistics) should be important priorities. This is due to the fact that "quality" reflects the properties and qualities of products, its characteristics etc., i.e., specifies parameters and functions that are of certain value to the customers and for which they are willing to pay. However, quality assurance is not enough to fully satisfy the customer. The second important factor in customer satisfaction is the delivery of products in the amount corresponding to their needs.

Having met the customers' requirements, it is necessary to focus on the profit of the own production. As soon as the business processes allow to produce the required number of products with the necessary level of quality, it's time to think about the costs that are incur to ensure supplies, the targeted quality level and the entire production as a whole.

Such business section as Cost also needs to be kept under control and to be monitored by appropriate key performance indicators.

Thus, it is possible to determine the structure of the key performance indicators monitoring system for business processes, which consists of five key sections – Safety, Personnel, Quality, Logistics and Cost.

For each of these sections, a number of indicators can be defined for regular monitoring and timely response measures.

Figure 2 shows a typical design for business processes key performance indicators monitoring system divided into five sections discussed above, as well as a visualization system that allows to quickly and accurately see the status of the process.

Safety	Personnel	Quality	Logistics	Cost
# of incidents	Attrition	FTQ	Schedule attainment	Efficiency
Injury frequency rate	Absenteeism	# of Customer complaints	Inventory	Waste

Figure 2. Company's key performance indicators monitoring system

In the Safety section the number of safety incidents and the frequency of injuries can be the metrics to be monitored. If the target level is zero, a constant monitoring of hazardous factors is required to prevent injuries and safety incidents.

To monitor aspects in the section of Personnel attrition and absenteeism can be used. They reflect the state regarding the level of turnover and the level of absence of personnel [7, p. 568].

The loss of qualified personnel carries business risks associated with the need of new hiring and training, let alone possible disruptions in the supply of products to customers.

As it has been already discussed, the level of quality plays an important role in the business. It can be monitored using such indicators as the number of customer complaints for the period of time and First time quality.

Performance indicators of logistics processes, such as schedule attainment and the level of inventory can show potential risks for production and shipments of products and give opportunities and time to prevent them [8, p. 211].

Finally, paying attention to the level of costs that the company incurs for example, labor cost, raw materials and other items, it is possible to take appropriate measures and prevent losses, which, otherwise, will lead to the increased costs and reduced profits.

Such indicators as Labor efficiency and level of waste can support the efforts in order to create conditions for cost optimization and more efficient work.

It should be noted that the structure of the monitoring system and the list of the particular performance indicators can be defined based on the actual situation and for each specific enterprise separately, however, the very essence of the monitoring and

the requirement to quickly and accurately see the status of the metrics remain unchanged.

Summing up, we can conclude that the monitoring of the key performance indicators of enterprises has a significant impact on the effectiveness of the business operations.

It should be noticed that a clear system of monitoring indicators does make it possible to cover the key processes and create conditions for the growth and development of the company in the long term as well, obtaining competitive advantages in the market.

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УДК 339.13

TARGET AUDIENCE OF THE GRAPHIC NOVEL: SPECIFICS OF DEMAND FORMATION AND PECULIARITIES OF CONSUMPTION IN RUSSIAN FEDERATION AND THE REPUBLIC OF CRIMEA

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Abstract. The graphic novel is becoming more and more widespread in the Russian book market: the number of specialized publishers and titles of new books is growing. One of the urgent problems remains the problem of undefined and unpredictable target audience of the graphic novel. The article is devoted to the study of consumer values of the graphic novel, the definition of natural and artificial factors determining demand, as well as the identification of consumer habits of the audience, features and factors influencing the choice of the publication. For this purpose, a questionnaire survey was conducted by the survey method, which makes it possible to more accurately segment the target audience and analyze the features of its behavior.

Keywords: graphic novel, target audience, segmentation, consumer behavior, needs, values, demand, ability to pay, questionnaire.

ЦЕЛЕВАЯ АУДИТОРИЯ ГРАФИЧЕСКОГО РОМАНА: СПЕЦИФИКА ОБРАЗОВАНИЯ СПРОСА И ОСОБЕННОСТИ ПОТРЕБЛЕНИЯ В РОССИЙСКОЙ ФЕДЕРАЦИИ И РЕСПУБЛИКЕ КРЫМ

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Аннотация. Графический роман получает все большее распространение на российском книжном рынке: растет количество специализированных издательств и названий новых книг. Одной из актуальных проблем остается проблема неопределенной и непредсказуемой целевой аудитории графического романа. Статья посвящена исследованию потребительских ценностей графического романа, определению естественных и искусственных факторов, детерминирующих спрос, а также выявлению потребительских предпочтений и привычек аудитории, особенностей и факторов, влияющих на выбор издания. С этой целью было проведено анкетирование методом опроса, позволяющее более точно сегментировать целевую аудиторию и проанализировать особенности ее поведения.

Ключевые слова: графический роман, целевая аудитория, сегментация, потребительское поведение, потребности, ценности, спрос, платёжеспособность, анкетирование.

In Russian academic discourse, the graphic novel is a relatively new phenomenon: the methodological base on this topic includes mainly a small number of articles, including works by such authors as O. A. Isaeva [1], E. A. Kozhevnikova [2] and L. A. Yudin [3], and their thematic focus is limited to the study of the history of the comic book and the graphic novel, as well as the definition of the boundaries of this phenomenon: the classification of its styles and types, characteristics, structure, potential, and so on. In other words, the focus of attention is mainly on the final solution of the problem of the separation of the comic book and the graphic novel (and the isolation of the latter), as well as on the internal organization of the graphic novel and the reader's relationship with it. There are practically no domestic studies that focus on the interaction of the graphic novel as a book product with the buyer, devoted to the definition and segmentation of the target audience of the stand-alone graphic novel and providing information about the specifics of consumption of this product.

At the same time, the number of publishers specializing in comics and graphic novels in Russia is increasing – at least five major enterprises can be identified for 2023: "Zangavar", "Zodiac", "Jellyfish Jam", "Bumkniga", "Comics Publisher" [4]. The number of graphic novel titles is also increasing in the context of import substitution [5]. These factors indicate the necessity and relevance of studying the target audience of such publications, identifying consumer preferences, as well as those features and factors of consumption that affect the choice; determining a set of values of this product that can potentially meet the needs of the reader and increase demand. To solve these and other problems, it is advisable to conduct a questionnaire survey using the survey method among residents of the Republic of Crimea and other regions of Russia, having determined in advance the approximate age range of respondents and gender identity. The data obtained in the course of the research can be used both academically and practically – when working with the realization of the graphic novel and its promotion in the market.

Any demand for goods or services, as a rule, begins to form from a need, which serves as a starting point and is expressed in the individual's desire for forms of life activity that are absent at the moment [6]. Consequently, the content value and variety of a particular product offer are able to satisfy the greatest number of needs of a potential buyer.

However, it is worth noting that consumer choice is becoming more and more thoughtful and less random – this is determined, in turn, by the type of need that a certain product is able to satisfy. In the framework of the theory of A. Maslow's theory, needs are arranged in a hierarchical classification, each level of which depends on the phase of development of an individual: physiological needs, need for safety, need for love, need for respect, cognitive needs, aesthetic needs and need for self-actualization

[6]. Accordingly, the need belonging to the lower (basic) levels causes a buyer's more stable motivation and desire to spend more money in order to satisfy it.

It is an obvious fact that the graphic novel, like most books, is not a commodity of primary (physiological) needs and first necessities. In this case, we are dealing with the satisfaction of social and spiritual needs. Accordingly, it is necessary to determine what properties and functions of this product usually carry value for a potential buyer and determine the choice, making which he satisfies his cognitive and aesthetic needs, as well as the needs for self-actualization.

The theory of consumer values of Sheth, Newman and Gross allowed us to formulate those independent values that must be met by certain characteristics of the product. Thus, the following types of values were identified: functional, social, emotional, creative and conditional [6]. The characteristics and intended purpose of the graphic novel allow it to meet the following values:

1. Social value. While the comic book is still associated with some negative stereotypes, the graphic novel is gradually becoming isolated and acquiring a more positive image. Accordingly, buyers of graphic novels begin to realize a certain "elitism" and "innovativeness" of these works and strive to be involved in "trends", especially when it comes to bestsellers.

2. Emotional and creative value. The artistic and technical design (external and internal), as well as the literary and artistic content of a graphic novel allows it to combine two complementary values. The very innovative form of a graphic novel, for example, in the case of visualizing literary classics, arouses curiosity and interest, and the possible presence of prejudices towards these publications may cause a desire to confirm or deny one's own assessments. It is worth emphasizing that more than 70 % of purchase decisions are made under the influence of emotions, so special attention should be paid to this aspect [7].

3. Conditional value. For example, a buyer buys an edition of a graphic novel with the purpose of using it as a gift.

At the moment when each particular graphic novel hits the store shelves and thus turns into a real need, certain groups of readers, who are the target audience, begin to feel desire [7]. The latter, in turn, is gradually transformed into primary demand, which can be interpreted as a form of expression of needs provided by the ability to pay of a person [6]. The factors that determine demand are usually divided into natural and artificial. The natural (uncontrollable) factors that determine the demand for graphic novels in Russia and the Republic of Crimea include:

– the geographical location of the Republic of Crimea, which is conditioned by the tourist season, and consequently a greater flow of potential buyers;

– cultural trends, as exemplified by the well-known comic book adaptation "Major Thunder", which stimulates the growth of sales of Russian comics;

– fashion, which is present in various spheres of activity (for example, the author of a graphic novel is a well-known personality who is at the peak of popularity);

– general socio-demographic factors that regulate consumer behavior and determine the system of expenditures, priorities of choice of goods;

– external political factors, primarily related to the withdrawal of foreign publications from the Russian market, which affects the state of the market, as well as the unpredictable behavior of readers in relation to new domestic comics and graphic novels;

– economic factors, which are mostly expressed in the risks of the region, as well as characterized by the foreign policy situation, which affects the solvency of the population;

– state support, which consists in stimulating and developing national and innovative projects.

As for the artificial factors determining demand, they are mainly determined by the elements of marketing [7]. Marketing strategy directly depends on situational analysis and demand forecasting. In general, demand forecasting is a rather complex process, which depends on many factors that are in constant change. In our case, it is advisable to use the method of sales forecasting "consumer expectations", which mainly consists of conducting surveys of potential buyers [7].

The use of this method is effective for new products, and the forecast itself is formulated by potential buyers [7]. Thus, analyzing and studying the experience of interaction with graphic novels of representatives of target groups with the help of quantitative-qualitative survey will determine the general relevant information about:

– recognizability or unrecognizability of graphic novels as a distinct subspecies of comics;

– the existence of links between preference for comic books and preference for graphic novels;

– consumer habits and patterns of choice for such titles;

– the relationship between general characteristics of graphic novels and their influence on choice;

– other factors influencing the choice of publication;

– the presence or absence of demand for certain topics of graphic novels;

– willingness to purchase a new domestic edition.

Due to the fact that the target audience of graphic novels is somewhat "vague" and is not fully segmented, in addition to the above-mentioned characteristics, this survey will provide information related to the main criteria of audience segmentation. Thus, according to the information of the "Agency of Social Information" [8], the survey sample of 100 people will have a statistical error of about 10–15 % and, thus, can be considered representative of the general population. Accordingly, the results of the conducted survey will lead to conclusions reflecting potential target groups (regarding basic criteria), peculiarities of their behavior, as well as factors influencing demand and choice, which should be used and taken into account when implementing a particular graphic novel project.

Before starting the questionnaire design and the subsequent survey, it is necessary to segment the audience according to demographic and geographic criteria, which will be the basis for grouping and analyzing the data [9]. Based on the opinion of most researchers and common practice, graphic novels are categorized as "older"

and “meaningful” readers, it can be assumed that the potential target audience is within the age range of 16 to 44 years old. The lower limits are explained by the widespread practice of using graphic novels in educational institutions and their “lighter” perception, while the higher limits are explained by the literary and artistic component and the often global and serious themes raised.

It is reasonable to divide this target audience into three standard groups – 16-24, 25-34 and 35-44. It can be assumed that a certain intersection of the first and second segment is a potentially more promising and loyal group, since this age range is more characterized by the ability to pay and affinity to comics in general, and the third segment is the most controversial, since early sociological studies show that prejudices and stereotypes continue to hinder the perception of such innovative forms as graphic novels (in other words, preference is given to literature in standard text form). Accordingly, the general population of the survey will be the target group of 18 to 30 years old, and the results of the questionnaire survey of the sample will make it possible to confirm, refute or adjust the segmentation by this criterion. As for the gender of respondents, they will be both men and women, which is due to the need to study the dependence of consumption patterns on the gender of the reader.

Geographical affiliation of the respondents is mainly the Republic of Crimea and some other regions of Russia. Given that the market of comics and graphic novels in the Republic of Crimea is an integral part of the overall Russian market of such publications, accordingly, the factor of belonging to a particular region does not affect the range of consumer choice, but influences, perhaps, only the purchasing power and frequency of such purchases.

The quantitative-qualitative online survey will be conducted by means of a Google form and distributing a link to it in social networks, namely in thematic groups (groups of stores and publishers of graphic novels and comics) and other places where potential audiences congregate. The structure of the questionnaire will be set according to the textbook by B. C. Katashinskikh “Methods of collecting social information” [10] and includes: a header-introduction, containing an address to the respondent; the main part of the questionnaire, including open, semi-closed and closed questions, which are conditioned by the research objectives; a socio-demographic block, displaying the basic characteristics of the respondent.

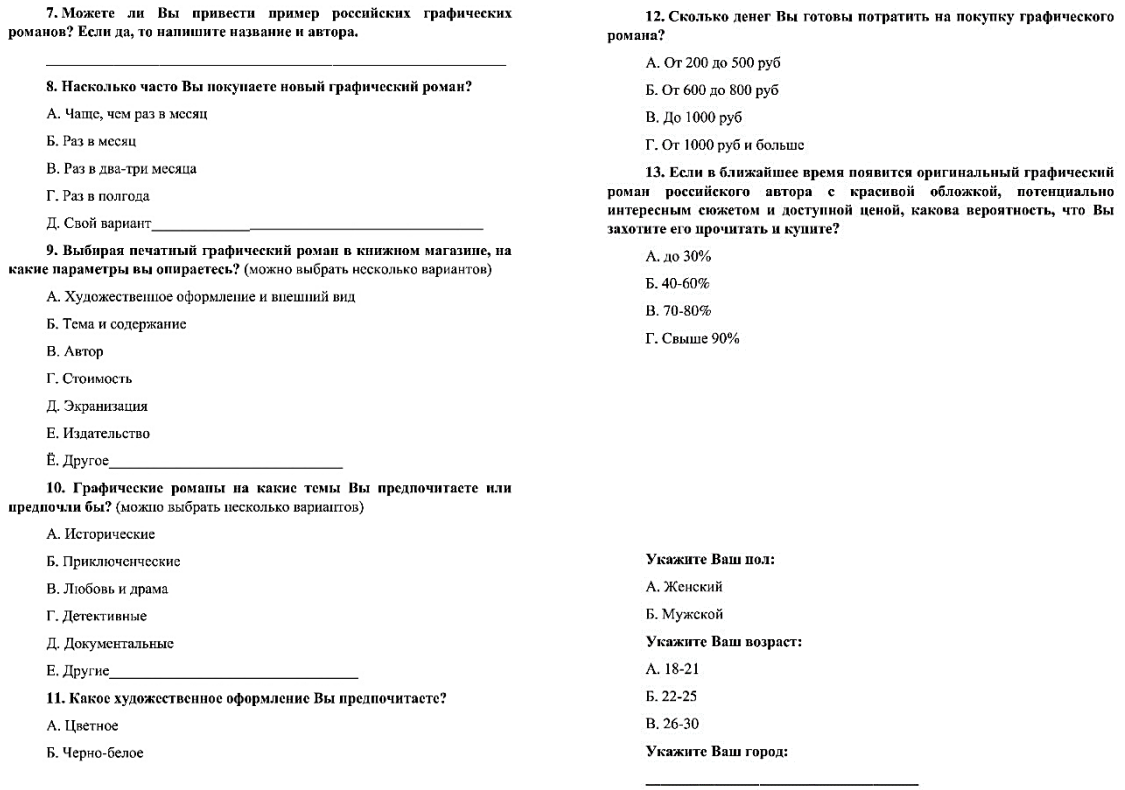
As for the main block with questions, their logical sequence is determined both by the research objectives and general principles of questionnaire design:

– the first four general questions, which will be aimed at identifying the relationship between the consumption of comics and the consumption of graphic novels among readers, as well as at identifying the latter, with three of them having quite concise question wording and answer options (the fourth question depends on the third and is open);

– the next three questions, two of which are closed and polyvariant, and the third is open-ended, refer to general aspects of interaction with graphic novels and abstract choice of such editions (the respondent's attitude to domestic and foreign editions is determined);

– the remaining six questions relate directly to the graphic novel as a commodity: frequency of purchase; factors influencing the choice; preferences in terms of subject matter; preferences in terms of artistic design; purchasing power; readiness to purchase a new domestic edition (test question for questions No. 6 and No. 7).

Consequently, the total number of questions in the questionnaire is thirteen items, of which eight are closed, three are semi-closed, and two are open questions. “Passport” includes three questions determining the gender, age and city of the respondent (Figure).



7. Можете ли Вы привести пример российских графических романов? Если да, то напишите название и автора.

_____

8. Насколько часто Вы покупаете новый графический роман?

А. Чаще, чем раз в месяц

Б. Раз в месяц

В. Раз в два-три месяца

Г. Раз в полгода

Д. Свой вариант_____

9. Выбирая печатный графический роман в книжном магазине, на какие параметры вы опираетесь? (можно выбрать несколько вариантов)

А. Художественное оформление и внешний вид

Б. Тема и содержание

В. Автор

Г. Стоимость

Д. Экранизация

Е. Издательство

Ё. Другое_____

10. Графические романы на какие темы Вы предпочитаете или предпочли бы? (можно выбрать несколько вариантов)

А. Исторические

Б. Приключенческие

В. Любовь и драма

Г. Детективные

Д. Документальные

Е. Другие_____

11. Какое художественное оформление Вы предпочитаете?

А. Цветное

Б. Черно-белое

12. Сколько денег Вы готовы потратить на покупку графического романа?

А. От 200 до 500 руб

Б. От 600 до 800 руб

В. До 1000 руб

Г. От 1000 руб и больше

13. Если в ближайшее время появится оригинальный графический роман российского автора с красивой обложкой, потенциально интересным сюжетом и доступной ценой, какова вероятность, что Вы захотите его прочитать и купите?

А. до 30%

Б. 40-60%

В. 70-80%

Г. Свыше 90%

Укажите Ваш пол:

А. Женский

Б. Мужской

Укажите Ваш возраст:

А. 18-21

Б. 22-25

В. 26-30

Укажите Ваш город:

_____

Figure. Questionnaire with questions for the survey

Thus, having interviewed 160 people (91 men and 69 women) both from the Republic of Crimea (Simferopol and Sevastopol) and from other Russian regions (Moscow, St. Petersburg, Ufa, Lipetsk, Penza, Surgut, Murmansk, Cheboksary, Vladivostok, Krasnoyarsk, Krasnodar, Rostov-on-Don, Nizhny Novgorod, Kursk, Yekaterinburg, Barnaul and many others) the following conclusions can be drawn:

1. In terms of age, the target audience can be divided into the following two groups: 18-24 (more promising) and 25-34 (less promising). These age groups account for more than 65 % of the total sample, with about 90 % of the representatives of these groups being interested in graphic novels and comics. A small group of people aged 35-43 should be singled out [11].

2. There is a direct and logical correlation between interest in comics in general and in graphic novels. Thus, 71 % of respondents who prefer graphic novels also read comic books. In other cases, respondents either read only comics or only graphic novels, and there is no direct correlation with age or gender: for example, only graphic

novels are read both by people aged 18-21 and 22-25 as well as 26-30 (and above), and the same is true for comic books.

3. 51 % of respondents do not understand the difference or do not separate comics and graphic novels, with 49 % claiming to know the differences.

Among the distinguishing features were named the following: volume, format, quality of printing, belonging to literature, themes. At the same time, it should be noted that some respondents consider graphic novels to be a marketing technique.

4. 45 % of respondents read comics and graphic novels in print media only, with 41% preferring both electronic and print media.

5. 90 % of respondents prefer foreign translated graphic novels, 53 % prefer domestic graphic novels, and 32% prefer Russian adaptations of classic literature.

6. 30 % of respondents were able to give their own examples of domestic graphic novels.

7. 23 % of respondents buy graphic novels once every six months, 15 % – once a month, 14 % – more often than once a month, and 13 % – once every two or three months. In other cases, respondents either do not buy graphic novels or buy specific titles that they expect to be published. It should be noted that the majority of those who buy graphic novels with greater frequency are ready to spend on buying such editions from 1000 rubles, which is predominantly true for older ages (logical dependence of purchase frequency on purchasing power and income).

8. The main factor influencing the choice of a graphic novel is the theme and content (84 %). Less important, but influencing the choice, are also artwork (68 %), price (54 %), author (36 %) and publisher (26 %).

9. Adventure themes are most favored by readers of graphic novels (78 %). Detective (54 %), love (41 %) and historical (35 %) themes are less prioritized. It is worth noting that the choice of the theme does not directly depend on the gender of the respondent, since, for example, love themes were often chosen by men.

10. 64 % of respondents prefer both color and black-and-white artwork, with 31 % liking only color editions.

11. The majority of respondents (33 %) are ready to spend on buying graphic novels from 1000 rubles. 29 % are ready to spend up to 1000 rubles, and 21 % – from 200 to 500 rubles. It is worth noting that the key factor influencing this is age, as the majority of respondents willing to spend from 1000 rubles are aged 25 and above, which, of course, is explained by the level of income. The geographical factor plays an indirect role, as among the people who are ready to spend from 600 to 800 rubles on a graphic novel there are both residents of Ulan-Ude, for example, and residents of Moscow. In addition, the range “from 1000 rubles” often includes residents of cities of the southern federal district (Krasnodar, Rostov-on-Don, Sevastopol), although, for example, St. Petersburg is consistently more common in this category.

12. The majority of respondents (31 %) are ready to buy a new graphic novel by a Russian author with a 70-80 % probability. Approximately the same proportion of respondents (30 %) are ready to do so with a probability of 40-60 %. It should be noted that this factor mainly depends on the level of income and willingness to spend a certain

amount of money – people who are ready to buy an edition of a Russian author with a 70-80 % probability are generally ready to spend on a graphic novel more than 1000 rubles.

Thus, given the nature of demand origination, the consumer values carried by graphic novel publishing and the natural factors that determine demand were identified. In order to correctly create artificial factors that will determine and increase the demand for graphic novels, as well as to more accurately identify the target audience an online survey was chosen as the "consumer expectation" sales forecasting method. The survey of 160 people aged 16 to 44 divided the audience into two age groups 18-24 and 25-34, and confirmed the fact that the graphic novel is in the process of becoming isolated while remaining dependent on the comic book – graphic novel readers are often current or "former" comic book readers. The main value in a graphic novel to readers is the content and theme, as well as the artwork, which are the factors influencing their choice.

In addition, it is evident that respondents are used to reading foreign titles, but are also interested in domestic titles and are potentially willing to accept a new product. The purchasing power of readers and the frequency of purchasing a new graphic novel suggests that people are willing to purchase new titles, with the older the respondent, the more expensive an edition they will potentially consider and the more often they will do so.

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УДК 791.43

F. F. COPPOLA'S "THE GODFATHER" AS A SOCIOCULTURAL PHENOMENON

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Abstract. "The Godfather", created by Francis Ford Coppola, has had a huge impact on cinematography and culture in general since its release in 1972. This article is aimed at a detailed analysis of the impact of "The Godfather" on modern society and its cultural aspects.

Keywords: criminal saga, family, italian-american community, ethnic stereotypes, cinema development.

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Аннотация. Фильм «Крестный отец», созданный Фрэнсисом Фордом Копполой, оказал огромное влияние на кинематографию и культуру в целом с момента своего выпуска в 1972 году. Данная статья содержит детальный анализ воздействия «Крестного отца» на современное общество и его культурные аспекты.

Ключевые слова: криминальная сага, семья, итало-американское сообщество, этнические стереотипы, развитие кино.

All art in one way or another refers to the sense of reality in the audience, with cinema being able to do it to the greatest extent. "The Godfather" has become an exemplary film that affects the next generations of filmmakers. Many directors and writers around the world were inspired by the style and approach of Francis Ford Coppola's film, making its elements into their own works. He influenced the work of M. Scorsese, G. Lucas and other popular film directors. The film is often regarded as

a masterpiece of cinema thanks to its magnificent script, strong acting performances, wonderful direction by Francis Ford Coppola, exquisite cinematography and editing. It became the standard of screenwriting and filming of a literary work. “The Godfather” received recognition from both critics and viewers. The film became a significant commercial success, collecting high fees, and was repeatedly awarded with prestigious cinema awards, including an Oscar.

To fully understand the film, it is necessary to refer to its original source – Mario Puzo’s novel with the same name. The themes of love, crime, family slavery and Old-World values were addressed in Puzo’s artwork “The Godfather” (1969), an international breakthrough story about the roots of the mafia, corruption, violence and honor [1]. The creation of the gangster saga is inextricably linked to the ethnic issue that acutely worries America in the 1960s. It is well-known that in the 1960s, the civil rights movement initiated by Martin Luther King forced America to recognize its ethnic diversity, legitimizing the claims of other groups, ethnicity became the subject of a serious investigation for sociologists and discussion in popular media. Ethnic pride, combined with the perseverance with which the media and the authorities covered the mafia, forced Mario Puzo to write “The Godfather” in 1969, which became a bestseller. As Gardafe explains, the book not only attracted the American audience, but also had a great impact on the Italian-American community. In “Breaking and Entering”, his personal story about his experience with Italian-American literature, Gardafe states that “Because of his number of familiar characters, “The Godfather” was the first novel with which I could fully identify myself” [2]. Paramount Pictures acquired the rights to the novel to make it a film, and decided to hire an ethnic Italian actor to give more credibility to the narrative. According to the vice president of Paramount, the film was supposed to be “ethnic in nature” [2].

“The Godfather” was a huge success throughout the country and abroad, not only for Coppola’s experience and the superiority of the actors – many of them also of Italian origin – but also for the striking similarity with which Italian ethnicity was depicted.

It is impossible not to mention the immeasurable talent reflected in the script and director’s approach. The script is written by Puzo and Coppola. The method of their work on the text is interesting. They wrote simultaneously, but separately: Puzo in Los Angeles, and Coppola in San Francisco. At the same time, the authors kept in touch with each other, determining the general vector of work and key scenes [3]. In total, they rewrote at least three drafts, which took about a year. The final version of the script consisted of 163 pages, which is 40 pages more than required by Paramount. Today, “The Godfather” is considered to be one of the standards of classical film drama. Firstly, the picture has a clear, intelligent three-act structure. The exposition is the wedding scene: in half an hour the viewer gets acquainted with all the main characters and their characters and key issues. The first act ends around the 45th minute with a turning point for the whole story – the assassination attempt on Vito Corleone. The picture is separated exactly in two parts by the point of no return – Michael takes revenge on his father’s abuser, thus starting the Corleone family’s war against other gangster clans. The second act ends around the 135th minute with Michael’s return to New York and his appointment as head of the family. The third act – the last 45

minutes of the film – marks Michael's full statement as the godfather. The culmination of this process (and the entire film) is the famous, parallel-edited scene of the baptism of Michael's niece and the murder of heads of hostile families. The final frame marks the final demonic transformation of the hero and his alienation from the only loved one. However, the ideal dramatic form would not have such value if it were not for the content. As the authors themselves note, the main reason for the popularity of the film is its central theme – the theme of the family. Coppola dropped the excess details and side plot motifs of Puzo's novel, focusing on the dramatic father-son relationship. In three hours of screen time, these two heroes experience a giant evolution, turning into their opposites in interaction with each other. An all-powerful mafioso becomes a weak old man, and an idealistic young man becomes an unscrupulous killer. The son changes, trying to protect his father, but thereby only breaks his heart. Perhaps it is difficult to come up with a plot that is just as tragic and at the same time understandable and close to the ordinary viewer. Another notable feature of the dramaturgy of the film, which provided it with the status of a classic, is the abundance of aphoristic remarks that have gone to the people. Let's remember at least statements "You don't ask with respect" or "Nothing personal. Only business". As for the most famous phrase – "I'm going to make him an offer that he can't refuse" – it was inspired by a line from "Father Godio" by Honoré de Balzac. Today, the phrase ranks second in the top hundred most famous quotes of American cinema according to the American Film Institute.

Coppola used technical innovations and proprietary shooting techniques that made the film unique. The style and aesthetics of the film cannot leave any viewer indifferent.

A true connoisseur of beauty, Francis Ford Coppola, turns to the techniques of other famous artists during filming. The enveloping haze, the sinister knocking of footsteps in the hospital corridor, barely peeking out from behind Michael, tense in anticipation — all this refers to Hitchcock's atmosphere (Figure 1). In the scene where Hagen talks to the director of film, and later the latter finds the head of a dead horse in bed, Coppola quotes the film "Citizen Kane'' (1941), copying Orson Welles' techniques. It is worth mentioning that to achieve a more realistic effect, Coppola used the real head of a recently killed horse. In this case, and throughout the film, the Italian director made inanimate matter work on the plot.

He appeals not only to his colleagues in the workshop, but also to writers of the past. The growing tension, sharp conflicts, contrasts of life and death make up most of the film. So, Coppola gave the film true drama, gave the criminal saga Shakespearean chic. In the film Santino, Don's son, was killed because he was framed by his sister's husband, Connie. During her wedding, family and mafia issues will be resolved, and all the enemies of Don will be killed during the baptism of his nephew. These contradictions plunge into the ambiguous life of Italian-Americans, who are forced to maneuver between established values all the time.



Figure 1. Michael in hospital

Thus, Coppola used a special style of shooting, creating a visual perception that influenced many subsequent films. Analysis of technical aspects, such as lighting and framing, makes it possible to understand how these elements have become part of “The Godfather’s” cultural heritage.

Many people recognized the soundtrack before the film itself. The sound design of the film is worked out no less than the script and visual component. Chief composer Nino Rota did a tremendous job, giving the film as much Italian flavor as possible. The musician, creating the soundtrack “The Godfather Waltz” relied on the “Symphony №1” of the Finnish composer Jan Sibelius. Nino Rota admitted that the defining moment in the creation of the soundtrack was the relationship between Vito and Michael Corleone. The compositions carried not only the spirit of nostalgia, but also hope for the future. That’s why his son inherited his father’s composition. Nevertheless, the composition changes the tone – it becomes more disturbing and louder at the end of the film, showing the ambiguous side of Michael. The introductory melody to this work became Rota’s starting point in creating the musical accompaniment of the film. His “Love Theme” was written back in 1958 for the film “Fortunella”, but he used it again in “The Godfather”, hoping that the American audience is not very well versed in Italian cinema. The main musical themes of the film included ten compositions, which are variations of the two main compositions mentioned above. There is only one soundtrack “The Baptism” that sounds during one of the most significant scenes, when the baptism of Don Michael Corleone’s nephew is accompanied by a bloodthirsty massacre of the enemies of the new godfather.

In addition to Nino Rota, Carmine Coppola, the composer, conductor and father of the film’s director, worked on the musical accompaniment of the film. He wrote music for Connie Corleone’s wedding. In the sequel, he will co-write the soundtracks and share the Oscar for Best Soundtrack with Nino Rota. Of course, the most popular was “Love Theme” also known as “Speak Softly Love”. The instrumental composition was immediately turned into a song (lyrics written by poet Larry Cuzick).

So, the sound design helped the director recreate the true Italian spirit, the musical compositions competently complemented the film.

“The Godfather” has become a large-scale project demonstrating that gangster films can be not only entertaining, but also an art. It contributed to the heyday of the gangster cinema genre in the 1970s and stimulated the creation of other important films of this genre, such as “The Good, the Bad and the Ugly” (1966) by Sergio Leone and “The People vs. Larry Flynt” (1996) by Milos Foreman. Puzo and Coppola, being Italian by origin, offered a more authentic dramatization of the Italian-American character, immersing him in his Italian ethnic origin. There is no doubt that “The Godfather” saga has created models that future books, movies and TV series will try to imitate so far. However, with “The Godfather”, the stereotypical Italian gangster ceases to be an exceptionally sinister criminal, as it was until then. Instead, the image acquired a new dimension, which was first at least forged by Italian Americans themselves, and not by other ethnic groups. Years later, HBO’s hit “The Sopranos”, also created by an Italian-American, reintroduced the stereotype, setting a story in our time to illustrate the complexities of the modern American family [4]. Coppola created the world’s first blockbuster, thanks to which such directors as S. Spielberg, G. Lucas, M. Scorsese and many Italian-American actors broke out on world screens.

“The Godfather” has become an exemplary film that affects the next generations of filmmakers. Many directors and writers around the world were inspired by the style and approach of Francis Ford Coppola’s film, making its elements into their own works.

One of the main themes of the film is family. The film emphasized the importance of blood ties, creating an idealized idea of how power and power can be passed on through generations. The concept of family values and loyalty has become one of the key elements taken up by society.

The saga put forward family values in the context of organized crime. Analysis of the impact of these topics on culture allows us to understand how “The Godfather” influenced the perception of family and morality in modern society. In American classic films, each character represents either pure good or pure evil. Nevertheless, in real life, people have both good and bad traits, because, in fact, goals and expectations may differ from each other, which is natural. Similarly, the characters in “The Godfather” go beyond good and evil. A merciful father can give horrifying orders when necessary. The younger son, Michael, kills his older brother Fredo so that the family does not weaken and lose prestige. Again, similarly, brother Michael kills his sister’s husbands after leaking information to the families of opponents. As you can see, strong family ties and mercy can be replaced by political behavior when the situation requires it. Interests dominate political behavior, and strong family and relative ties or humanely vulnerable feelings can be replaced by such behavior. Belief in the opposite requires an attitude close to naivety [5].

“The Godfather” shows the family as a unifying and authoritarian patriarchal structure, in which non-mafiosi are weak and women are subordinate, as opposition to the society of extreme individualism, without undermining it. Francis Ford Coppola, as a Catholic, understands that the family is above all, the family is a small church. But the head of this church is a man of lies, and people of lies are those who made a deal with the devil. The final scene of the film where Michael, the new don of the family,

deceives his wife only confirms the essence of the head of this church, just as Vito Corleone does throughout the film.

Coppola can't help but make the image of the godfather the leitmotif of the whole picture. The director immerses the viewer in the world of contradictions from the first shots. The scene depicting the meeting of Luca Brasi and Vito Corleone, full of darkness, absorbs you like Malevich's Square. This darkness holds you back, the emptiness is suddenly filled with the face of the don and the sinister silence is broken by his monologue. The play of light and darkness, transmitted thanks to talented camera work, enhances the image of the godfather. According to Ju. M. Lotman, the frame is equal to the word, and if the word is rich, a rich text is born from this word [6]. Based on the work of Caravaggio and the principles of tenebrism, the operator creates a fascinating frame (Figure 2). Lighting plays a huge role especially in the scenes with the godfather. This is how what they want to show is exposed to the light, and all the secrets of the family remain in the dark.



Figure 2. Vito Corleone

Throughout the film, there is a parallel between the current godfather Vito Corleone and his son Michael Corleone. Mikey is the youngest and beloved son, he is different from his older brothers, who would probably follow in his father's footsteps. He is a war veteran and tries to stay away from the family business, he is separated from this family. Michael, in spith of tradition, meets an American girl, doesn't want to start a Sicilian family. But he soon begins to shrink more and more in this family, becoming an inseparable part of it. At some point, Michael, like his father, has to become a godfather, a mafia don. He returns to traditions, marries an Italian woman. An enthusiastic romantic in military uniform eventually tries on the image of a cold-blooded family boss. Complex characters and their deep emotional conflicts reveal the image of Italian-Americans of the mid-twentieth century, allowing society to experience this difficult experience. The film formed the ideals of the heroes' personalities. The characters of the film, such as Michael Corleone and Vito Corleone, have become an example of elegance, intelligence and strategic thinking. Their paths to power and moral dilemmas were discussed and inspired many people in the field of leadership and success.

“The Godfather” presented the audience with unusually deep and complex characters, which became archetypes for many subsequent films and literary works. Analysis of the moral dilemmas of heroes, especially Michael Corleone, opens up questions about power, family and morality that remain relevant in modern society. The link between political behavior and power is also observed on the film poster (Figure 3). It implies that the one who holds the strings (which symbolizes power) will control the people around him in accordance with his goals. The fact that the strings fall on the word “father” (which refers to both its real meaning and the meaning of the Godfather) can be assessed as a reference to its ruling power [5].



Figure 3. Film poster

The film largely influenced the romanticization of the image of the criminal. “The Godfather” broke the idea of the mafia and gangsters, turning them into symbols of strength, power and honor. Some elements of gangster culture, such as quotes from the film, costumes and character images, have become popular among fans and have influenced young people.

Phrases and images related to the film have become an important part of pop culture. Expressions like “I’ll make you an offer you can’t refuse” have become famous and widely quoted. This made the mafia plots and mafia ideology more attractive to the public. It is impossible not to mention the effect produced on fashion trends related to the gangster film. The film designed the mafia aesthetics and style that have become significant for fashion. The most recognizable and later quoted costume of the patriarch of the mafia clan Vito Corleone, which he wears at his daughter’s wedding in 1945, is a black tuxedo, a white shirt, a black vest, a black butterfly and a red rose in a buttonhole. Clothes, hairstyles and images of the film’s characters inspired fashion designers and stylists, as well as formed a public perception of style and elegance (Figure 2).

In addition to the above, Coppola’s work had a strong impact on Italian-American culture. “The Godfather” caused various reactions in this ethnic community.

It gave considerable popularity to Italian-American actors and artists, but also caused a discussion of group identity and stereotypes. Society and culture have ambiguously perceived the film, but its influence on pop culture, the film industry and society as a whole cannot be denied. The criminal saga has become a colloquial phenomenon, continues to inspire and stimulate Western culture and remains an important element of the history of cinema. “The Godfather” has become the object of many cultural references and parodies. The study of how these elements were integrated into modern culture makes it possible to understand how the film became part of the collective consciousness.

The initial success of “The Godfather” occurred in an era of change and sociocultural transformation in the United States. The film was released during the period of unrest related to the Vietnam War and social movements. This has created a unique platform for the film to become not only an icon of cinema, but also a reflection of time. Francis Ford Coppola’s film has already in many ways overcome the genre of the classic gangster film of the 1930s. It offers a franker depiction of violence and murder, while avoiding the image of Italian Americans as just cruel and bloodthirsty monsters. This is combined with radical criticism of dominant American values, which did not exist before. Classic gangster films were usually limited to describing how, in accordance with the ideology of the Great Depression era, in a situation of clearly racist anti-immigration laws, a certain ethnic minority, which the life sciences and psychology of that time called “lower”, was forced to fight for the American dream in illegal ways because of their “wrong” genes. On the other hand, “The Godfather” proves that criminal activities for personal gain ultimately are no different from achieving financial success in an allegedly legal way: American capitalism, with its aggressive individualistic ethics based on the struggle for survival and dating back to the extermination of the indigenous population, is inherently lawless. Coppola himself said: “The Mafia is a metaphor for America <... > The mafia, like America, has roots in Europe. Both the mafia and America consider themselves generous. The mafia, like America, has a bloody hand because of the need to protect its power and its own interests. Both of them are a completely capitalist phenomenon and profit-oriented” [4]. However, the social message of the film turns out to be in an insoluble paradox. It is impossible to separate the condemnation of the “good America” myth from the propaganda of family values. The main goal of all the illegal activities of Don Vito Corleone is the power and prosperity of his clan, not himself. Despite all the criticism of the United States by Coppola, “The Godfather” still became an extremely popular film.

By making a film about an ethnic minority, it is impossible to avoid both positive and negative stereotypes. The main definition of stereotype is that it is a “concept, image or belief in individuals and/or specific social groups”, and once these views or beliefs are established, they can be difficult to change. Each ethnic group may have stereotypes that have been stuck with them for a long time, because once stereotypes are formed, it is difficult to get people to change their mindset. Entertainment films can create and strengthen public images of ethnic groups, such as Italian Americans, for example, and these stereotypes can form negative perceptions [3]. Although there were some differences in the way Italian-American characters were portrayed for decades,

from the 1970s to the present day, many films found one thing in common: there were more negative than positive images of the personality traits, stereotypes and professions of Italian-American characters, regardless of the decade. For example, in both the films “The Godfather” and “Goodfellas”, participation in the “family business”, the mafia and criminal activities is portrayed as dangerous; these are people with whom you do not want to communicate or communicate. In “Goodfellas” (1990) by M. Scorsese, criminal activity involving men assumes that Italians do not have humanity and moral principles, but they lead an easy, “glamorous lifestyle”, earning tons of money from the drug trade, but having bad taste (for example, with excessive decorations in their apartments and houses) [6]. In most films, women portray themselves as maternal, constantly focusing on their children and doing their best for them. For example, women of the Corleone family throughout the film are engaged exclusively in cooking, raising children. Connie Corleone, Apollonia Vitelli and other characters are not directly related to the main plot of the film, they are dehumanized and presented only as objects of sexual view (Figure 4). This is how Coppola conveyed life and relationships in Italian families of the mid-20th century.

The Italian-American characters in each of the films are very similar to each other. Characters either dress in business casual clothes (suits, trousers and coats) or wear casual clothes, such as shirts with a collar or T-shirts. One notable aspect was how often the characters wear black clothes, including leather jackets, suits, coats, etc. Women are sometimes depicted in tight clothes and noticeable accessories that make them stand out. Men either style or comb their hair back, and women have voluminous styling, which they combine with an abundance of cosmetics. Italian-American characters are portrayed, in general, as very in love with their appearance, dressing fashionable and loving to look presentable in public.



Figure 4. Apollonia

Stereotypes of Italian-American characters are a mixture of both negative and positive images. One of the main stereotypes usually depicted is participation in the mafia and organized crime. It also leads to the characters being stereotyped as aggressive, cruel and protecting their loved ones. All characters are also often depicted for cooking and meals [7]. No one ever eats alone, and food usually serves as a social event and a mechanism for overcoming. The question of whether this stereotype can

be called negative or positive is subject to discussion, but this is a common feature that constantly appears in these types of films. For example, in the “Rocky” movie, the boxing rival mentioned that “if he can’t fight, I bet he knows how to cook”. This suggests that all Italians can cook, and this is one of the things they do for themselves, even if everyone else doesn’t. One of the stereotypes that was also found in “The Godfather” is the importance of the family in Italian culture, as well as the love, care and support that come with it. It can be concluded that some stereotypes and behavior of Italian-American characters have changed since the 1970s, but some of them still remain the same over time, as a result of which this ethnic group continues to be negatively portrayed on the screen.

The conclusions of this analysis suggest that “The Godfather’ is not just a film – it is a cultural phenomenon that has left a deep mark on the art, society and consciousness of people. Its impact extends far beyond cinema, defining some cultural and moral norms in modern society.

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УДК 698

DEVELOPMENT PROSPECTS FOR CONTROL SYSTEMS DEBUGGING AND ADJUSTMENT

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Abstract. The article discusses the existing methods of debugging and adjusting control systems and their effectiveness. The main problems and ways to improve debugging systems are described. Different types of regulators are considered.

Keywords: control systems, methods, artificial intelligence, debugging, regulator.

ПЕРСПЕКТИВЫ РАЗВИТИЯ СИСТЕМ ОТЛАДКИ И РЕГУЛИРОВКИ СИСТЕМ УПРАВЛЕНИЯ

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Аннотация. В статье рассматриваются существующие методы отладки и регулировки систем управления и их эффективность. Описаны основные проблемы и пути улучшения систем отладки. Рассматриваются различные типы регуляторов.

Ключевые слова: системы управления, методы, искусственный интеллект, отладка, регулятор.

Currently, control systems are widely used in many areas, ranging from industry to road transport and robotics. However, debugging and adjustment techniques are required to ensure that the control system operates efficiently and optimizes its operation and achieves the desired results.

Important areas of development are system identification methods that allow you to determine unknown parameters of the control system. New identification methods and algorithms allow you to achieve high accuracy in determining the parameters of the system and increasing its efficiency.

Optimization methods for configuring control systems also do not stand still. Modern optimization algorithms make it possible to find the optimal parameters of the control system in conditions of a large number of variables and uncertainty in the data.

This is especially important for complex control systems where many parameters need to be configured to achieve the desired results.

There are several methods for debugging and adjusting control systems, each of which has its own effectiveness depending on the specific situation:

1. The analytical method is used to analyze mathematical models of the control system and determine optimal parameters. It is effective for systems with simple mathematical models, but requires accurate data and understanding of the system.

2. The experimental method involves conducting physical experiments with the system, measuring the reaction and making changes to the parameters to achieve the desired results. It is effective if real system data and the ability to conduct experiments in real conditions are available.

3. Frequency tuning includes frequency modulation and frequency demodulation, which use high frequency signals to tune the system to specific frequencies.

4. The methods of setting the optimal regulator are based on optimal control and are used to achieve maximum control efficiency and accuracy.

5. Adaptive adjuster settings allow the system to autonomously adjust its settings to account for environmental changes.

6. The adjustment of the noise level regulators is based on minimizing the noise of the system output signal to achieve more stable operation.

7. Systems analysis and synthesis methods include a mathematical model of the system, analyze its operation and offer optimal settings for achieving the desired results.

8. PID adjuster settings are used to adjust the parameters of proportional-integral-differential (PID) regulators, which are widely used in industry. They are effective for setting up simple systems with relatively low levels of uncertainty and based on adjusting the proportional (P), integral (I) and differential (D) coefficients to achieve the desired system response to changes in input signals [1].

Each of these methods has its own advantages and limitations, and their effectiveness will depend on the specific management system and goals set. It is important to choose the appropriate method depending on the specific task or problem facing the management system.

Systems for debugging and adjusting control systems face a number of problems that impede their effectiveness and the ability to achieve the desired results. Here are some of the main problems and possible approaches to solving them:

1. Modern control systems are becoming more complex and contain many interconnected components. This makes debugging and adjusting such systems a difficult task, especially when there are a large number of variables and parameters.

2. One of the main problems is the lack of accurate system data, such as process parameters, sensor and actuator characteristics, and other important parameters.

3. Efficient operation of the control system requires fine-tuning of parameters and variables. However, the adjustment process can be difficult and costly because a series of experiments and analysis of the results are required.

4. Modern control systems can be very complex, with a large number of parameters and subsystems. This complicates the debugging and adjustment task.

5. Many control systems debugging and adjustment systems require active intervention by operators and engineers. This can lead to human errors and limit the efficiency and reliability of the process.

6. There are many different methods and approaches for debugging and adjusting the control system, and their choice can be subjective. This often leads to insufficient standardization and difficulties in sharing information and experience between different industries.

To solve these problems and improve the efficiency of debugging systems and control system adjustment, the following approaches can be considered:

1. The development and application of automatic debugging and adjustment systems can help to eliminate human error and increase the speed and accuracy of the process. This can be achieved through machine learning algorithms and artificial intelligence.

2. Developing and using standardized methods and protocols to debug and adjust the control system can help simplify and speed up the process. It will also facilitate the exchange of information and experience between different industries and organizations.

3. The use of diagnostic and monitoring systems can help to detect problems and faults in the management system in the early stages and prevent serious consequences. This will allow operators and engineers to respond quickly to problems and fix them before they become serious.

4. The use of simulations and virtual models allows engineers to debug and adjust the control system in a controlled environment without the risk of damage to the equipment or system. This reduces costs and improves process efficiency [2].

Application of these approaches can help to solve the main problems faced by debugging systems and control system adjustments at present, and increase their efficiency and reliability.

There are several modern technologies that can be used to improve debug systems and adjust control systems. Some of these include:

1. Using IoT devices, you can collect data on the operation of the control system in real time. This data can then be analyzed to identify problems and optimize system performance.

2. Virtual and augmented realities can be used to create virtual environments where management systems can be modeled and tested in a secure and controlled environment. This allows for more realistic system testing and debugging without the need for physical resources and hazardous conditions.

3. Blockchain technology can ensure the reliability and security of data collected during the debugging and control system adjustment process. Blockchain can also be used to create a universal register of errors and defects that will allow developers and engineers to quickly find and fix problems.

4. Cloud technologies offer computing resources and data storage that can be used to analyze and debug management systems. Distributed computing allows you to efficiently process large amounts of data and perform complex calculations, which improves the performance of debugging and adjustment systems.

5. Visualization and interactivity technologies allow you to present data and information about the control system in a convenient and understandable way. This helps control system operators better understand what is happening and make better decisions about debugging and adjustment.

6. Intelligent artificial intelligence systems are becoming more common in the development of control systems. Neural networks, genetic algorithms, machine learning algorithms and other artificial intelligence techniques enable the creation of automatic and adaptive debugging and adjustment systems that can self-learn and adapt to changing conditions [3].

This is not a complete list, the development of technologies in the field of computer science and automation continues, and new innovative approaches always appear to help improve efficiency.

The requirements for debugging and adjustment systems for different industries may vary depending on the characteristics of each industry:

1. Autonomous systems:

– the debugging and adjustment system should be able to detect and eliminate potential safety risks, for example, in the case of cars on autopilot it should be able to detect errors in the control system that can lead to emergencies;

– the system shall be flexible and able to adapt to changing traffic and environmental conditions;

– the system must automatically configure management settings to optimize performance and resource utilization [4];

2. Electronics:

– the debugging and adjustment system should be able to detect errors in electronic components and circuits, as well as ensure the stability of the system operation;

– the system shall be able to operate under conditions of high noise activity and resist interference;

– the system shall be able to automatically test electronic components and circuits;

3. Aerospace:

– the debugging and adjustment system shall be highly reliable and capable of detecting and correcting errors in the aircraft or spacecraft control system;

– the system shall be able to automatically detect anomalies in operation and respond to them to ensure flight safety;

– the system must automatically optimize control parameters to ensure optimal performance and flight efficiency [5].

Debug and adjustment system requirements may vary by industry, but common goals include improving the security, reliability, and performance of the control system.

Examples of successful implementation of debugging and control systems in various industries are as follows:

1. Autonomous systems: Alphabet Inc's subsidiary Waymo has developed a debugging and adjustment system for its autonomous cars. They use machine learning and artificial intelligence to detect and correct errors in vehicle control algorithms. This allows them to improve the security and reliability of their stand-alone systems.

2. Electronics: Intel has developed a debugging and adjustment system for its processors. They use machine learning algorithms to detect and correct errors during the production and operation of processors. This helps them improve the accuracy and reliability of their electronic devices.

3. Aerospace: NASA used a debugging and adjustment system for its spacecraft. They used machine learning algorithms to detect and correct errors in control and navigation systems. This allowed them to improve the reliability and safety of their space missions [6].

These are just a few examples of successful implementation of debugging and control systems in various industries. All demonstrate how the use of machine learning and artificial intelligence can improve the efficiency, reliability and security of such systems. In the future, even more use of these technologies is expected to develop debugging and adjustment systems in various industries [7-8].

Control system debugging and adjustment systems are an integral part of modern technological processes. Together with the development of the industry and the emergence of new technologies, the prospects for the development of these systems are becoming more important and relevant.

The use of machine learning and artificial intelligence allows you to automate optimization processes, facilitate error detection and elimination, as well as improve system reliability and performance [9].

Despite the specific requirements of each industry, the use of machine learning and artificial intelligence in debugging and adjustment systems will undoubtedly continue to develop, making a significant contribution to improving the efficiency, reliability and security of control systems. Debugging and adjustment systems will continue to evolve and become increasingly intelligent, adaptive and automated to meet the modern challenges of different industries.

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УДК 004.89

METAVERSE POTENTIAL: STUDENTS' ASSESSMENT FOR CAREER-RELATED TECHNOLOGICAL ADVANCEMENTS

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Abstract. This article examines the potential impact of the Metaverse on students in technical universities, focusing on the Bonch-Bruevich Saint Petersburg State University of Telecommunications and ITMO University as the case study. It evaluates the current state of the Metaverse concept, technological advancements, and students' awareness and readiness for metaverse-related technological advancements. The comparative analysis reveals the varying adoption and exploration of the metaverse concept by both universities, emphasizing the need for further education and discourse.

Keywords: metaverse, virtual world, students' awareness and readiness, education factors and conditions, self-realization.

ПОТЕНЦИАЛ МЕТАВСЕЛЕННОЙ: ОЦЕНКА ВОЗМОЖНОСТЕЙ ДЛЯ СТУДЕНТОВ ТЕХНИЧЕСКИХ ВУЗОВ РОССИИ

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Аннотация. В данной статье исследуется влияние концепции Метавселенной на готовность студентов технических университетов к профессиональной самореализации в данном направлении. Оценивается текущее состояние концепции, технологические достижения, а также осведомленность и первый опыт студентов на примере Санкт-Петербургского государственного

университета телекоммуникаций имени проф. М. А. Бонч-Бруевича и Университета ИТМО. Сравнительный анализ результатов показывает различия в подходах и внедрении концепции в обоих университетах, что подчеркивает необходимость более глубокого вовлечения студентов в изучение концепции Метавселенной и продолжения дискуссии по этой теме.

Ключевые слова: метавселенная, виртуальный мир, осведомленность и готовность студентов, факторы и условия обучения, самореализация.

During the past decade, a term known as the Metaverse has gained considerable attention from a diverse range of professionals in various fields, both domestic and foreign. This term has sparked the interest of major technology companies such as Google, Microsoft, Amazon, Yandex, as well as philosophers, public figures and educational practitioners. Telecommunications companies, IT developers, and other professionals have also been captivated by this concept.

This study aims to analyze students' awareness of this term, their practical experience and expectations regarding the integration of the metaverse in their educational process. To gain this, the research tasks have included assessing the current state of the Metaverse concept, understanding technological developments in the field, and evaluating the readiness of the Russian university students for new technological challenges of the modern era, using the Bonch-Bruevich Saint Petersburg State University of Telecommunications and ITMO University as the case studies.

The research is grounded in the hypothesis that the effectiveness of developing students' readiness toward the metaverse concept in leading universities is influenced by several factors, including the specific conditions and focus of the educational system, as well as the extent of popularization and promotion of the metaverse concept within the telecommunications and innovative technical fields.

To achieve research goals, a combination of theoretical research and survey methods, data processing techniques, comparative analysis, and graphical presentation of research findings were employed. The theoretical research methods involved analysis, synthesis, generalization, and hypothesis building. Surveys were conducted to collect data on students' knowledge, experiences, and expectations related to the metaverse concept. The collected data were processed and analyzed by using appropriate statistical methods. Comparative analysis was employed to compare the findings from different universities, while graphical presentation techniques were used to visually represent the research results.

Though the term "metaverse" was originally introduced by science fiction writer Neal Stephenson in his 1992 novel Snow Crash, there has been a recent resurgence of interest in the concept. This was sparked by Mark Zuckerberg's announcement at the end of 2021 that his company would be rebranded as Meta [1] (currently banned in Russia due to its classification as an extremist organization). Additionally, in the same year, the word "metaverse" was included by lexicographers in the Collins Dictionary's list of the top ten most popular words of 2021 [2]. The dictionary defines the metaverse

as a “proposed version of the Internet that includes three-dimensional virtual environments” [3].

After analyzing a variety of literature sources of both foreign and domestic origins [4, 5, 6, 7, 8, 9], several key attributes of the metaverse have been identified:

1. The metaverse is a complex and multi-faceted concept that does not currently have a precise definition. This lack of consensus arises from differing perspectives among researchers in the field of technical developments. Some perceive the metaverse as a platform for next-generation social networks, while others see it as the evolution of the internet or even as a distinct type of technology within the framework of the fourth industrial revolution [4, 5, 6].

2. The metaverse is an ambitious project, and many of its key elements, such as virtual and augmented reality or cryptocurrency transactions, have been developed for decades and are now actively being implemented in virtual space. The metaverse, according to the consolidated opinion, offers an alternative for human socio-cultural interaction in various fields of activity [5, 6]. By essentially creating a replica of the real world, it opens up limitless possibilities for business, education, entertainment, commerce, and global human interaction, on the one hand, and raises concerns about the environmental impact and ethical implications of this technology, on the other.

Retrospective literature analysis shows that the debate surrounding the concept of the metaverse is ongoing and unresolved. According to some Russian philosophers, such as A. P. Segal and others, the discussion is currently in a stage of “critical reflection” [7] and the phenomenon requires further understanding.

In academic discussions, it is crucial to recognize the existence of different perspectives concerning the future possibilities of metaverse development. These contrasting viewpoints emerge from ongoing debates and speculations on the interplay between the technosphere and the anthroposphere. The convergence of philosophical, political, and socio-economic discourses at this intersection highlights the high stakes involved [8, p. 234].

The advancement of a comprehensive metaverse ecosystem continues to be a topic of uncertainty, demanding careful consideration of several prominent challenges. These challenges apply both in Russia and globally, and include the lack of standardized platform solutions and interoperability, fragmentation, and issues related to security and high equipment costs. From a philosophical perspective, there are concerns about the impact of the virtual realm on people and whether it could serve as a substitute for the physical world. This raises questions about the concept of “happiness” and whether people’s lives will be more interesting, happier, or easier in the metaverse. Additionally, the level of appeal that escapism holds for contemporary individuals remains indeterminate.

Skeptical comments about the future of the metaverse were voiced by authoritative experts in 2022 [9, 10]. Ethereum co-founder, Vitalik Buterin, expressed doubts about Meta’s (currently banned in Russia due to its classification as an extremist organization) attempts to create a metaverse, noting that they lead nowhere, and the proposed concept of virtual space is just a “misfire” [9]. Similarly, Elon Musk also

questions whether people will be willing to leave the physical world and replace it with a virtual one, especially in the near future. On the other hand, Russian developers Dmitry Volkov, Sergey Orlovsky, Andrey Ivashentsev, and Pavel Muntian view the metaverse as ephemeral and believe that it needs to be filled and described. They acknowledge that nobody knows exactly how the system will work, but there is a widespread belief that it will have a transformative effect on reality [10].

To determine the level of awareness and readiness of students towards the metaverse, as well as to emphasize the relevance of this topic, a survey was conducted among 129 students from two universities located in St. Petersburg: the Bonch-Bruevich Saint Petersburg State University of Telecommunications and ITMO University [11]. The students from these universities are pursuing careers in fields such as information and communication technologies, technological management, and innovations.

The survey revealed that almost half of the students (47 %) have a clear understanding of the concept of the metaverse. 37 % of the respondents have only heard of the term but do not fully grasp its meaning. 14 % of the students who were unaware of the term expressed a desire to learn more about it, while only 1 % of the respondents expressed no interest in it at all, and 1 % of the surveyed students have had personal experience interacting within a metaverse environment (Figure) [11].

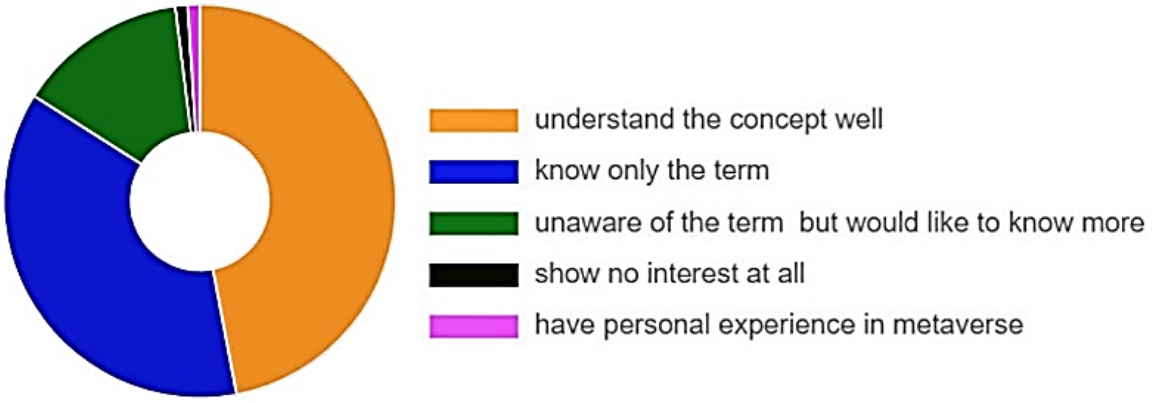


Figure. Students' awareness on the Metaverse concept

Differentiating the responses of students from SPbSUT and ITMO, there is a slight discrepancy between them. Slightly more students from ITMO, by 2 %, are familiar with the concept, and 10 % more students from ITMO have heard of the term but do not fully understand its essence. However, students from SPbSUT, unlike ITMO students, have personal experience in interacting within virtual worlds, although this accounts for only 2 % of the respondents.

The differences in the adoption rates of the metaverse concept between the two universities are likely attributed to the unique characteristics of their respective educational processes. ITMO University actively keeps its students informed about the latest trends in information technology, including the metaverse, through regular

updates on its website. The university's National Center for Cognitive Development is renowned for its advancements in machine learning and cognitive technologies. These developments encompass decision support systems, predictive modeling, digital avatars, and more, all of which are essential for the comprehensive implementation of the metaverse concept.

A few noteworthy examples to illustrate ITMO's experience in implementing metaverses are the following:

– ITMO University, in collaboration with "Gazprom Neft", is currently testing a meta world in the form of a virtual replica of one of its campuses;

– In March 2022, Daria Yakovleva, a graduate of the ITMO Accelerator Program, introduced the startup Metapunks. This venture combines the development of the metaverse, 3D-NFT, and De-Fi. Metapunks emerged as the victor of the Algorand Innovative Hackathon, earning a $10,000 prize. The project focuses on creating a generative NFT collection of 3D avatars on the Algorand blockchain. Within the initial three months, Metapunks achieved over $100,000 in sales and secured a position among the top 10 NFT collections on Algorand [12]. These examples demonstrate that metaverse-related technological advancements not only offer exciting opportunities for students but also have the potential to generate income and foster self-realization.

On the other hand, SPbSUT, known for its strong traditions and leading position in the field of esports in Russia, has a different focus. The university's esports club, established in 2014, has trained graduates who excel as esports athletes and achieve top rankings globally. The club at SPbSUT trains players and regularly organizes competitions, such as the co-organized regional stage of the "All-Russian Collegiate Esports League" held in spring 2023, which offered a substantial prize pool of 3 million rubles. Saint Petersburg State University of Industrial Technologies and Design was also among co-organizers of this event [13]. As computer virtual games create their own virtual worlds, esports athletes gain firsthand experience of interaction within these virtual environments.

Thus, the adoption and exploration of the metaverse concept vary between ITMO University and SPbSUT due to their distinct educational approaches and areas of expertise. While ITMO emphasizes technological advancements and entrepreneurial endeavors in the metaverse, SPbSUT focuses on the integration of esports and virtual worlds, providing unique opportunities for student engagement and personal growth.

According to the analysis conducted on students from both universities regarding the future of the Metaverse, the results indicate that the majority of students, accounting for 64 % of respondents, lack confidence in the capabilities of the Metaverse. Conversely, 30 % of students acknowledge the advantages it offers, while 6 % express concerns about potential negative impacts. The students from both universities have identified the following advantages of the Metaverse: enhanced communication opportunities, simplified information search, and facilitation of innovative technologies. However, they have also highlighted several challenges and potential risks associated with the Metaverse, such as the need for expensive equipment to access

it, limitations for individuals with hearing or vision impairments, and the potential development of addiction leading to a detachment from reality, known as escapism.

Thus, the concept of metaverses is a notion that is interpreted differently and situationally by representatives of various fields of knowledge, while a universally accepted definition and comprehensive understanding of this concept is currently absent. The survey results reflect the diversity of opinions and perspectives surrounding the metaverse concept. While some students are enthusiastic about its potential, others remain cautious and have concerns. The findings highlight the need for further education and discourse on the topic to foster a better understanding of the metaverse and its implications.

Based on the research findings, it can be inferred that students in technical universities perceive significant potential for self-realization in the development of the Metaverse concept. However, ethical norms for interaction within the Metaverse and the establishment of a legislative framework are crucial considerations.

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УДК 342.5

THE USE OF BIG DATA IN PUBLIC ADMINISTRATION

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Abstract. In this article Big Data technologies are considered as a tool for regulating social dynamics. The main directions of data-oriented management of public processes are analyzed and formulated: infrastructure development, political forecasting, optimization of the work of medical, educational, law enforcement and tax authorities, and economic development of the state.

Keywords: big data, information technology, digitalization, government, public administration.

ПРИМЕНЕНИЕ ТЕХНОЛОГИИ BIG DATA В ГОСУДАРСТВЕННОМ УПРАВЛЕНИИ

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Аннотация. В данной статье технологии Big Data рассмотрены как инструмент регулирования общественной динамики, а также проанализированы и сформулированы основные направления ориентированного на использование данных управления общественными процессами: развитие инфраструктуры, политическое прогнозирование, оптимизация работы медицинских, образовательных, правоохранительных и налоговых органов и экономическое развитие государства.

Ключевые слова: большие данные, информационные технологии, цифровизация, государство, государственное управление.

The global trend in the use of big data, caused by the development of information technology and universal digitalization, entails a transition to a new level of decision-making: data-based. Their qualitative analysis allows the state to make more informed decisions based on up–to-date and reliable information, reduce the cost of management, provide citizens with more convenient services, predict the needs of society and monitor and regulate social processes in a new mode for public administration – real-time, by an incremental method of decision-making.

As information, big data can be determined by paying attention to its subject characteristic – a large array of information. In the digital world, big data means huge

databases with which information is stored and processed in incredible volumes. So, in 2022, the volume of all data accumulated by mankind amounted to approximately 97 zettabytes, and by 2025, according to forecasts, this number will increase to 180 zettabytes [1]. A remarkable comparison is given by Platforma: 1 zettabyte is 1 billion terabytes. If we transfer all the volumes of data that exist today to 1 terabyte hard drives and put them one on top of the other, then the total height of the resulting tower will be twice as large as the distance from the Earth to the Moon.

Also, big data should be considered as a technology with which data is sorted, processed and analyzed. This is a set of approaches, tools and methods for processing significant amounts of data, subject to constant updating and taken from various sources. Among such techniques, one can single out A/B testing, which is based on a sequential comparison of a control sample with others; association rule learning, a technique focused on determining the relationship of variables in a large amount of information; classification, a technique used in marketing: experts use it to predict consumer behavior, etc.

Considering the concept of big data, it is worth paying attention to their classification. Based on the purpose and scope of big data, it is customary to allocate metadata describing the structure and characteristics of data; reference data – data from reference books and classifiers; basic data – data about objects and business entities of value to the organization; transactional data – information reflecting the result of data changes related to a fixed point in time, not changing in the future.

The classification of databases (big data) according to the degree of structuring is more significant: “structured data is data with a strictly fixed structure, semi-structured data is data that does not have a strictly defined structure or a permanent scheme, but assumes the presence of rules that allow you to distinguish individual semantic elements when interpreting them; unstructured data is data that is arbitrary in form that does not have a strictly defined structure and is not organized according to certain rules, for example, video / audio materials, biometric data. And definitely, unstructured data prevails, consider its ratio: in 2019, the share of unstructured data was at the level of 80-90 %. But in 2022, researchers believe that the amount of raw data has increased and is now above 90 %” [2]. This is due to the constant increase in the volume of information and the lack of opportunities and technological capacities of organizations to process it.

Considering big data as an object of research, it is worth mentioning a stable set of the most important characteristics of big data, which is known in English-language sources as 5V: Volume (in 2023, big data includes data with a volume of more than 1 petabyte), Variety (heterogeneity), Velocity (generation speed: now organizations are faced with a continuous flow of raw data, the average relevance of which is 1 hour), Veracity (reliability) and Value.

An important distinguishing characteristic of big data used in public administration is the compulsion factor in their collection. The private sector is forced to offer goods and services, advantages for the consumers in order to get the necessary amount of information (mainly personal) from them, the state, in turn, is a monopolist in the unhindered borrowing of data.

Big data can be used in public administration in several functional areas: monitoring and analysis of the activities of public services: with the help of big data, it is possible to monitor the activities of public organizations, monitor performance indicators and, based on this, make decisions about optimizing activities. Moreover, there is a place for predictive analytics and resource optimization: big data can be used to predict future events and determine optimal resource use decisions. Such an analysis can help ministries and departments make safer and better decisions. Also, data-based decisions become involved in all decision-making processes: big data can be used to make decisions based on actual data on the state of various sectors of the economy and other aspects of society. For example, doctors and government agencies can use big data to improve medical services and optimize the healthcare system and the last area is operational and analytical information processing: big data can be used for operational analysis of the situation and decision-making in real time. This can help ministries and departments to respond quickly to changes in the economy or in other areas of society.

The use of big data is a tool for regulating social dynamics and is widespread in most developed and developing countries in the following areas. Next, the most important vectors of the activities of state bodies based on the use of Big Data in management are considered.

1. Analysis of public opinion and social statistics for forecasting and building electoral policy. For example, let’s recall the victory of Donald Trump in the US elections. While the sociological company Ipsos and the analytical company Gallup strongly predicted the victory of Hillary Clinton, the research of V. I. Shalak, a researcher at the Institute of Philosophy of the Russian Academy of Sciences, showed by the example of big data analysis, namely Twitter and Facebook messages, that Donald Trump would win, and turned out to be right [3].

2. Creation of intelligent cities and infrastructure management, improvement of the ecological situation and safety of the urban environment. One example of the use of big data in public administration to improve the environmental situation is the air quality monitoring system. Such a system can collect data on air pollution from sensors installed at various points in the city. Big data can also be used to monitor the state of natural resources, such as reservoirs and land plots, in order to take measures to prevent the deterioration of environmental conditions in the city.

3. Improving the quality of healthcare by analyzing medical data, managing medical systems and developing medicines. So, smart watches and fitness trackers are gaining popularity in the insurance sector, using which companies monitor the state of physical health and the level of activity of citizens and, depending on these factors, model prices.

4. Evaluating the performance of schools and universities by analyzing education data. For example, big data can be used to analyze student performance and identify trends in different groups of students. It is also possible to predict the educational needs of students and identify areas that need more funding.

5. Analysis of crime data to assess the level of crime by the police and government organizations and develop a strategy to reduce it. A textbook example is the Blue CRUSH program (English Crime Reduction Utilizing Statistical History –

“crime reduction based on statistical data”), implemented in Memphis, USA. The program provides police with data on potential threat zones and its time. Based on them, law enforcement agencies allocate their resources in a more optimal way.

6. Optimization of budgeting and taxation by using big data to analyze income and expenditure flows, forecasting and planning their financial resources. An illustrative case was given by O. V. Savarovskaya: one of the subjects of the Russian Federation, in the course of solving the problem of improving the quality of data concerning the cadastral value of objects in the unified state Register of real estate (EGRN), found many errors in the data. The search for errors was carried out, among other things, by analyzing extremes (for example, a one-room apartment has an area of 3000 sq. m. m – probably a comma was lost in the number). Thanks to this approach, the Rosreestr department corrected a significant number of such errors, and the calculation of taxes in the subject of the Russian Federation became more fair and increased by several billion rubles [4, p. 26].

7. Development of management decisions based on data to improve the economic development of companies and regions. For example, government organizations in Singapore, including the Singapore division of City Bank, use big data as a marketing tool, for example, based on data on the time and location of customer transactions, sends them individual advertising offers.

8. Transport and logistics management (e.g. freight and public transport routing) using big data. For example, a digital service based on a predictive analytics system was created in the Novgorod Region, designed to prevent accidents on the roads. When developing this service, specialists of the regional Ministry of Digital Development analyzed data on road elements that increase road safety, such as speed bumps, pedestrian barriers, video cameras, as well as data on the number of accidents, the number of dead and injured, as well as the location of buildings and public transport stops. The created predictive analytics system allows predicting the number of accidents based on the presence of certain road elements, the intensity of traffic flow and other factors [5].

9. Detection and suppression of financial fraud and corruption through the analysis of financial transactions. Thus, the world’s largest database of multibiometric data of Pakistani citizens NADRA (National Database & Registration Authority) helped to identify citizens who received pension payments several times, serving sentences in prison for money instead of real criminals or even registered among voters more than 20 times. Moreover, thanks to the analysis of data on the property of citizens, NADRA revealed discrepancies in the lists of taxpayers and came to the conclusion that 1.2 million citizens do not pay taxes.

10. Increasing the speed of public services provided and simplifying communication between citizens and the state. Online data storefronts are being created everywhere in the Russian Federation, for example, the Ministry of Internal Affairs has its own IT system, the showcase of which gives data to the user’s personal account on Public Services. The use of Big Data technologies makes it possible to improve financial services in public services, digitalize document flow, and speed up the receipt of services by citizens. The Federal Bailiff Service has implemented a program under

which users of Public Services have acquired the opportunity to receive online notification of the start and progress of enforcement proceedings against them [6 - 9].

Thus, the use of big data in public administration is comprehensive and promising: having the opportunity to focus not on sample data, but on their totality, management decisions become more accurate, government agencies improve management processes, improve the quality of life of citizens and create digital platforms useful to society.

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УКД 504.5

ANALYSIS OF THE NEGATIVE IMPACT OF THE SMOLENSK HYDROELECTRIC POWER PLANT ON THE ECOLOGICAL STATE OF THE ENVIRONMENT

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Abstract. The development of energy sector affects various components of the natural environment: the atmosphere, the hydrosphere, the lithosphere and the biosphere. Today, this impact is becoming global, affecting all structural components of our planet. Thermal power plants have a significant negative impact on the environment.

Keywords: environment, thermal power plant, power engineering, atmospheric air, industrial waste.

АНАЛИЗ НЕГАТИВНОГО ВОЗДЕЙСТВИЯ СМОЛЕНСКОЙ ГИДРОЭЛЕКТРОСТАНЦИИ НА ЭКОЛОГИЧЕСКОЕ СОСТОЯНИЕ ОКРУЖАЮЩЕЙ СРЕДЫ

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Аннотация. Развитие энергетики влияет на различные компоненты природной среды: атмосферу, гидросферу, литосферу и биосферу. На сегодняшний день это воздействие приобретает глобальный характер, затрагивая все структурные компоненты нашей планеты. Тепловые электрические станции и теплоэлектроцентрали оказывают значительное отрицательное воздействие на окружающую среду.

Ключевые слова: окружающая среда, тепловая электрическая станция, энергетика, атмосферный воздух, отходы производства.

One of the urgent problems of modern society is atmospheric pollution.

Most of the industries remaining from the Soviet economy, as before, do not have modern filters and are reluctant to comply with environmental protection requirements.

The analysis of the report on the state and environmental protection of the Smolensk region in 2022 and the report on environmental safety of the Smolensk region for 2021 showed that one of the main sources of air pollution in our region is Smolenskaya GRES.

GRES is a state district electric power station.

Thermal power plants have a significant negative impact on the environment. Assessment of the negative impact on the ecological state of the environment by calculating economic damage is time-consuming, and therefore there is a need to automate this process [1, p. 216].

The purpose of this work is to analyze the negative impact of Smolenskaya GRES on the ecological state of the environment due to emissions of pollutants into the atmosphere.

The development of energy affects various components of the natural environment. Today, this impact is becoming global, affecting all structural components of our planet. But it cannot be argued that all electric power facilities are ecologically equivalent.

The object of the study is the analysis of environmental damage from emissions of pollutants from the activities of Smolenskaya GRES.

The subject of the study is the negative impact of emissions of pollutants into the atmosphere from the activities of Smolenskaya GRES.

One of the most important components for human life is air. Moreover, the air must be clean enough for a comfortable existence. The health of people, the state of flora and fauna, the strength and durability of any structures of buildings and structures depend on air quality. If the air is polluted, then not only the person will suffer, but also the places near which we live, such as seas, forests, the soil itself.

According to an approximate calculation, the production and distribution of electricity, water and gas in Russia ranks third in terms of the number of emissions of pollutants coming from stationary sources, this is due to a significant share of mining and processing industries. These indicators vary by region, and the production and distribution of electricity may be in the first place.

Waste of production and consumption includes substances or objects that are formed in the process of production, performance of works, provision of services or in the process of consumption, which are removed, intended for disposal or subject to disposal [2, p.17].

Currently, the level of atmospheric air pollution in the Smolensk region remains quite high. The data is shown in Figure 1.

UNIPRO sets itself the strategic goal of continuously reducing gross emissions into the atmosphere for all pollutants. Currently, all emissions of pollutants into the atmosphere carried out by Smolenskaya GRES are carefully controlled using instrumental and calculation methods and do not exceed the standards established by law. Data for 2019-2021 are shown in Table.

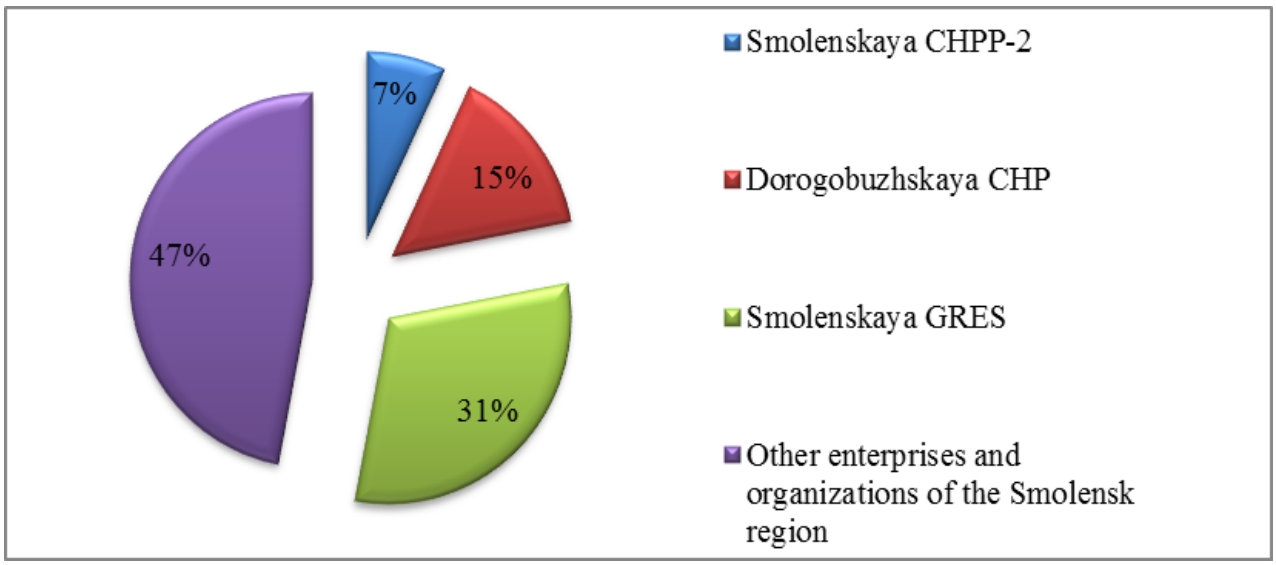


Figure 1. Contribution of Smolensk Region enterprises to atmospheric air pollution

Table – Emissions of NOX, SOX and other significant pollutants into the atmosphere, thousand tons

Indicator	2019	2020	2021
Total, including	54,859	43,171	43,369
NOX	37,162	28,743	29,460
SOX	8,550	6,081	6,758
Carbon monoxide	7,553	7,256	5,970
Volatile organic compounds (VOCs)	0,048	0,044	0,047
Solid particles (PM)	1,507	1,007	1,096
Other pollutants	0,037	0,039	0,039

NOX is the collective name of nitrogen oxides NO and NO2. Ingestion of this substance into the human body can cause breathing problems, headaches, chronic decrease in lung function, eye irritation, loss of appetite. It also harms ecosystems [3].

SOX is a group of sulfur oxides having a common formula of the SO type. At high concentrations, it can harm trees and plants. Together with other sulfur oxides, it can contribute to the precipitation of acid rain, and by reacting with other compounds in the atmosphere, small particles are formed that reduce visibility.

Carbon monoxide is a poisonous gas. If this substance is inhaled in large quantities, poisoning can be caused, which can lead to death. Even at low concentrations, it can cause suffocation, headache and deterioration of well-being.

The change in emissions of pollutants into the atmospheric air is associated with changes in the mass of processed raw materials by hydraulic presses, the operating time of railway equipment, and the volume of waste.

A large amount of various pollutants in the atmospheric air adversely affects the entire complex of wildlife.

The sources of greenhouse gas emissions into the atmospheric air at Smolenskaya GRES are backup diesel generators running on diesel fuel, as well as a start-up boiler house.

According to the Russian waste classification, “non-hazardous waste” includes waste of hazard class V, whereas “hazardous waste” includes waste of hazard classes I-IV [4, p.264].

The main hazardous wastes are: sludge for cleaning tanks, pipelines and wastewater from petroleum products, garbage and estimates from the territory of enterprises and industrial premises, garbage from demolition and disassembly of buildings, waste (garbage) from construction and repair work. The diagram of hazardous waste for 2019-2021 at Smolenskaya GRES is shown in Figure 2.

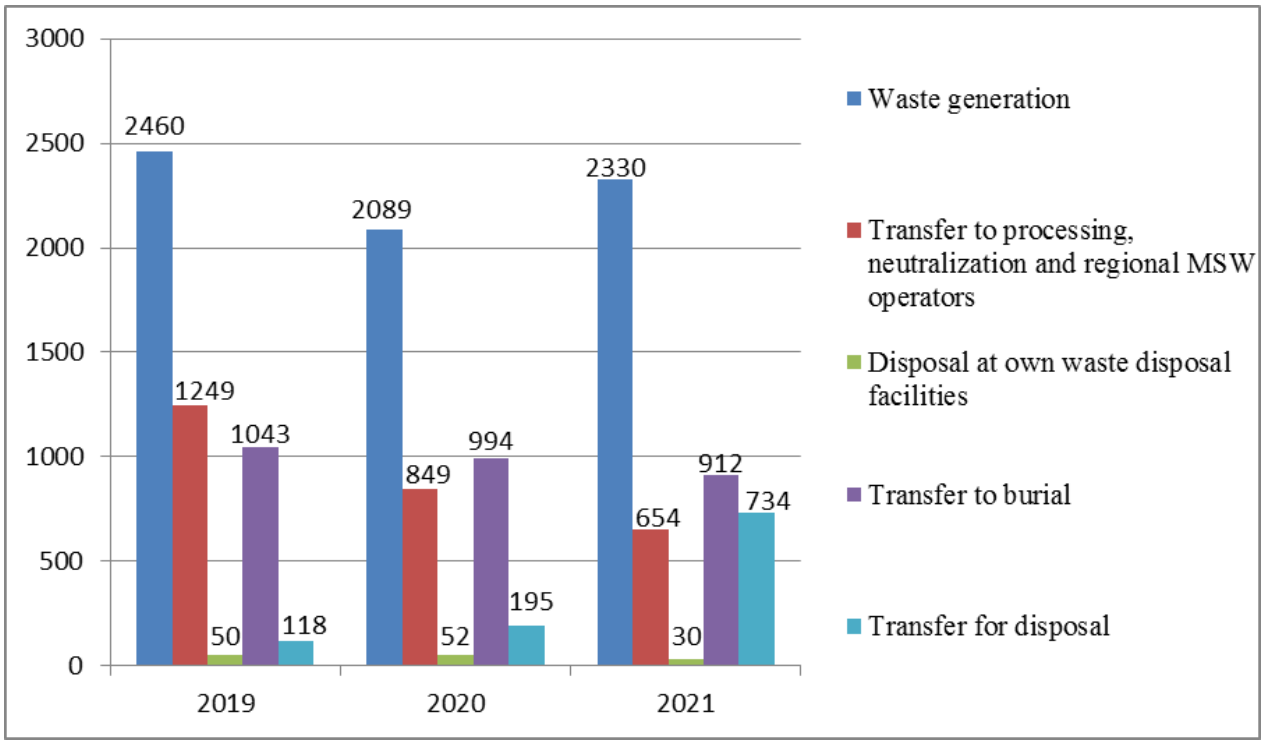


Figure 2. Volume of hazardous waste by method of treatment at Smolenskaya GRES for 2019-2021, tons

MSW is solid municipal waste.

The main non-hazardous wastes include: scrap and metal waste, waste (precipitation) of water treatment during mechanical purification of natural waters, ion exchange resins, plant waste during the care of tree and shrub plantings, scrap brickwork, cement and fireclay brick waste. Data for 2019-2021 of non-hazardous waste at Smolenskaya GRES are presented in Figure 3.

The change in waste generation is associated with a change in the volume of construction and repair work of objects and structures of the Smolenskaya GRES [5, p.48].

Having analyzed the ecological state of the environment of the Smolensk GRES for three years (2019-2021), it can be concluded that it is necessary to develop measures to ensure the environmental safety of the region and the development of an information system to analyze the negative impact of the GRES on the environmental state.

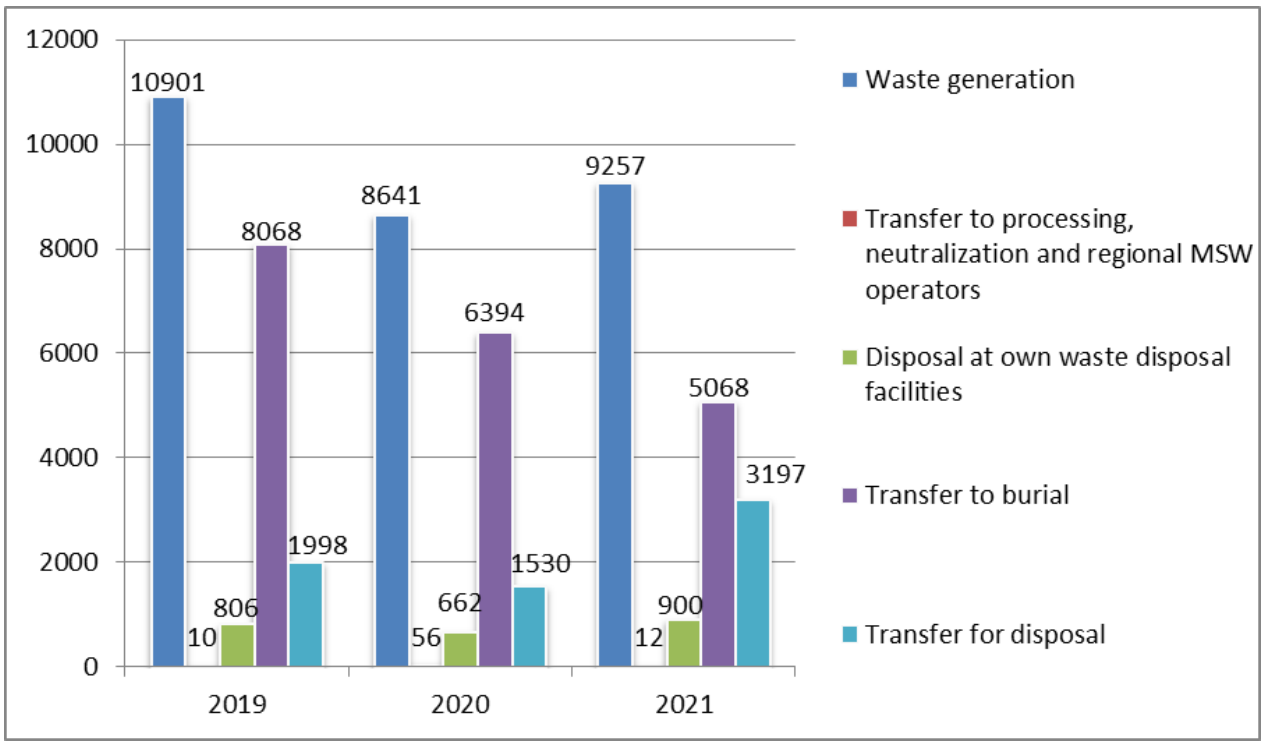


Figure 3. Volume of non-hazardous waste by method of treatment at Smolenskaya GRES for 2019-2021, tons

Over the past 5 years (2019-2023), UNIPRO has been constantly modernizing production. We hope that the work carried out will lead to an improvement in the environmental situation and bring Smolenskaya GRES to the forefront.

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УДК 336.71

PROBLEMS AND PROSPECTS OF DIGITAL SERVICES BASED ON BLOCKCHAIN

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Abstract. The growing reliance on digital services has led to an escalation in cyber risks and attacks targeting banks and financial institutions. Such cyber threats necessitate innovative solutions. But to achieve it, one needs to overcome the challenges of seeking reliable information on utilizing blockchain technology to combat cyber attacks. Hence, this work aims to use a systematic literature review to study the potential of blockchain technology to mitigate cyber threats in the banking and financial sector as well as the advantages and challenges of blockchain technology. Blockchain provides heightened security, improves transaction processes, ensures transparency and privacy, optimizes operational performance and reduces fraud.

Keywords: bank, blockchain, security, protection, technology.

ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ ЦИФРОВЫХ УСЛУГ НА ОСНОВЕ БЛОКЧЕЙНА

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Аннотация. Растущая зависимость от цифровых услуг привела к эскалации киберрисков и атак, нацеленных на банки и финансовые учреждения. Подобные киберугрозы требуют инновационных решений, но для этого необходимо преодолеть проблемы поиска достоверной информации об использовании технологии блокчейн для борьбы с кибератаками. Таким образом, данная работа направлена на использование систематического обзора литературы для изучения потенциала технологии блокчейна для смягчения киберугроз в банковском и финансовом секторе, а также преимуществ и проблем технологии блокчейна. Блокчейн обеспечивает повышенную безопасность, улучшает процессы транзакций, обеспечивает прозрачность и конфиденциальность, оптимизирует операционную производительность и снижает уровень мошенничества.

Ключевые слова: банк, блокчейн, безопасность, защита, технология.

Digitalization is a comprehensive area that is constantly evolving, with the aim of streamlining business processes to promote both individuals and companies. In line with today’s ongoing development of digitalization, the growth of FinTech has had a major impact in the banking sector. This is because FinTech has contributed to the possibility of establishing innovative financial services, as banks have previously

lacked this capability. FinTech companies are covered by higher innovation capacity and banks are thus today facing challenges, to create value for their customers. While FinTech development promotes opportunities for banks, cyber risks and threats also occur because of the rapid changes [1].

Blockchain technology offers a secure and trustworthy framework for transferring data in different types of transactions such as financial transactions and contracts. Cryptography plays a critical role in ensuring the genuineness and accuracy of the data being transferred.

Blockchain technology is attracting interest from many industries and has spread to security, real estate, computer games, law, insurance, energy, and finance. Almost every industry is trying to use blockchain to improve their business.

Nearly every sector is currently researching the benefits of blockchain technology. The research on the uses of blockchain is being looked into by several academics and organizations, such as banks, software developers and governments to improve organizations and performance. Because of its promising ability blockchain has gained wide recognition in recent times. Organizations are trying to utilize this technology in order to meet their challenges. This innovation has the potential to be highly disruptive in many areas of society [2].

The data architecture of blockchain includes different frameworks such as SQLite, RESTful API, and Python. The private key in the blockchain encrypts customer transaction records, which are then sent to the Blockchain Database API. This API boosts user authentication by decrypting the data with the private key and calculating a hash value with a nonce to prevent unauthorized changes [2].

Blockchain technology allows for a fast and secure exchange of money without the need for third parties [3]. This is possible because blockchain technology uses a combination of a peer-to-peer network that is distributed across the network. In the network, all the transactions that are made are recorded and shared. The digital ledger is available to all participants in the network making it transparent.

For blockchain to work different techniques such as mathematics, peer-to-peer net-works, algorithms, cryptography, and distributed consensus are used. Blockchain technology is mainly used to prevent double-spending. Double spending happens when the same digital currency is spent multiple times before it is realized that the funds are already used. In blockchain, when two transactions happen simultaneously, the one with the most confirmations gets approved, even if it is not the first one. This process, known as proof of work, can be slow and take over an hour.

The system uses a combination of public and private keys, along with a password attributed to each party to authorize transactions and keep users' private information secure. The public key is the address displayed for anonymous users on the public ledger. This will make sure that everyone's private information remains secure. The public key is used to conduct the transaction and the private key is used for self-identification as the assets are connected to the private key. Every peer-to-peer transaction is validated and made into a block. In order to ensure that it cannot be tampered with, each block contains a hash and timestamp. The hash is cryptographed so no data or information can be changed [4].

The information about the transaction is stored in a block and linked to the previous block. It is then transmitted to multiple nodes throughout the network to

validate the transaction and for everyone to see. Each block in a blockchain contains data related to a specific transaction and consists of the same main components. The primary component contains the critical transaction information, such as the payer and receiver's identification and the amount of money exchanged. A unique hash number is generated, being a validation for the transaction. Any modification in the transaction data will cause the hash number to change significantly. If the hash number of a block is different from that of the majority in the network, that block is considered invalid and will be overwritten by the block in the majority's content. Another aspect included in the hash number is the hash number of the previous block.

The cryptographic features of the blockchain make it possible to trust a system that can uphold the ledger's integrity and prevent attacks with a few nodes. When the nodes approve the transaction, it is authenticated and added to the public ledger. The entire procedure is accomplished anonymously, meaning no information concerning the identity of the participants is available to any parties or nodes involved. Due to it being decentralized and with open-source standards, blockchain technology can be used in various industries [3]. One important characteristic of blockchain is the immutability of the digital ledger. Therefore, it cannot be altered or modified. Once a transaction is validated by the nodes on the network, it becomes a permanent entry in the ledger and cannot be altered or erased from the system.

The benefits of blockchain technology in facilitating asset transfers within business networks have generated significant interest. Nevertheless, concerns remain regarding the capability to meet the processing speed, reduce costs, and restrict the growth of unutilized mining resources with the rise in transaction volumes. In addition, while transactions in blockchain technology are almost instant, their confirmation time depends on the consensus mechanism and the role of miners.

Before blockchain technology can be widely adopted, there are concerns about security, cost and scalability that need to be addressed. The first one is the ability of blockchain to process transactions as quickly as traditional payment systems. The second is the higher computational power needed and lastly, the costs when substantial transaction volumes are involved are all points of concern [5].

The benefits of blockchain technology in banking and finance are vast, including efficient processes and sustainable development. Two significant challenges to blockchain adoption are the high cost of equipment and high energy consumption. According to Cocco, Pinna & Marchosi, these challenges are present in Bitcoin which has high energy consumption and computer power required for mining cryptocurrencies. Cryptography is a significant environmental cost. Additionally, the cost of equipment required for mining and running blockchain networks is a significant barrier to entry for smaller firms. According to research, the cost of using the Ethereum blockchain is twice as much as the cost of utilizing traditional cloud services offered by Amazon SWF. Consumer-facing applications, such as Google Pay, Pay Pass, and Apple Pay, have increased capability and transaction speed severely. However, they caution that the acceptance and proliferation of blockchain still lag behind traditional methods.

Blockchain technology faces significant challenges in achieving scalability, hindering its widespread adoption in various industries. One of the primary scalability limitations of blockchain is the limited ability to support a high volume of transactions,

leading to low processing efficiency and network congestion. To tackle this issue, sharding, a technique that can divide workload and storage into parts, can be used to increase processing power scalability. Furthermore, the integration of blockchain with current systems remains a challenge in many industries, low throughput and scalability limitations being significant roadblocks to its adoption as well.

Blockchain business security is not foolproof, and hackers will always try to exploit it when there are large sums of money at stake. This can hinder the broader adoption of blockchain. Additionally, the privacy and anonymity provided by blockchain may come at a cost as it could facilitate theft and fraud without consequences. The banking industry requires a comprehensive strategy to ensure dependable computer network security. This includes review and risk assessment of procedures and policies related to security [2]. The banking and financial sectors are particularly susceptible to security attacks, and user behaviour is a significant risk. Banks can invest in state-of-the-art technology and shift some of the concerns away from customers to provide a secure environment. While blockchain offers benefits, it is more susceptible to security attacks compared to conventional financial infrastructures [6].

Security breaches like private account hacking and DDoS attacks have occurred in Bitcoin. Technical challenges such as privacy, security, and scalability issues hinder industry-wide implementation of blockchain. Information security issues like illegal transactions, 51 % attacks, or botnets can impact trust in blockchain's digital systems. Additionally, blockchain transparency may create privacy concerns [2].

Blockchain technology enables decentralized and peer-to-peer organization within a business community. Bitcoin serves as a demonstration of a decentralized organization, devoid of a central authority controlling its operation and maintenance. Nodes in a blockchain system interact in a peer-to-peer manner.

Network security, trustless computing, and smart contracts are key components of the blockchain system. Network security ensures the reliability of the system for business transactions. Trustless computing allows for consensus in a decentralized blockchain, while smart contracts provide autonomous execution of agreements without the need to rely on trust [1].

Blockchain technology has the ability to transform claims processing and fraud detection through the utilization of smart contracts, which enable automatic verification and validation processes. By integrating investors within a distributed ledger infrastructure, transaction verifications and customer information can be handled efficiently and securely. However, the regulation of cryptocurrencies remains a complex issue, requiring the classification and treatment of digital assets and the adaptation of traditional contract law to accommodate smart contracts.

The implementation of blockchain technology in banks and financial institutions can have a significant impact. It offers many benefits, including heightened security, transparency, reduced fraud, improved trust, and increased efficiency. By utilizing cryptographic algorithms and distributed ledger infrastructure, blockchain provides secure and tamper-resistant data storage, preventing data breaches and unauthorized modifications. Furthermore, the implementation of blockchain can automate and streamline several banking processes, such as regulatory compliance, submissions, and payments. Smart contracts, a feature of blockchain, increase operational efficiency by

enabling self-executing agreements and reducing the need for intermediaries [7]. However, along with its advantages, implementing blockchain technology also presents challenges. In the banking and financial sector, regulatory compliance, privacy requirements, scalability, and possible vulnerabilities are the most prevalent challenges. Integrating blockchain into an existing system requires careful planning and coordination [8].

Blockchain technology holds significant potential to revolutionize various industries, particularly in the banking and financial sectors. It offers numerous benefits, including increased security, transparency, reduced fraud, improved trust, and increased efficiency. Blockchain can update processes, eliminate intermediaries, reduce transaction costs and automate tasks through smart contracts. Still, implementing blockchain also presents challenges, such as regulatory violations, privacy requirements, scalability, and vulnerabilities, which need to be carefully addressed. Despite these challenges, the benefits are significant, and organizations that adopt blockchain can gain a competitive advantage in the market. However, the implementation of blockchain requires careful planning, research, and financial investment.

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УДК 159.99

FEATURES OF CHILD-PARENT RELATIONS AS A CAUSE OF DEVIANT BEHAVIOR OF CHILDREN AND ADOLESCENTS

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Abstract. In the modern world, there is an increase in deviations in the adolescent environment, therefore it seems relevant to consider the causes of the deviant behavior of children and adolescents. This article discusses the influence of destructive child-parent relationships, which can be transformed into a teenager's stable rejection of his or her own "I" and the world of social relations. The main causes of deviant behaviors of adolescents are highlighted, which include individual psychological characteristics of personality and features of social interaction. The author of the article reveals the main characteristics of constructive and destructive child-parent relations. The article presents the results of a review and analytical study that can be used in organizing educational work with parents.

Keywords: deviant behavior, deviations, family upbringing, child-parent relations, adolescents, parents, parenting styles.

ОСОБЕННОСТИ ДЕТСКО-РОДИТЕЛЬСКИХ ОТНОШЕНИЙ КАК ПРИЧИНА ДЕВИАНТНОГО ПОВЕДЕНИЯ ДЕТЕЙ И ПОДРОСТКОВ

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Аннотация. В современном мире наблюдается рост девиаций в подростковой среде. Актуальным видится рассмотрение причин, обусловливающих девиантное поведение детей и подростков. В данной статье раскрывается влияние деструктивных детско-родительских взаимоотношений, которые могут преобразовываться в стабильное отвержение подростком собственного «Я» и мира социальных отношений. Выделяются основные причины девиантных форм поведения подростков, к которым относятся индивидуально-психологические особенности личности и особенности социального взаимодействия. Автор статьи раскрывает основные характеристики конструктивных и деструктивных детско-родительских отношений. В статье представлены результаты обзорно-аналитического исследования, которые могут быть использованы при организации просветительской работы с родителями.

Ключевые слова: девиантное поведение, девиации, семейное воспитание, детско-родительские отношения, подростки, родители, стили воспитания.

Constant changes in the political, economic and social spheres in modern society cause a significant increase in deviations in the adolescent environment. Deviations in the adolescent environment are particularly dangerous, because this phenomenon is associated with the formation of “abnormal” attitudes in the minds of adolescents, which further influence value orientations, patterns of behavior and assessments of social interaction.

The problem of deviant behavior has been worrying scientists for a long time. There are many definitions of the concept of “deviation”. E. V. Zmanovskaya defines deviant behavior as behavior that does not comply with generally accepted or officially established social norms. Deviant behavior can manifest itself in aggression, challenges, unauthorized and systematic deviations from school, running away from home and vagrancy, drunkenness and alcoholism of children and adolescents, early anesthesia and related antisocial actions, antisocial sexual acts and suicide attempts.

The development of deviant behavior has a multifactorial conditionality. According to foreign researchers, such factors include: individual psychological characteristics of the individual (K. Anderson, S. Grof, C. Lombroso, S. Magnusson, F. Stattin), features of social interaction (Sh. Gluck, G. Johnson, D. Dolman, E. Lemmert, K. Shaw, etc.).

Domestic scientists name the following reasons influencing the formation of deviations: personality attitudes (K. E. Igoshev), value orientations of personality (Yu. A. Vasilyeva, A. I. Dolgova), personality orientation (A. G. Kovalev, G. M. Potanin, A.M. Yakovlev), character accentuation (V. V. Kovalev, A. A. Rean), features of self-consciousness (S. V. Chudnovsky).

Researchers also believe that deviations have a close connection with “anomalies” of character, i.e. psychopathies. Individuals with hyperthymic and epileptoid types of character accentuation are more susceptible to this.

Highlighting individual psychological characteristics as a factor scientists note that in this case, the deviant behavior of the individual is associated with violations of the emotional-volitional, motivational and cognitive spheres of the personality. As a result of these disorders, there may be low cognitive activity, decreased empathy, lack of ability to resist, as well as malice, impulsivity, lack of will, etc. This leads to a violation of social regulation.

Speaking about deviations as an antisocial orientation, scientists in their research use the following terms: antisocial orientation of the individual, criminogenic deformation personality, illegal motivation, antisocial orientation. In this case, according to researchers, the main reason for the deviant behavior personality is specific motivation. The concept of “specific motivation” means a system of stable and dominant personality motives – internal motives, needs, attitudes, value orientations [1, 2].

Western researchers (E. Fromm, K. Ziller) note in their works that the growth of deviant behavior in the adolescent environment is associated with the process of deindividualization, which is characteristic of modern society. Now we can see how many young people are striving to be like their idols, thereby merging into the crowd, while losing their individuality. In the modern urbanized world, the individualization

of personality contributes to the formation of a sense of loneliness, isolation, which motivates people again to join different groups.

Joining a modern teenager to a group often entails a reduction in prohibitions. As a rule, a teenager in a group has a reduced sense of responsibility for his actions. This is because the attention of society is focused on the group as a whole, and not on its individual members. Social control over the personality of a teenager begins to decline. A teenager in a group becomes indifferent to various sanctions and punishments from society, as a result, the behavior of a teenager ceases to obey external rules and norms [3].

By joining a particular group, a teenager himself ceases to understand his individuality. In this regard, the teenager is not able to control and analyze his behavior. Analyzing the indicators over the past few years, it can be seen that crimes in the teenage environment are getting younger (every third criminal offense is committed by minors). One of the important factors, contributing to the formation of deviations, is distrustful child-parent relationships, because family relationships have a great influence on the formation of a child's personality. At all stages of the child's personality development, both he and his parents are influenced by factors of the social environment. These factors can be both positive and negative. The type of child-parent relationship is important here.

With a constructive relationship between children and parents, the negative effects of the social environment can be leveled by socially positive activities. If we observe destructive relationships between children and parents in the family, then the above factors can provoke deviant behavior in children [4, 5].

By destructive child-parent relationships, we mean a system of negative feelings shown by parents towards their child, as well as by the child towards parents, their inadequate perception, misunderstanding of each other, which serves as the basis for conflicting behavioral manifestations. We have identified the parameters of destructive relationships between children and parents, which, in our opinion, give rise to this phenomenon. Let's focus on a detailed consideration of the parameters [6].

The nature of the emotional connection. This parameter determines the psychological distance between the child and the parent and implies deep attachment – rejection, acceptance – non-acceptance (J. Bowlby, V. V. Stolin, V. Schutz), interest in the personality of the child (parent) – indifference (L. I. Wasserman, I. A. Gorkovskaya). In destructive child-parent relationships, there is a conditional emotional acceptance of the child's personality (love caused by success, good behavior, etc.), in other words, the child needs to earn love for himself. This contributes to the formation of increased anxiety, self-doubt and self-confidence in him. Destructive relationships between children and parents are characterized by an ambivalent emotional attitude (a combination of love and hostility), or emotional rejection, which is characterized by a lack or absence of emotional contact between the child and the parent. Emotional rejection can be explicit or implicit. In the first case, the parent openly demonstrates to the child his or her dislike, rejection, irritation. With hidden emotional rejection, the parent, as a rule, is masked by exaggerated attention and care for the child, but rejection can be noticed by a lack of love and aspiration, avoided physical contact with the child.

Destructive relationships between children and parents can be transformed into a stable rejection of the child's own "I", as a result, the child can reject the world of social relations. It is the emotional connection that determines the authority of a parent in the family and satisfaction with the relationship between children and parents. The nature of the emotional acceptance of a teenager by a parent is the basis for the development of child-parent relations.

The next parameter is the nature of the interaction of the subjects of child-parent relations, which is a qualitative characteristic of the relationship. The nature of the interaction between the child and the parent can be traced by observing the use of certain communication methods: duties, prohibitions, punishments, communication style during interaction. Analyzing the experience of researchers on this problem, we observe that the parameter we have identified is concretized through such concepts as "rigor" (I. M. Markovskaya, P. Slater), "exactingness" (O. Conner, E. E. Maccoby), "consistency" or its absence (A. I. Zakharov, I. M. Markovskaya). All this reflects a certain background on which the parent-child relationship is based. The manifestation of cruelty on the part of parents may be situational, but when considering this parameter, we determine the chronic form [7].

One of the features of destructive family interaction is the inconstancy and unpredictability of parents' behavior. The response of parents to the behavior of children is relatively random and depends on many factors, including mood swings of parents. Children rarely get an explanation of what to do, how not to act and why.

Education in such families is based on the principle of prohibitions and punishments. As a result, the child does not develop norms regulating his behavior. The child needs external control. Undoubtedly, control as a certain pressure and deliberate guidance by the parent of the child's life is one of the functions of parental education, allowing the parent to take an authoritative position in relation to the child. It is worth noting that a different position is also possible when the child is an active subject of upbringing. Dominant parental demands can cause children's alienation from their parents, a sense of uselessness in the family, as well as aggression, protest behavior, low level of volitional regulation, apathy and passivity. All these manifestations lead to social maladaptation in adolescence.

The next parameter reflecting the degree of representation and realization in the child-parent relationship of the motives of the parent's desires are the motives of upbringing. The structure of motivation for raising children is determined by the different values of the child in the family. In families in which there is a destructive relationship between a child and a parent, children have low value, often their birth is the result of external circumstances. Utilitarian-pragmatic motives and motives of self-affirmation of parents dominate in education. As a result, the child develops a feeling of uselessness [8, 9]. Destructive child-parent relationships are characterized by: internal conflict, contradictions, ambivalence. All this has a negative impact on the formation of the child's personality and negatively affects the attitude of children and parents.

Adolescents are sensitive to various adverse factors and conditions of development. In our study, this is a destructive child-parent relationship. In combination with the acceleration observed today, child-parent relationships burden

the physical and mental state of a teenager. In turn, this manifests itself in behavioral disorders, including deviant behavior.

Thus, destructive child-parent relationships significantly complicate the formation of a child's personality and the formation of self-regulation of behavior. They lead to the appearance of undesirable individual psychological characteristics of a teenager's personality, such as aggressiveness, increased anxiety, lack of empathy, infantilism, and in behavioral terms, destructive child-parent relationships are a factor of deviant behavior.

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УДК 681.3:620

CAUSES OF LOW-QUALITY ELECTRICITY

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Abstract. The quality of electricity is an important aspect of the electric power industry, known since the creation of energy systems. Nevertheless, topics in the field of electricity quality have risen to the fore since the advent of powerful semiconductor switches, transmission networks. In addition, the trends in modern power engineering are to maximize the benefits of the existing installed system and this has also focused attention on the issues of the accuracy of the sinusoidal waveform, the absence of high and low voltage conditions and other distortion of the AC waveform.

Keywords: electrical energy, long-term asymmetry, short-term asymmetry, voltage, sinusoidal shape.

ПРИЧИНЫ НЕКАЧЕСТВЕННОГО ЭЛЕКТРОСНАБЖЕНИЯ

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Аннотация. Качество электроэнергии – это важный аспект электроэнергетики, известный с момента создания энергетических систем. Тем не менее, темы в области качества электроэнергии вышли на первый план с момента появления мощных полупроводниковых ключей, сетей передачи. Кроме того, тенденции в современной энергетике состоят в том, чтобы извлечь максимальную выгоду из существующей установленной системы, что обуславливает необходимость акцентировать внимание на вопросах точности синусоидальной формы сигнала, отсутствии условий высокого и низкого напряжения и другого искажения формы волны переменного тока.

Ключевые слова: электрическая энергия, длительная несимметрия, кратковременная несимметрия, напряжение, синусоидальная форма.

The quality of electrical energy (EE quality) is a complex property. It characterizes the electromagnetic environment and the capabilities of the technological process for the production, transmission, distribution and use of electrical energy by consumers.

SVEL electric energy quality improvement devices are an effective solution for improving the reliability of power supply systems, increasing stability and reducing costs.

The quality of electricity is responsible for reliability: the mode of power supply to consumers is considered normal if electricity reaches consumers uninterrupted, and in the amount that was agreed in advance with the energy supply organization.

The quality of electricity is also called “electromagnetic compatibility” (the ability of an electrical installation to function normally in its electromagnetic environment without creating electromagnetic interference to other electrical appliances operating in this network).

The quality of electricity is determined by the degree of compliance with the operational parameters of electricity and the established values of the declared indicators. Such individual properties include:

– Tension.

It consists of the following indicators:

– steady-state voltage deviation;
– the magnitude of the voltage change;
– flicker dose;
– duration of voltage failure;
– pulse voltage;
– the coefficient of temporary overvoltage.
– Sinusoidal voltage.

It consists of the following indicators:

– distortion factor of the sinusoidal voltage curve;
– the coefficient of the harmonic component of the voltage.
– Voltage frequency (the number of oscillations per unit of time).
– Symmetrical mode of the three-phase system.
– The coefficient of stress asymmetry in the reverse sequence;
– The coefficient of stress asymmetry in the zero sequence.
– The shape of the current and voltage curve.

Electricity is the most versatile and adaptive form of energy. It is used to transform into other forms: heat, light, motion, electromagnetic and acoustic vibrations, etc.

This property of electricity is the basis for modern telecommunications, transport, industry and information technology.

Electrical energy, long-term asymmetry, short-term asymmetry, voltage, sinusoidal shape.

In the modern world, electromagnetic energy is the most widely used of all types of energy. In practice, such energy is called electric.

In general, if we consider the concept of energy, it is a quantitative measure of the movement and interaction of all forms of matter.

Electrical energy has a very extensive application and is explained by its valuable properties, for example, the possibility of efficient conversion into other types of energy (mechanical, thermal, light, chemical) in order to activate machines and

mechanisms, produce heat and light, change the chemical composition of the substance, production and processing of materials, etc. [1].

For normal operation, the voltage quality of electrical equipment connected to the AC network, the best form is considered to be an ideally sinusoidal form of the supply voltage.

In modern enterprises, such loads as volt- and weber-ampere characteristics are common. They have a non-linear character, that is, non-linear loads [2].

The connection of such consumers, which have nonlinear elements in their composition, often leads to a deviation of the voltage form from the sine wave.

The presence of various types of nonlinear resistances is the main cause of distortion of the sinusoidal voltage form in power supply systems.

For example, these are semiconductor devices, coils with ferromagnetic cores and other elements [3].

Let’s take a closer look at other reasons for the decrease in the quality of electrical energy:

1. Overload of generators at the power plant due to deviations and frequency fluctuations, the occurrence of which is obtained in the case of short circuits.

2. Deviation can also occur due to incorrect selection of network elements.

3. A powerful shock load is another reason for voltage fluctuations. For example, the use of welding units with incorrectly selected parameters of the power supply system.

4. There is a long and short-term voltage asymmetry. Long-term asymmetry occurs when there are lighting loads in the network. Short-term asymmetry is associated with emergency processes in electrical networks, such as short circuits, wire breaks, earth faults.

The increase in the number and increase in the installed capacity of electric receivers with nonlinear and asymmetric nature of loads, the emergence of new electrical installations have made distorted modes a characteristic and integral feature of the modern power supply system.

The reason that causes non-sinusoidality, asymmetry, voltage fluctuations and deviations is one or another type of electric receiver determined by the technological process (production). Voltage deviations cause a change in the load of any production. Enterprises with powerful welding devices also generate fluctuations, voltage asymmetry; arc steelmaking furnaces also lead to non-sinusoidality; during electrolysis in non-ferrous metallurgy, fluctuations, non-sinusoidality occur; with a single-phase load asymmetry is the case; when operating traction substations, non-sinusoidal and voltage asymmetry results [4].

In addition to distortions in steady-state operating modes, there are industrial sources of voltage distortion that create interference in starting modes or during regulation. Higher harmonics generate AC motors with adjustable speed during start-up and braking, converters – during regenerative braking. Transformers cause short-term overvoltages when switched on and off.

The sources of voltage fluctuations in modern electrical systems are powerful electric receivers with pulsed, sharply alternating nature of consumption of active and reactive power. They are characterized by: power supply from 35-220 kV buses;

significant changes in the consumed active and reactive power, equal to (10-130) % P, at a high speed during the day; the presence of nonlinear elements in current collectors.

Such electric receivers include, in priority order according to the degree of impact on this PCE: arc steelmaking furnaces; ore-thermal furnaces; high-power electric motors (in particular, rolling mills); induction furnaces; contact welding machines; converters of electrolysis plants; synchronous motors; drives of pumps and compressors in distribution networks.

The sources of harmonic distortion are mainly loads with nonlinear characteristics: arc steel furnaces; valve converters; transformers with nonlinear volt-ampere characteristics; frequency converters; induction furnaces; rotating electric machines powered through valve converters; television receivers; fluorescent lamps; mercury lamps [5].

Voltage asymmetry has a significant impact on the operation of electrical equipment, primarily on electric motors and power transformers. With a reverse voltage sequence coefficient equal to 4 %, the service life of electric motors is reduced by about half [6, 7].

Various equipment is used to solve power supply problems:

– varistor surge arresters;
– voltage relay;
– network high-frequency filters;
– higher harmonic filters;
– dynamic power compensators;
– variable voltage stabilizers;
– alternators;
– uninterruptible power supplies.

The quality of the supplied electricity may change over time, which largely depends on the number of consumers in the network. In order to determine all the above parameters in a timely manner and assess the quality characteristics, periodic inspection of electrical installations is required at least once every 12 months, in accordance with the recommendations described in regulatory documents [8].

In practice, there are many ways to evaluate the parameters of the quality of electricity.

As a rule, these indicators are expressed in a sharp change in the amplitude of the sine wave, which describes fluctuations in the AC network. Exceeding the nominal values by an amount not exceeding 5 % is considered the norm, and such parameters do not affect the operational characteristics of the electrical network in any way.

With an increase in deviations up to 10 %, the energy quality requires improvement, but is still within acceptable values. If these quality characteristics are exceeded, third-party intervention is required to improve operational parameters.

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УДК 550.462

AEROSOL CONTAMINATION OF THE AIR BASIN, METHODS OF ANALYSIS AND METHODS OF REMOVAL

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Abstract. Thanks to the atmosphere, animals and people can breathe, and the process of photosynthesis does not stop in plant cells and some types of bacteria. The number of chemical enterprises is increasing every year, therefore, atmospheric pollution with gaseous substances and aerosols is becoming more and more serious. Therefore, consideration of the influence of aerosol pollution on the atmosphere, as well as methods of detecting and combating it is currently one of the urgent tasks.

Keywords: aerosols, impact on the atmosphere, detection and removal methods.

АЭРОЗОЛЬНЫЕ ЗАГРЯЗНЕНИЯ ВОЗДУШНОГО БАССЕЙНА, МЕТОДЫ АНАЛИЗА И СПОСОБЫ УДАЛЕНИЯ

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Аннотация. Благодаря атмосфере животные и люди могут дышать, а процесс фотосинтеза не останавливается в клетках растений и некоторых типах бактерий. Количество химических предприятий увеличивается с каждым годом, вследствие этого загрязнение атмосферы газообразными веществами и аэрозолями становится все более серьезным. Именно поэтому рассмотрение влияния аэрозольного загрязнения на атмосферу, а также методов обнаружения и борьбы с ним является одной из актуальных задач в настоящее время.

Ключевые слова: аэрозоли, воздействие на атмосферу, методы обнаружения и удаления.

In the atmosphere, an aerosol is liquid or solid particles suspended in the air. In some situations, solid aerosol elements are particularly dangerous for living organisms, as they can contribute to the appearance of various human diseases. Examples of aerosol in the air can be smoke, smog, haze or fog. A large percentage of them occurs due to the interaction of solid and liquid particles with each other or with water vapor [1].

The relevance of the current research is due to the problem of the receipt and influence of aerosols on the quality of the air basin.

The purpose of this work is to study the influence of different types of aerosols on the quality of the air basin and their detection using gravimetric, photometric and other methods, as well as ways to remove them from the air.

To achieve this goal, it is necessary to solve the following tasks:

1. Consider the classification of aerosols;
2. Identify the sources of aerosol pollution of the air environment;
3. Consider the danger of aerosol poisoning;
4. Investigate the main detection methods;
5. Study methods for removing aerosols from the air.

Aerosols are classified according to the methods of penetration, as well as by chemical composition, method of formation and nature of exposure.

By its nature, the aerosol can be natural and artificial.

Natural aerosol appears due to natural forces, for example, soil erosion and a combination of winds and weather events or during volcanic processes.

Artificial aerosol is the result of human agricultural work. But among all aerosols, the main place is occupied by the industrial one.

Industrial aerosol appears during production processes in the form of their unwanted waste, negatively affecting nature and public health [2].

By chemical composition, aerosols are molecules.

With incomplete combustion of carbon compounds, carbon monoxide is formed. It enters the air environment with exhaust gases or due to solid waste incineration. Carbon monoxide is a substance that reacts with the components of the air basin and is the cause of the greenhouse effect, resulting in climate change, namely, the global warming [3].

The combustion of sulfur-containing fuel or the treatment of sulfur-containing mineral leads to the appearance of sulfur dioxide in the air. Some sulfur compounds are released from mines during the combustion of organic substances.

Sulfur anhydride is released during the oxidation of sulfur dioxide. The final product of the reaction is an aerosol or a solution of sulfuric acid in rainwater. It can acidify the soil environment and aggravate human respiratory diseases. In conditions of low clouds and high humidity, sulfuric acid aerosols accumulate in the smoke shafts of a chemical company.

Hydrogen sulfide and carbon disulfide enter the air separately or with other sulfur-containing compounds. Enterprises producing artificial fiber and granulated sugar are their most common sources. When they interact with another pollutant in the atmosphere, they are gradually oxidized to sulfur dioxide [4].

The most common sources of nitrogen oxide entering the atmosphere are enterprises that produce nitric acid, nitrogen fertilizers and other nitrate compounds.

Glass and aluminum manufacturing enterprises are considered to be the main sources of fluorine emissions, which is present in the air in the form of hydrogen fluoride or calcium and sodium fluoride. These substances are toxic, and fluorine compounds are strong insecticides.

Chlorine compounds enter the air from plants that produce hydrochloric acid, soda and bleach. In the air, they are like an admixture of chlorine molecules and hydrochloric acid vapors. The toxic effect of chlorine depends on the type and concentration of the substance [5].

Chemical enterprises can also be sources of pollution. The greatest risk of pollutants entering the atmosphere is associated with thermal power plants and cement plants. The particles they emit, carbon and silicon oxides, destroy the ozone layer.

Aerosols have a very strong effect on the climate. For example, brown and black carbon heat the air layer, while other substances, such as sulfate droplets, cool it. Researchers believe that all aerosols contribute to lowering the temperature of the planet. However, it is unclear how strong this cooling effect will be and how strong it will be in days, years or centuries.

There are several ways to detect aerosols in the air, the gravimetric method being the most common. During the study of aerosols, piezo-equilibrium weighing of the deposited sample is used here to control the lowest (0.01 - 10 mg/m^3) concentration.

Another method is nephelometric one, which is the most effective. Its principle of operation is based on the registration of scattered light radiation by direct, lateral and reverse methods. It is often used to measure low aerosol concentrations [6].

Unlike the nephelometric method, the photometric method is less effective for the reason that many substances have lower sensitivity, reproducibility and retention time. The method is based on attenuation of the intensity of the luminous flux, which is caused by the absorption of aerosol components. In addition to low sensitivity, its disadvantage is the inability to control large concentrations (more than 10 - 12 g/m^3) due to almost complete absorption of light.

Many methods have been developed to destroy aerosols, but any of them consists of 2 stages: stage 1 is to capture scattered particles and separate them from the gas, and stage 2 is to prevent the particles from returning to the gas sphere. Aerosols arise from trapped particles that “stick” to each other and form heavy precipitation.

Dust collection mainly occurs due to inertia or electrical force.

Inertial precipitation is carried out by a centrifugal separator, by a cyclone, in which the aerosol moves from top to bottom in a spiral, while the particles settle on the cylinder wall, and the pure gas is then separated by a cyclone.

Wet dust collection can also be called inertial deposition. The main purpose, in these cases, is for the particles to come into contact with drops of a special liquid, which will then remove them from the device [7].

An ultrasonic device is used to decompose the fog. Just a few seconds and the fog, being in the ultrasound area, dissolves (by 95 %). Today, industrial units with a capacity of up to 1200 m^3/min have been created. The disadvantage is that they cannot completely destroy aerosols and thus leave their harmful particles.

The electrostatic deposition technique is successfully used to capture dust and fog. It is mainly used in cement and metallurgical enterprises. This technique consists in the following: when the aerosol moves between the electrodes, it creates a high voltage field (approximately 80–110 kV), due to which a corona discharge occurs, thereby it releases a large number of electrons at the cathode. The electrons ionize the gas molecules in such a way that the formed anions are absorbed by aerosol particles,

and the cations are deposited on the negatively charged walls of the tube and then collected in special containers.

In the course of many methods and studies, it has been found that the use of a condensing filter with a capacity of 35 000 m^3/h allows you to purify the air from aerosols as much as possible. With an average particle size of 0.3 microns, its efficiency index turned out to be 99 %. At the same time, the filter dimensions are smaller than those of a bag filter and an electrofilter with the same performance [8].

Thus, many methods have been developed in order to purify the air from aerosols, but only a condensation-type filter had the best result with the greatest effect.

The nephelometric method turned out to be the most accurate method of detecting aerosols in the atmosphere. It is versatile and highly sensitive, and also provides an opportunity to quickly find artificial chemicals.

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УДК 646.04

EMOTIONAL INTELLIGENCE AS ONE OF THE COMPONENTS OF QUALITY MANAGEMENT OF HOTEL SERVICES

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Abstract. The paper considers the concept of emotional intelligence and its impact on the satisfaction of guests with the hotel services, considering the service provided by the staff. The importance of developing soft skills in communicating with the client and maintaining stable relationships in the team, leading to the effective operation of the entire hotel business enterprise, is noted.

Keywords: emotional intelligence, quality management, hospitality industry, guest satisfaction, service.

ЭМОЦИОНАЛЬНЫЙ ИНТЕЛЛЕКТ КАК ОДНА ИЗ СОСТАВЛЯЮЩИХ УПРАВЛЕНИЯ КАЧЕСТВОМ ГОСТИНИЧНЫХ УСЛУГ

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Аннотация. В работе рассматривается понятие эмоционального интеллекта и его влияние на удовлетворенность гостей предоставляемыми гостиничными услугами с учетом сервиса, оказываемого персоналом. Отмечается важность развития гибких навыков при общении с клиентом и поддержания устойчивых взаимоотношений в коллективе, что приводит к эффективной работе всего предприятия гостиничного бизнеса.

Ключевые слова: эмоциональный интеллект, управление качеством, индустрия гостеприимства, удовлетворенность гостей, сервис.

Nowadays, many services have become so standardised that it is difficult to see the difference between the offers of different companies, as well as to find a priority, trustworthy and willing to return organisation. In the hospitality industry, this issue is particularly relevant, as it is completely permeated by service, which determines the loyalty of consumers and their choice of place of stay. According to Rosstat data, in 2022, the number of collective accommodation facilities totalled 29547 units, which is 1,473 hotels more than in pre-pandemic 2018 (Figure 1) [1].

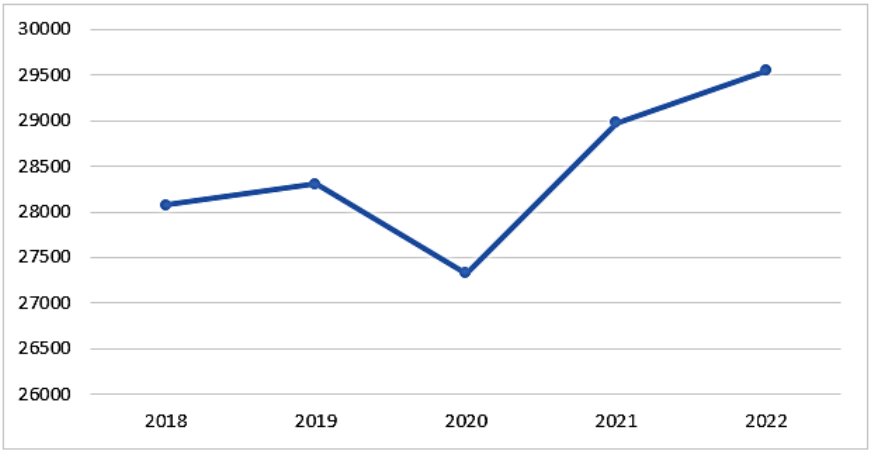


Figure 1. Dynamics of the number of collective accommodations over the last 5 years

Competition for consumers is growing, and not everyone can afford costly competitive advantages that influence the perception of the quality of hotel services, for example: introduction of innovations, renovation of design interiors, introduction of loyalty systems, additional or related services. Then the personal contact of the staff with the guests, which determines the emotional background of interaction and satisfaction with the accommodation, comes to the forefront of the quality management of services provided by accommodation facilities. The purpose of the work is to consider the impact of emotional intelligence of employees on the quality of hotel services and to propose recommendations for its development. The tasks were set to determine what emotional intelligence includes, for which employees it is necessary and how to develop it. In the course of the research it became clear that without emotional intelligence, interaction with guests and within the team is hampered by misunderstanding and lack of adaptability. Accordingly, the quality of the service provided will decrease and the consequence will also be a reduction in loyalty, on which the successful functioning of the accommodation facility depends. In such a case, no matter how luxurious and comfortable the hotel may be, if there is an emotional strain, the guest will prefer another, less expensive, but disposable place.

Emotional intelligence in hospitality is a skill set that tends to improve and includes primarily empathy, the ability to maintain a favourable emotional background and a keen understanding of guests' needs. It has such a strong influence on the image and reputation of the hotelier's business that it is considered to be one of the factors of quality management of hotel services along with safety management, service management and compliance with the declared category. In general, quality management is a certain list of activities aimed at maintaining and improving the quality of services provided on the basis of continuous analysis of hotel performance indicators. As a rule, managers use quantitatively measurable indicators: occupancy, profitability, etc. However, it is worth noting that regardless of the stars and their number, attention should be paid to developing not only material equipment and finances, but also the emotional intelligence of employees. It is when a guest will describe the service at a hotel as not just good, but great, when expectations of service delivery are exceeded through the skilful application of staff's ability to communicate,

care and build long-term relationships. And these are not the only components of emotional intelligence. These include awareness of one's strengths and weaknesses and the ability to cope with them, the ability to remain flexible in any, even the most critical situation, to be empathic, the ability to work in a team and neutralise misunderstandings and conflicts [2]. It is not easy to assess such qualitative characteristics, but by analysing reviews on the website or in social networks, implementing service standards, using a point system of guests' impressions on electronic boards at the reception, in mobile applications of hotels, in the rooms themselves or periodically inviting "secret" guests, it is possible to draw conclusions about the work of the staff.

Emotional intelligence is often underestimated in hiring, with so-called hard skills in management, data analysis, working with cash registers, etc. coming first. However, the Four Seasons chain has long noted that "only empathetic and self-aware employees will be able to ensure sustainable and competitive brand development in such a fiercely competitive market" [3]. Indeed, human capital is aimed at maintaining the image of the hotel, so training of employees in guest relations should be carried out everywhere. This should be initiated by the manager of the organisation because it is he or her who forms the team spirit and influences healthy relations in the team. Why is it important to develop emotional intelligence not only for those who are constantly in direct contact with guests? The empathy of a manager allows him or her to sense deviations in the work of subordinates, to individualise the issue of motivation in ways that will satisfy a particular employee. Satisfaction with the team atmosphere encourages employees to maintain a high level of interaction with guests. To do this, they need to hone the skills required by service standards, including resolving disputes and dealing with guest dissatisfaction. The first point of contact for guests is with the reception team. They represent the face of the hotel, i.e. they reflect the attitude of the whole organisation towards the guests. It is most important for the reception staff to show interest in the guest, to greet with a smile, to give signs of attention, to use positive phrases, to listen actively, to try to solve a problem before it is indicated, to offer additional services tactfully and to be as knowledgeable as possible about what is going on in the hotel. Despite high traffic and fatigue, staff with high emotional intelligence scores remain energetic and have the ability to sense each person subtly, even on a non-verbal level. Facial expressions, gestures, tone of voice, posture, gait – these are changing factors that are signals for staff to read the mood and emotions of the guest. Everyone has days when things go wrong and moods change, so it is necessary to understand and empathise with the person's behaviour, to sincerely assist in resolving issues, if it is within the area of responsibility of the accommodation facility. With employees offering help in resolving different situations and inspiring people to come back again, the emotional intelligence of the organisation increases which results in more positive feedback and a higher level of guest loyalty to the hospitality company.

How to help staff develop emotional intelligence? Conducting trainings will stimulate the practice of controlling their feelings and states, because based on this, the definition of emotions of others is formed. The most effective exercise is to stand in the guest's shoes and consider the situation from his or her side. In this way it is

possible not only to find a solution to one problem, but also to look at all the processes taking place in the hotel from a different angle and to draw lessons that help to develop algorithms of behaviour in similar situations. The next thing that can be useful for a better understanding of people is to take into account the interests of the guest, contributing to the emphasis on him/herself, because he/she needs to understand that he/she occupies a primary position in the busy hotel life. As Caesar Ritz bequeathed, “Never say ‘no’ to a customer’s request, even if they ask you to get the moon. You can always try to do it.” In addition, the main reason to fulfil a guest’s request and remove the cause of dissatisfaction lies in the satisfaction of their expectations. The SERQUAL methodology can be used to assess the degree of quality of a hotel or any other service [4]. The impressions received by the guest are compared with his/her ideas about how his/her stay at the hotel should have been, what the service should have been like. Positive ratings according to the criteria highlighted by this methodology depend on emotional intelligence. These include: reliability of service, promptness, confidence, empathy and external elements. It is noticeable that the behaviour of staff, their involvement in the guests’ lives and their ability to communicate well are a significant part of this methodology. It turns out that the service sector is dominated by the notion that people make all the difference. Indeed, recruiting and training employees must be approached with great care. Moreover, in a study by the Harvard Business Review [5] it is noted that only 5 % of the team (Figure 2) could always work perfectly without additional control, which, when considering the overall picture of the enterprise functioning, negatively affects the efficiency of hotel services and relations with guests.

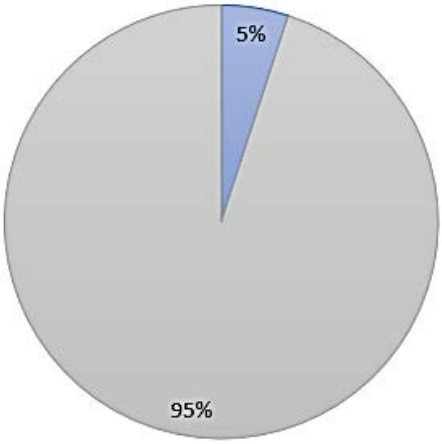


Figure 2. Percentage of employees who do not need additional supervision to work effectively

Performance depends on the motivation of personnel, supported by tangible and intangible incentives from management. Here again, the ability to read a person’s wants and needs plays a major role in determining the conditions under which the employee will feel comfortable to develop, contributing to the achievement of the firm’s goals.

So, guest satisfaction in the hospitality industry depends on the responsiveness and empathy of the employees from the reception desk to the management who indirectly influence the guests by forming favourable relationships within the team. In

a team where emotion is valued and a culture of understanding is prevalent, staff will be more willing to work. The lack of rigid standards applied to guest issues will allow staff to be creative in resolving incidents, fostering the flexibility of thinking and personalisation that guests value. The success of a collective accommodation facility, its reputation and the quality of the hotel services provided are inextricably linked to these concepts, as it is interpersonal relationships that build the service that best meets the needs of consumers. Emotional intelligence becomes a tool for finding an approach to each guest and the ability to hear and understand them. And guests' decisions to return or recommend a hotel are driven by their emotions about their stay. It turns out that hoteliers who contribute to employee training, increasing employee empathy and thus improving service quality, increase the value of the hotel product itself.

In conclusion, I would like to emphasise that the quality of services provided in hotels of different classes depends not only on the material component: rooms, equipment, design, but also on the intangible component: service. The service that an accommodation facility offers to its guests starts with the top management, which determines the standards and friendly atmosphere in the team. It is aimed at maintaining long-term relationships with guests, creating favourable living conditions and preventing conflicts. The availability of programmes for emotional development of the team determines the success of the entire hospitality enterprise.

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УДК 336.71

CRYPTOCURRENCIES AS AN INVESTMENT OBJECT

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Abstract. Nowadays, fast cryptocurrency market development attracts many participants from around the world due to high volatility and lower transaction costs in comparison to the traditional financial market. There are not only professional traders but also individual investors who prefer long-term investments expecting further development and the growth of the leading cryptocurrencies and the entire market.

Keywords: bank, blockchain, security, protection, cryptocurrency, technology.

КРИПТОВАЛЮТЫ КАК ОБЪЕКТ ИНВЕСТИЦИЙ

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Аннотация. В настоящее время быстрое развитие рынка криптовалют привлекает множество участников со всего мира из-за высокой волатильности и более низких транзакционных издержек по сравнению с традиционным финансовым рынком. Есть не только профессиональные трейдеры, но и индивидуальные инвесторы, которые предпочитают долгосрочные инвестиции, рассчитывая на дальнейшее развитие и рост ведущих криптовалют и всего рынка.

Ключевые слова: банк, блокчейн, безопасность, защита, криптовалюта, технология.

Money is an essential part of human society being a specific product of maximum liquidity, which is the universal equivalent of the value of other goods and services. The development of money is closely linked with the development of all human civilization. Products, weapons, coins of various types from bone to gold, paper banknotes and stocks are only a small part of what has been used as money.

With the development of information technology and communication networks, the world has entered the era of electronic money. Plastic payment cards are gradually replacing coins and banknotes, and there are many payment systems on the Internet that have been originally created only for electronic payments, such as PayPal or Google Wallet. Recently, many central banks have started to issue digital currencies that are fiat money but in a digital form.

Money is anything that is customarily accepted by parties engaged in a transaction of a financial arrangement. The definition of money that is generally

accepted requires money to fulfill its main functions that are a store of value, a medium of exchange and a unit of account [1].

At each stage in civilization development, money has evolved becoming more functional, adjusting to growing needs and solving miscellaneous tasks more effectively. Money has become the main tool in such important processes as trade, savings, lending, investment, regulation, etc. The currencies issued by states have also become a key mechanism of control and management both within countries and internationally.

The concept of a decentralized payment network proposed by Satoshi Nakamoto is different from the old solutions, so that its improvement will take some time. Freedom of movement, communication, etc., which recently seemed utopian, today have become a reality, directly or indirectly improving the lives of everyone. The main value of cryptocurrency is that it provides a higher degree of freedom of personal finances. The widespread of this technology will lead to a series of significant changes in many areas [2].

Recently emerging innovative technologies have allowed creating alternative money, cryptocurrency, which can become a global independent tool. Because of their decentralized nature, cryptocurrencies do not need any permission and can work everywhere, but the question of their large-scale use is more a social issue than a technical one. People need to learn about the alternatives that appear and not be afraid to use them. Awareness of alternatives is the first step towards its spreading, and broad discussions facilitate this [3].

Bitcoin can be described as an electronic payment system that uses its own currency with a limited emission and operates through its protected decentralized network. The Bitcoin network automatically verifies transactions, while security and reliability are ensured by the use of cryptography and modern information technology.

Before the advent of Bitcoin, the performance of all payment systems was based on the force of the central trusted authority (bank, payment service, etc.), opening an account for clients and certifying all their operations. Thus, in the banking system, transactions are executed when they are confirmed, secured and executed by banks. At the same time, users are completely dependent on both the banks themselves and all the higher organizations. Money in the banking system can be tracked, blocked, withdrawn, eroded by inflation, etc.

The situation is different with Bitcoin. Its technology allows refusing transaction assurances by intermediaries, all transfers are checked and authenticated by the Bitcoin network itself, which functions in a distributed way. The Bitcoin system does not belong to anyone, its users are equal, and the program code is open and publicly accessible, which guarantees independence, fairness, and security.

In Bitcoin blockchain, there is a data structure in which each non-leaf node is a hash of its previous nodes that is called the Merkle tree. Each transaction at the bottom level has a node containing its hash value. Blocks are grouped in pairs and hashes are stored a level up the tree [3].

When making transactions, an addressee receives the hashed message and decrypts it with the usage of the algorithm and receiving the hash. The message is only confirmed in case that hash is the same as the original one and can not be dehashed after being received and confirmed. This process guarantees that the addressee will receive the necessary message.

In order to confirm transactions and reach a consensus, Bitcoin blockchain applies proof-of-work (PoW) algorithm that is used in mining. The idea behind this method is that blockchain network nodes perform complex calculations that are checked by other nodes. The first node that has accomplished calculations, get a reward from the network. All nodes compete among themselves to receive the reward first increasing the capacity of computing resources. The main drawback of PoW is high energy costs as a huge number of nodes make computations, but the only one node receives the reward [4].

Another widely used consensus in blockchain networks is Proof-of-Stake (PoS). This algorithm means that blocks are confirmed according to the stake of the users who randomly choose a node that has a greater amount of resources, such as coins, and according to the age of the coins. Validators are determined not by their computational power, but a cryptocurrency investment. For the creation of the block itself, the node does not receive a reward that is paid for the transaction.

The main advantages are significantly lower costs for electricity consumption in comparison to the Proof-of-Work consensus, promotion of honesty, and a decrease in validators' fraudulent behavior. The disadvantages are the possible concentration of funds and network centralization due to the fact that those participants who hold more tokens have more favorable conditions.

Bitcoin is the first digital currency that is created to be transferred to the other party without any intermediaries who could approve or deny a transaction over the Internet. The digital asset does not have to be moved through one or several banks via debits and credits of the third party. It is possible to not simply transfer cryptocurrency, but make payments with it. Thus, there is an opportunity to use it as a medium of exchange.

A mass of cryptocurrencies, and primarily Bitcoin, performs effectively as a speculative investment. Having started with zero, many cryptocurrencies have increased significantly over the years. Each Bitcoin is worth a few thousands of dollars today in comparison to a price of zero in 2008 when it has been created. Other prominent cryptocurrencies have appreciated in value as well.

However, it is not that attractive to store value of assets transferring all the savings into cryptocurrency due to its instability and high price volatility compared to fiat-based currencies. For a good investment, it is crucial to buy the currency at the right time, but as a credible store of value, it is still controversial.

In the coming years, there can be an increase in investments in digital tokens and a rise of institutional investors in this market. As a result, cryptocurrency expects long-term and steady demand and a further appreciation respectively. One more advantage

of investing in cryptocurrency is that it is possible to start to invest with small amounts of money and in case of proper storage no one can take it away.

The cryptocurrency market seems spontaneous and unanticipated; nevertheless, any of its fluctuations can be explained by different factors. Cryptocurrency analysts study the nature of cryptocurrencies and predict the behavior of trends. Two powerful instruments that are useful in the conventional stock market are fundamental and technical analysis [2].

There are new cryptocurrency based financial instruments that have been developed and influenced the market. The biggest increase that has occurred on the market is 219 % change of Bitcoin price from $6,286 to $20,089 reached in 35 days. The reason was the news about the possible launch of bitcoin futures by Chicago Commodity and Options Exchanges. It was launched in December when almost simultaneously Bitcoin reached its historical peak. After that, the price started to decline and in 5 days it decreased by 35 % to $12,831. As soon as information flow declined, the cryptocurrency and the market fell as well [4].

Ethereum is the second largest cryptocurrency according to the market capitalization data. It is a relatively new cryptocurrency launched in 2015. There is a huge gap in capitalizations of Ethereum and Bitcoin, whose indicator is about 5 times bigger. Ethereum is built on a different technology rather than Bitcoin. While Bitcoin has been developed as a currency that can be used as regular money, Ethereum is also a platform and programming language that can be applied to construct and launch unstoppable applications and run smart contracts. Ethereum has succeeded as an asset and became the largest altcoin on the cryptocurrency market.

As the market is still young, there is no common approach or a strategy of cryptocurrency analysis that would work effectively in all of the cases and be relevant in different market conditions. Any news or unsuccessful partnership of a project can completely change the situation making it complicated to predict the future. Therefore, investors should continuously revise and analyze market information in a comprehensive manner [5].

Any distinctive characteristics of a coin can help investors determine the real value of the particular cryptocurrency. There are such indicators as the market capitalization, reliability of the technology and its potential to solve existing problems, qualification of a team, economic features, the maximum volume of supply, the issue parameters, the speed of block generation, average commissions, mining opportunities, trading volume, and price volatility.

Cryptocurrencies have the potential to develop and serve the basic functions of money such as a unit of account, a medium of exchange, and a store of value. As of today, they can probably become a more effective tool as a medium of exchange and attract businesses to implement this innovative technology in their daily activities. However, as an investment instrument, it has to improve and mature becoming more predictable and stable.

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УДК 62

CHRONIC SHORTAGE AND IMMINENT ABSOLUTE DEPLETION OF MINERAL RESOURCES. WAYS TO SOLVE THE PROBLEM OF EXHAUSTION

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Abstract. This article discusses the phenomenon of depletion of mineral reserves and raw materials. Special attention is paid to its causes, consequences and potential solutions. Emphasizing the urgency and importance of solving the problem of mineral depletion, this article aims to raise awareness of this problem and optimize actions for the sustainable management of mineral and raw materials resources.

Keywords: resource, minerals, scarcity, mineral resource base, agriculture.

ХРОНИЧЕСКИЙ ДЕФИЦИТ И НЕМИНУЕМОЕ АБСОЛЮТНОЕ ИСТОЩЕНИЕ МИНЕРАЛЬНЫХ РЕСУРСОВ. СПОСОБЫ РЕШЕНИЯ ПРОБЛЕМЫ ИСТОЩЕНИЯ

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Аннотация. В данной статье рассматривается феномен истощения запасов полезных ископаемых и сырья. Особое внимание уделяется его причинам, следствиям и потенциальным решениям. Подчеркивая актуальность и важность решения проблемы истощения запасов полезных ископаемых, данная статья направлена на повышение осведомленности об этой проблеме и оптимизацию действий по устойчивому управлению минеральными и сырьевыми ресурсами.

Ключевые слова: ресурс, полезные ископаемые, дефицит, минерально-сырьевая база, сельское хозяйство.

Mineral resources play a key role in modern society, providing the basis for the development of industry, energy and agriculture. They represent subsurface use, including minerals such as metals, oil, gas, coal, as well as mineral salts and stones. The importance of these resources for humanity cannot be overestimated, since they are an integral part of economic and social progress. Mineral resources serve as the basis for the production of a wide range of goods and services that meet the needs of modern society. Metals are used in construction, automobile manufacturing, electronics and other industries. Oil and gas are the main sources of energy, providing fuel and electricity production. Coal is used for the production of electricity and fuel, as well as in the metallurgical industry. In addition, mineral salts and stones are widely used in the chemical industry, agriculture and medicine.

With the growth of the population and the industrial development of the world community, an increasingly acute problem of chronic shortage and depletion of mineral resources arises. In this regard, leading economic and environmental experts draw attention to the need to study the causes and consequences of this problem. Scientists analyze and look for solutions to ensure further sustainable and productive development of society.

Let's consider the main causes of the problem of depletion of mineral resources.

– One of the main reasons is related to the natural depletion of deposits as a result of mining. Some resources are limited and non-renewable, such as oil and natural gas. Gradually, these reserves are exhausted, which leads to their shortage.

– With the development of technology and the increase in the world's population, the demand for mineral resources is constantly growing. Therefore, the growth of demand for resources also causes a shortage. Overall economic growth globally leads to higher use of energy and materials, which exacerbates the problem.

– The problem of the shortage of some minerals is due to the fact that different deposits are formed in different geological settings, and their distribution in the earth's crust is extremely uneven. Therefore, there is not a single state in the world that provides itself with all kinds of minerals. The natural solution to this problem for many centuries has been import. As the distance between the regions of extraction and processing increases, the time required for the delivery of raw materials to production increases. An increase in processing time may also affect the quality of the final product.

– International competition in the field of mineral resources is another problem associated with their shortage. The increasing demand for mineral resources causes competition between countries. More developed countries with stronger economies may have an advantage in access to resources, which may create a deficit for less developed countries [1].

The problem of scarcity has been raised with particular urgency and continues to be discussed in relation to non-renewable resources – a wide range of mineral raw materials concentrated in the earth's crust. It is necessary to pay special attention to the causes of scarcity in order to avoid "resource waste", as it was in the XIX and XX centuries. Humanity did not care about the preservation of natural resources. This led

to the energy crisis of the seventies, when gasoline simply ran out in many countries, and in particular in the USA. As a result, it is necessary to understand what consequences may be due to irrational extraction, use and processing of resources.

The consequences of depletion of mineral resources can be catastrophic. They include a sharp deterioration in economic stability, loss of jobs, an increase in prices for goods and services, and a deterioration in the quality of life.

1. Economic consequences. The depletion of resources leads to an increase in their prices, as well as a decrease in productivity. This makes serious changes in the state of the economy, as rising prices for resources lead to a reduction in the number of consumers, which can lead to a decrease in economic activity. In addition, dependence on the supply of resources from other countries creates vulnerability for the national economy.

2. Social consequences. Depletion of resources can lead to changes in the structure of the population, a decrease in the quality of life and an increase in poverty. Reducing the amount of necessary materials leads to a decrease in the number of jobs and, as a result, to an increase in unemployment. Small groups of people benefit from the exploitation of the remaining resource, while a huge number of people remain unemployed and with deteriorating living conditions.

3. Environmental consequences. The depletion of resources leads to the destruction of ecosystems and a decrease in biological diversity. For example, deforestation, which is a source of wood, leads to a significant loss of housing for animals and disrupts the biological balance (Figure). It is also extremely important to remember that not all resources can be replenished in the possible time due to global consumption. Thus, we can experience real prosperity, but we will not be able to stay in this position for a long time.

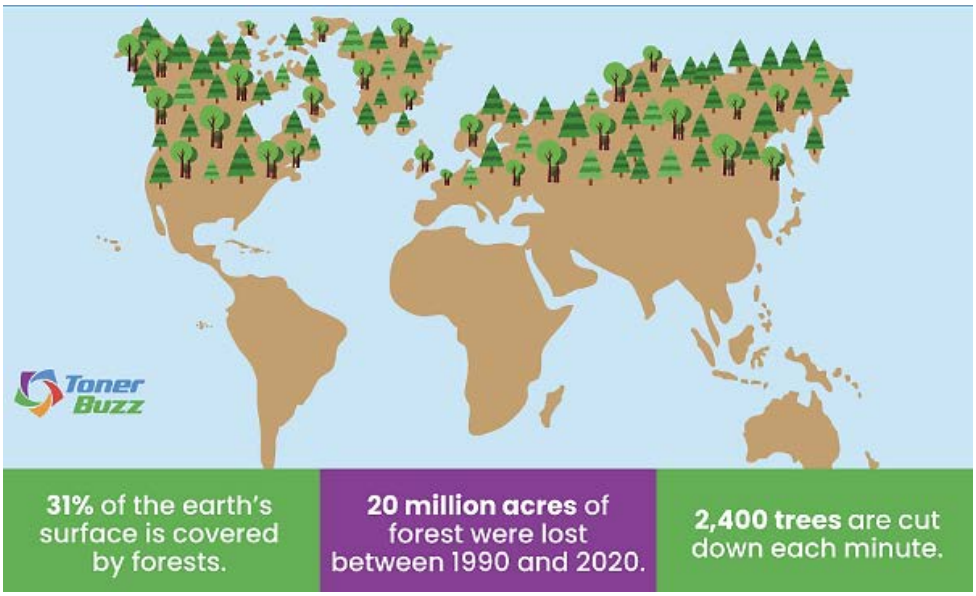


Figure. Global deforestation facts

4. Geopolitical consequences. Intensive use and depletion of resources can lead to conflicts between countries and peoples who are fighting for the right to access

resources. This can lead to armed conflicts between countries and threaten the world peace as a whole [2].

Uncontrolled depletion of natural resources can eventually lead to the complete depletion of the Earth's resources. To prevent these consequences, it is necessary to modify the systems of mining and their use.

Modification of the system of distribution of licenses for environmental management. A license in natural resource law is a document according to which a legal entity or an individual entrepreneur is provided with access to state property – subsoil. It certifies the right of its owner to use a subsoil plot within certain boundaries in accordance with the purpose specified in it within a specified period, subject to the owner's compliance with pre-agreed conditions. Often, these conditions are not met by the owners, in addition, the currently existing auction system for obtaining a license is such that the main applicant is a legal entity offering the highest amount of a one-time payment for the right to use a subsoil plot. However, this practice is incorrect in the sense that license areas may fall into the hands of subsoil users who grossly violate the terms of the license agreement in order to maximize profits and other purposes. As a result, over 250 licenses were revoked in 2004 and 2005 alone. It is necessary to legislate the existence of a field development program for the applicant for a longer period – more than 5 years. This will allow the state, as the owner, to provide the subsoil to an effective tenant who is interested not only in a quick return of invested funds, but also in a more rational use of the subsoil in the extraction of minerals. As a consequence, it is necessary to introduce strict control over the use of resources: the introduction of economic mechanisms to stimulate consumption reduction and interaction between the state, business and the population for the joint development and implementation of sustainable resource management strategies [3].

Modification of methods of enrichment and processing of minerals. Among the new processing methods, we can single out the disintegration of mineral complexes – the most energy-intensive operation in the processing technology. It consumes up to 10 % of all electricity generated in the world. Therefore, the most important task is to reduce the energy consumption for crushing and grinding ores. Consider the technology of ore preparation: coarse-grained and lumpy materials are separated by traditional methods of gravity enrichment – separation in heavy suspensions, deposition, concentration in liquid flows, etc. For the separation of fine materials, research and practice have shown the prospects of using centrifugal separators of various types. Centrifugal concentrators, which have a large specific capacity at a high degree of concentration, are widely used [4].

The development and implementation of new technologies in the extraction and processing of minerals can significantly increase their efficiency and reduce their consumption.

Integrated waste recycling, one of new technologies, plays a key role in the conservation of minerals. Today's state policy is focused mainly on obtaining material and social rents from the extractive industry and raw materials exports, as a result of

which legislative initiatives aimed at ensuring real resource conservation and proper waste processing are blocked [5].

There are also a lot of eco-friendly and economic recycling methods. For example, for the processing of plant raw materials, it is proposed to use explosive autohydrolysis – a process in which a mixture of crushed biomass with water is first heated under pressure, and then this pressure is sharply reduced. As a result, an explosion occurs that destroys the structure of wood, decomposing it into cellulose, lignin and hemicellulose. Scientists note that explosive autohydrolysis is an environmentally safe method, since it does not require the use of chemicals. And although in the world this technology is used mainly in the processing of waste from the woodworking industry, this process has been adapted to the processing of agricultural waste.

For example, CMG company together with advanced scientists have developed a unique technology for solid waste recycling. The uniqueness of this technology is that garbage incineration does not occur at all. The new method of catalytic pyrolysis, patented in 2013, provides the possibility of complete, 100 % recycling of solid waste without careful sorting. Valuable commodity products of high quality and secondary raw materials are obtained from waste. Based on the method, a unique type of recycling complex is created. This technology makes it possible to recycle waste accumulated at existing and closed landfills for solid waste disposal [6].

Of course, we should not forget about the coverage of the problem: it is very important to raise awareness in the field of environmental history and resource consumption policy. This can help reduce excessive resource consumption and promote sustainable consumption and production. In general, in order to prevent the complete depletion of the Earth’s minerals, it is necessary to implement sustainable and rational use of resources, improve extraction and processing technologies, develop alternative sources of energy and materials, and promote the development of recycling systems.

Minerals are an essential resource for the functioning of modern societies. However, their use is so rapid that resources are becoming increasingly depleted and their shortage is becoming a chronic problem. The importance of this problem cannot be underestimated, as it can lead to negative consequences for the economy, the environment and society as a whole.

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УДК 330.34

ANALYSIS OF ESG STRATEGY IMPLEMENTATION BY BELARUSIAN BANKS

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Abstract. The article discusses the analysis of ESG strategy implementation in Belarusian banks and explores the key areas in which these strategies are being implemented. It highlights banks that are actively adopting CSR initiatives. The paper also examines the challenges faced in implementing the ESG concept within the Belarusian banking sector and concludes by discussing the future prospects for ESG development.

Keywords: ESG, banks, ecological aspects, social aspects, governance aspects, CSR initiatives.

АНАЛИЗ ВНЕДРЕНИЯ ESG-СТРАТЕГИИ БЕЛОРУССКИМИ БАНКАМИ

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Аннотация. В статье представлены результаты анализа внедрения ESG-стратегий в белорусских банках и рассмотрены основные направления их реализации. Выявлены банки, которые наиболее активно осуществляют КСО инициативы. Обозначены препятствия, затрудняющие внедрение концепции ESG в банковской сфере Беларуси, а также сделан вывод о будущем развитии ESG.

Ключевые слова: ESG-стратегия, банки, экологические аспекты, социальные аспекты, аспекты управления, инициативы КСО.

Introduction. Nowadays, the world is going through a period of severe turbulence. Recovery from the COVID-19 pandemic, economic instability and social tensions in different regions of the world are adding complexity to the fragile global landscape. Despite challenges the planet faces at this moment, the topic of sustainable

development continues to be relevant. Sustainable development is an integral part of our future, as actions taken today have long-term consequences for the entire planet.

Main part. The most influential stakeholder that impacts the economy, society and the environment is Business. Therefore, it is important for companies to develop, considering ecological, social, and governance factors. Organizations should strive to minimize their negative impact on ecology and adhere to current societal values. To achieve these goals a lot of companies implement Environment, Social, Governance (ESG) strategy. The main goal of implementing an ESG strategy is to achieve a harmonious equilibrium between profitability and environmental sustainability, social responsibility and efficient governance. By doing in that way, companies can not only thrive in today's society but also generate benefits for their stakeholders and broader community [1].

In accordance with Bloomberg Intelligence's ESG 2021 Midyear Outlook report, ESG assets are projected to surpass $50 trillion by 2025, accounting for over one-third of the estimated $140 trillion total global assets under management [2]. It is worth noting that nowadays investment funds demonstrate a preference for investing in companies with strong positions in ESG ratings

Belarusian companies are also embracing the trend of sustainable business development and incorporating ESG strategies into their operational activity. Conceptually, all Belarusian companies with a developing ESG strategy can be divided into 3 groups: companies with foreign capital ownership (A1, Alivaria, Coca-Cola), banks (Belarusbank, Belinvestbank, Sberbank) and other companies [3]. The banking sector, as a vital infrastructure component of the economy, possesses the potential to act as a catalyst for the advancement of these ESG principles among clients.

In 2006 MTBank took a significant stride towards integrating the ESG concept into Belarusian banks' operations when the bank became the first one to sign the UN Global Compact. Five Belarusian banks have already committed to implement measures to support the attainment of the SDGs and align with the 10 principles of the UN Global Compact [4].

According to BIK Ratings' survey "Implementation of ESG standards by banks in Belarus", in 2023 the majority of banks in Belarus (77 %) have implemented ESG principles in their operations. It is highlighted that the most active promotion of ESG principles is carried out by foreign banks and banks that continue to operate in foreign markets [5].

To ensure comprehensive awareness of all stakeholders, most large banks are publishing non-financial reports (46 %), receiving ESG ratings (BSB Bank, Sberbank, BNB-Bank), and have or develop strategic documents related to sustainable development. Almost half of the surveyed banks (46 %) pointed out the existence in their structure of a department or a person who is responsible for the implementation of ESG strategy. In most cases, the communication or marketing department (or a functionally similar unit) acts as such a department, indicating that the ESG agenda is viewed primarily as part of the reputational agenda.

As part of the environmental aspect, the most urgent and significant issue for banks is the organization of separate collection and environmentally safe disposal of

bank waste (85 %). Nevertheless, it is noteworthy that only 2 out of 13 surveyed banks (15 %) assess their carbon footprint and have a strategy to reduce it.

As for social aspect, banks emphasize the relevance of such traditional topics as labor protection (100 %) and human rights (92 %). However, gender equality (62 %) and inclusion (46 %) are considered less relevant topics at present for Belarusian banks.

What concerns corporate governance, the Belarusian banking sector is firmly associated with a high level of this aspect, which is achieved, particularly, through extensive government regulation. All respondents of the survey have a code of business ethics (100 %), and an anti-corruption policy is present among almost all (92 %) Belarusian banks.

The authors of the article conducted an analysis of Corporate Social Responsibility (CSR) initiatives by major Belarusian banks in 2022-2023, which is presented in the Figure.

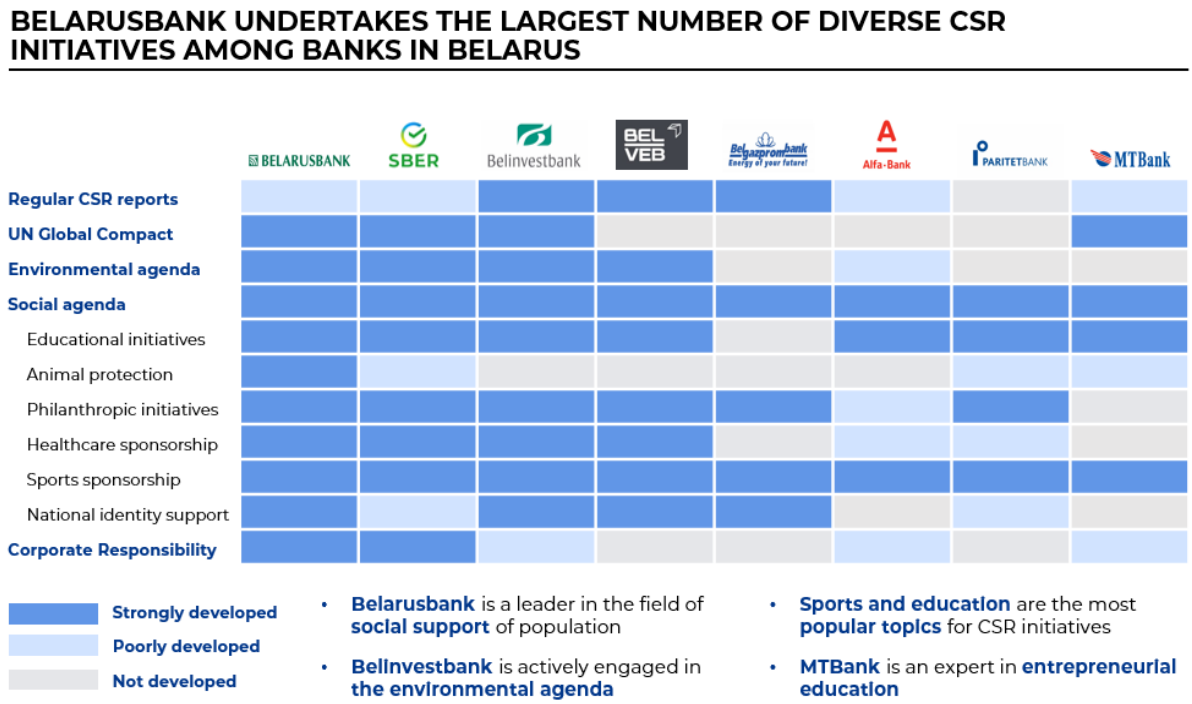


Figure. Analysis of CSR initiatives by major Belarusian banks

Among banks in Belarus, Belarusbank stands out for its extensive range of diverse Corporate Social Responsibility initiatives, undertaking the largest number of such initiatives compared to other banks in the country. Examples of Belarusbank CSR initiatives include organizing a charitable night run event “Belarusbank Museum Run” and supporting project for orphaned children “Parent’s home” [6].

As for main barriers of implementation ESG strategy by Belarusian banks, there are the absence of material and financial resources, lack of ESG competencies and a shortage of necessary specialists. In addition, experts note that a significant barrier to the development of the ESG concept in Belarus is the insufficient presence of a well-defined national agenda (including standards, methodologies, recommendations, and incentives) designed to promote ESG practices at the country level [7].

Conclusion. The majority of banks in Belarus have already implemented or plan to implement ESG principles in the near future. Social and governance factors in ESG agenda are considered as the most relevant. However, for further extensive development sustainable principles in Belarusian banking sphere, there is the need for government regulation of rules and methodologies in the field of ESG.

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УДК 621.31

THE USE OF BLOCKCHAIN TECHNOLOGY IN THE ELECTRIC POWER INDUSTRY

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Abstract. This article discusses the possibility of using blockchain technology in the electric power industry. The main features and advantages of blockchain technology are also described. An analysis of the experience of using blockchain technology in other countries is carried out.

Keywords: blockchain, electric power industry, open blockchain model, closed blockchain model, P2P network, features of blockchain technology.

ИСПОЛЬЗОВАНИЕ ТЕХНОЛОГИИ БЛОКЧЕЙН В ЭЛЕКТРОЭНЕРГЕТИКЕ

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Аннотация. В данной статье рассматривается возможность использования технологии блокчейн в электроэнергетике. Описываются также основные особенности и преимущества технологии блокчейн. Проводится анализ опыта применения технологии блокчейн в других странах.

Ключевые слова: блокчейн, электроэнергетика, открытая блокчейн-модель, закрытая блокчейн-модель, P2P-сеть, особенности технологии блокчейн.

Introduction. To date, there are a number of problems and shortcomings of the electricity metering system in the electric power sector. According to Rosstat, annual electricity metering losses are about 10 %. On a national scale, these are very large economic losses that need to be reduced.

Also, there is a problem of increasing the cost of services, and as a result, the debt of the population. In addition to all of the above, there are a large number of intermediary companies between the consumer of electricity and its producer. Because of this, we have considerable transaction costs and the opacity of all operations.

Blockchain has attracted attention in academic circles and industry due to the fact that it helps to guarantee the validity of transactions by recording them not only in the main register, but also in a distributed system of registers, all of which are connected. Blockchain technology enables the parties to reach an agreement on a common digital record. And all this is achieved without the participation of third-party intermediaries. Blockchain technology can fit well in sectors where there is no physical exchange, such as the financial, banking and insurance sectors. In them, the "blockchain" can provide reliable transaction records without a specific tangible product. However, of the sectors with physical exchange, it is the electric power sector that is more suitable for technology integration.

In this industry, different countries, depending on the tasks they set for themselves, can use the "blockchain" for different purposes:

1. Distributed generation.
2. Creation of an accounting system.
3. Transaction billing.
4. Creation of P2P platforms.
5. Assistance in the development of "green energy".

Blockchain technology. Blockchain is a distributed database consisting of a "block chain", block storage devices are not connected to a common server, the database allows you to control the reliability of transactions without the supervision of any financial regulators (Figure 1).

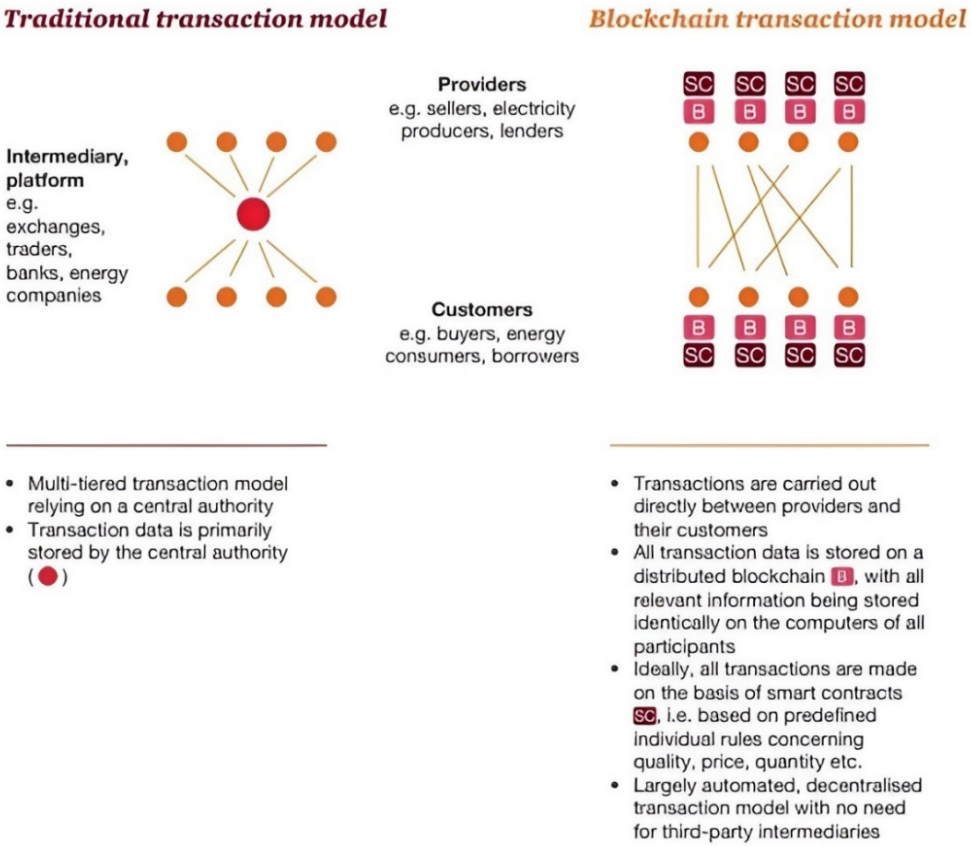


Figure 1. How the order of transactions changes due to blockchain technology

Transaction verification is carried out by the so-called miners – participants of the system, who confirm the authenticity of the actions performed, and then form blocks from transaction records. The registry is stored simultaneously by all participants of the system and is automatically updated at the slightest change. Everyone has access to information about any transaction ever made. Users act as a collective notary who confirms the truth of the information in the database.

The blockchain is a distributed and decentralized database formed by participants, in which it is impossible to falsify data due to chronological recording and public confirmation by all participants of the transaction network. The main feature of the blockchain is the use of mathematical calculation algorithms, and the exclusion of "man" and the human factor when making a decision by the system.

Blockchain technology is now being actively implemented in the financial sector of England, Japan, the USA, China and other countries. According to analysts, Frost & Sullivan, medicine, energy and industry are extremely promising for the introduction of blockchain. There are about 100 blockchain startups in these areas. In the energy sector, blockchain can solve such tasks as the organization of intelligent accounting systems at enterprises, as well as the creation of Peer-to-peer networks, where data is transferred between equal participants. Energy corporations like RWE Group, Siemens and GE are already cooperating with such blockchain startups as Slock.it and LO3 Energy [1].

Features of blockchain technology. Let's consider the main features.

– Security through asymmetric encryption. This is a more reliable and modern data protection and encryption system. This protection system has already shown its reliability in the financial sector and has become an integral part of the blockchain, as well as one of the main advantages of this technology. Nodes in the network can be divided into open and closed. An open node, if it is clearer to disclose this term, is the user's ID address. It is known to all nodes of this open network. A closed node is known only to its owner, it is also needed for self-identification, but other users do not have access to information about other nodes. The node, which is the sender, automatically encrypts the information using a "public key" and also produces a digital signature. After that, the information can be accessed by the rest of the nodes of this network. But only the recipient node can decrypt the transaction information using the private key.

– The possibility of decentralized system management**.** The functions of managing, financing and confirming transactions can occur without centralized decision-making – based on consensus.

– The data recorded in the blockchain cannot be changed, and any additions are made only in the form of new "blocks". Thanks to this, the system becomes more stable and reliable, and it becomes almost impossible to rewrite history "retroactively".

– The parties involved in the transaction may not resort to the help of an intermediary and interact directly with each other. As a result, the costs and time for the operation are reduced. Integration of smart contracts (smart, self-executing, program-coded contracts that are automatically executed upon the occurrence of agreed conditions), allows you to achieve a high level of automation of business processes, provided there is a technologically mature environment.

– Transparency of the information stored on the blockchain allows you to track the history of transactions in real time, which increases the level of trust (Figure 2).

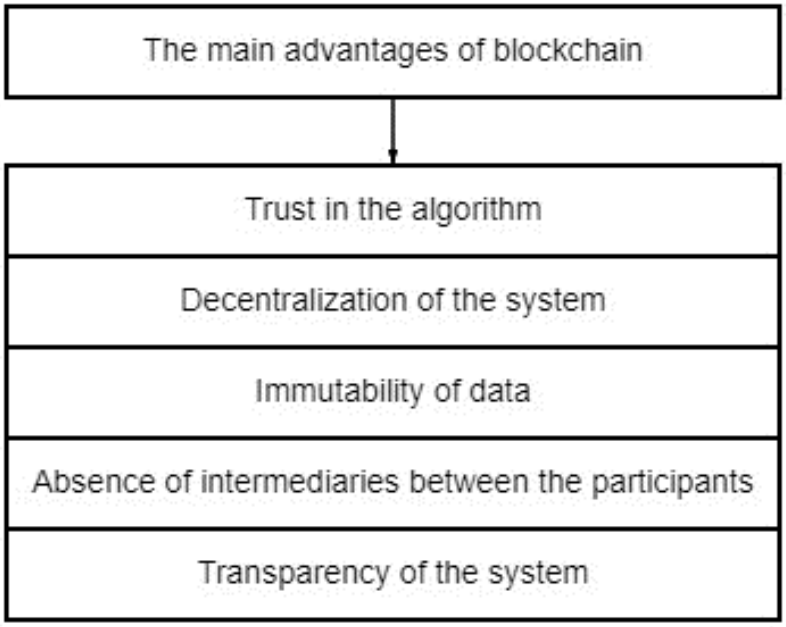


Figure 2. The main advantages of blockchain

Due to the features of open and closed nodes and their use, open and closed “blockchain models” have appeared [2].

Open and closed “blockchain model”. The open “blockchain model” is described in some detail above, so you can only consider the description of the closed one.

In order to protect their economic models, exchange operators, banks and other financial organizations use a closed “blockchain model”, since it is possible to redirect their customers to the block chain controlled by them. The use of blockchain makes financial organizations more efficient and profitable, due to the fact that all processes are automated.

Another advantage of closed “blockchain models” is that the rules by which the block chain works can be easily changed, which allows the operator to make a write-back in order to correct an error in the transaction after it appears in the system. In addition, in this model, the operator performs the functions of a central-controlling authority that verifies transactions. But from all of the above, it becomes obvious that many closed “blockchain models” no longer work according to the basic principles of the “blockchain”, since the possibility of outside interference and even changes by the operator after the data appears in the system is allowed. In this regard, closed “blockchain models” practically repeat the traditional systems of interaction between the consumer and the manufacturer. Both open and closed “blockchain models” may be suitable for the electric power industry. Everything will depend on the tasks that the industry sets for itself [3].

Blockchain in the electric power industry in 2023.

Innovative companies use different versions of block chains: from corporate to public. For example, the Energy Web Foundation platform runs on Ethereum and multi-signature wallets. As the global community strives for grid parity, the cost of renewable energy becomes equal to the price of traditional retail capacity and even happens to be lower. People generate their own electricity and can legally trade these capacities.

The Australian company Power Ledger has united communities with each other to create micro grids (groups of interconnected loads and distributed energy resources). These systems exist as a layer on top of the national structure. Many companies using blockchain in the energy sector imagine a future with larger and fully distributed peer-to-peer networks.

The use of blockchain in the USA. In Brooklyn, LO3 Energy has teamed up with Siemens to create a pilot microgrid using blockchain technology. Residents with solar panels can sell excess electricity to their neighbors through peer-to-peer transactions. Micro grids minimize energy losses during transmission (~5 % of the power generated in the USA is lost during transportation).

The company TransActive Grid has developed software that combines a meter and a computer, measuring the volume of production capacity and their consumption. Blockchain has allowed people to use alternative “green” energy. Previously, owners of photovoltaic panels (PV) could sell excess capacity to utility companies, but did not profit from it. The use of microgrids eliminated the intermediary, leaving manufacturers the right to independently control the generation of electricity. The Brooklyn Microgrid is an example of what changes blockchain is making in the energy sector.

The use of blockchain in Germany. PONTON’s German Enerchain 1.0 project, launched in May 2019, became the world’s first blockchain-based wholesale energy supplier. The company provides data transmission services to electricity sellers through decentralized platforms. Block mining in the Enerchain network is 1 second. This is very fast compared to traditional Bitcoin (10 minutes) and Ethereum (10-20 seconds).

The use of blockchain in Russia. The total amount of debts for electricity as of September 2021 reached 309.2 billion rubles. At the same time, the share of the population accounts for 68.8 billion rubles. The main reasons are related to the fact that people do not pay their bills, payments do not reach manufacturers, data is often disconnected or unavailable, and intermediaries provide inaccurate amounts of payments. With proper implementation, the blockchain will help overcome these obstacles.

Within the framework of the Russian Waves project, an attempt was made to eliminate the possibility of data manipulation in the electricity market. The developers created an application based on the blockchain, which was directly integrated into electricity meters. In order to establish an end-to-end payment chain between consumers and capacity suppliers, Waves has entered into a partnership with Alfa-

Bank. About 400 families from Kaliningrad and Sverdlovsk regions participated in the first tests.

There are many players involved in the Russian retail electricity market: generating and distribution companies, network suppliers, consumers and banks. The transmission process is accompanied by technical power losses [4].

The potential of introducing blockchain technology into the Russian electric power industry. Based on international and Russian experience, the main directions of the potential use of blockchain technology in the Russian electric power industry can be identified:

1. P2P trading with direct interaction.
2. Certification and confirmation of sources.
3. Digital and error-free settlement.
4. Absence of intermediaries.
5. Falling electricity prices.
6. Independence from a single authority for consumers who are also producers of electricity.

Risks of introducing blockchain technology into the Russian electric power industry. Regardless of the full potential of the technology, it should be noted that it has a number of limitations and disadvantages:

1. A large amount of information that needs to be stored.
2. Scalability of the system and its performance. Since blockchain is a system for conducting P2P operations, it has a rather low speed, lower than with a traditional centralized system. And the creation of new nodes, that is, the scalability of the system, does not increase its performance.
3. Lack of experience with the “smart contract”. A smart contract is a program that will be written by a person. This means that it is impossible to provide for the absence of errors and vulnerabilities in the program.
4. There is a possibility that it will be difficult for the consumer to accept the new system.
5. Lack of long-term experience with such systems [5].

Conclusion. Theoretically, the technology has the potential to determine the future of our energy supply. The prospects for the development of technology will depend on technological progress and the success of competing technologies, as well as on regulatory practices in individual countries. Some promising implementations of blockchain-based systems in future power systems are presented, as well as its key capabilities. Successful examples of both foreign and Russian companies are analyzed. In these examples, you can clearly see how flexibly the blockchain technology can be applied to various conditions and prospects for the development of the energy system. Summarizing the above, it is safe to say that the characteristics of blockchain – decentralization, reliability, security and transparency – make it a very promising technology for future energy systems of different countries.

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УКД 504.5

THE INFLUENCE OF A COOLING POND ON THE SAFE OPERATION OF A NUCLEAR POWER PLANT

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Abstract. Cooling tanks are reservoirs adapted for the removal of a significant amount of heat generated during technological processes. They are mainly used as elements of technical water supply systems of nuclear power plants. They have aquatic ecosystems that are not inferior to natural ones in their biological diversity. The impact of nuclear power plants on cooling tank ecosystems is multifaceted.

Keywords: flora, cooling pond, ecology, water supply, power system, operation, water intake facilities.

ВЛИЯНИЕ ПРУДА-ОХЛАДИТЕЛЯ НА БЕЗОПАСНУЮ ЭКСПЛУАТАЦИЮ АТОМНОЙ ЭЛЕКТРОСТАНЦИИ

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Аннотация. Водоемы-охладители – это водные объекты, приспособленные для отвода значительного количества тепла, образующегося в ходе технологических процессов. Главным образом они используются как элементы систем технического водоснабжения атомных электростанций. В них функционируют водные экосистемы, по своему биоразнообразию не уступающие природным. Воздействие работы атомных электростанций на экосистемы водоемов-охладителей носит многоплановый характер.

Ключевые слова: флора, пруд-охладитель, экология, водоснабжение, энергосистема, эксплуатация, водозаборные сооружения.

Significant changes in the environmental situation can occur even with the accident-free operation of a nuclear power plant. That is why at all stages of NPP operation it is necessary to anticipate potential environmental problems and propose ways to minimize them.

The study of the flora of cooling reservoirs is important, since the results of this study help to solve a number of issues related to maintaining the safe operation of nuclear power plants. For example, excessive overgrowth of flora complicates the process of operation of a cooling reservoir, and plants covering the water surface and clogging the grilles of water intake structures can even create an emergency situation within the framework of the power plant's technical water supply system. It is quite obvious that it is necessary to predict the appearance of such conditions and develop methods to solve them. This can be realized only on the basis of a systematic study of the patterns of flora growth in cooling reservoirs [1].

Smolensk NPP is one of the largest nuclear power plants in Russia. It is located in the city of Desnogorsk, Smolensk region. The nuclear power plant was founded in 1976, and became the first nuclear facility built on the territory of the former Soviet Union. At the moment, three power units are operating at the station, with a total capacity of 3,000 MW.

The Smolensk NPP uses a closed water supply system, which reduces the impact on the environment and ensures the continuity of the plant's operation. The cooling system uses the Desna River, on the bank of which the station is located. The water from the river enters a special reservoir, which serves to cool the equipment of the station. After cooling, the water returns back to the river.

One of the advantages of the Smolensk NPP is its high degree of safety. The station is equipped with modern security systems that guarantee protection from possible accidents. In addition, the station regularly conducts inspections and tests of its equipment to ensure its reliability and safety.

In general, the Smolensk NPP is an important source of electricity for Russia and plays a key role in ensuring the country's energy security [2].

Smolensk NPP is located 150 kilometers from Smolensk, 180 kilometers from Bryansk and 350 kilometers from Moscow and is one of the key points in the national energy system. The main recipient of the electricity produced here is the energy system "Center", which includes 18 regional power systems of the Central Federal District, as well as the Kaliningrad Region and Belarus. Three power units with RBMK-1000 channel reactors based on uranium-graphite are in operation at the Smolensk NPP. The reactors are located in concrete shafts and represent a system of channels containing fuel assemblies. Special systems guarantee reliable heat removal from the reactors even when the power supply to the plant is completely cut off, including possible equipment failures. Power units with RBMK-1000 reactors are of the single-circuit type. This means that the steam that is supplied to the turbines is formed directly in the reactor from water. Since January 1, 2007 in the Russian Federation, there is a new edition of the Water Code of the Russian Federation, according to paragraph 4 of Article 60 of which the design of direct-flow systems of technical water supply is not allowed [3].

Smolensk NPP uses a closed system of technical water supply, using a channel type of cooling reservoir formed on the Desna River. Constant maintenance of the required water level is provided by an earthen dam. For uniform distribution of warm water over the entire surface of the cooling reservoir, two outlet channels are used, taking into account the peculiarities of the local terrain. Water from the cooling reservoir passes through the supply channel and enters the pumping station, from which

it is supplied to the heat exchange units of the NPP via water supply networks. Then, after heating, the water is returned back through the outlet channel for cooling and then fed back to the water intake facilities of the NPP. The use of such a closed system of technical water supply not only reduces the load on the environment, but also ensures the stability and continuity of the operation of the nuclear power plant, which is a key factor for ensuring the safety and reliability of equipment operation.

The hydraulic engineering facilities of the current circulating water cooling system include:

1. Water intake and spillway structures.
2. Water channels, pipelines and circulation pipelines.
3. Regulatory structures, such as siphon wells and duckers.
4. Dams.
5. Pumping stations.
6. Cooling towers and splash pools.
7. Water support structures.

The Desnogorsk cooling reservoir, which provides the Smolensk NPP, is of the channel type and is located in the upper part of the Desna River. Its length is 98 km.

The first power unit of the Smolensk NPP began its work in 1982, the second power unit was commissioned in 1985. Since 1991, three power units of the station have been in operation. The discharge of spent, heated water occurs simultaneously in two different sections of the water area of the cooling reservoir. Since the nuclear power plant is a significant consumer of water, the use of water resources plays an important role in the context of environmental protection activities of the Smolensk NPP, and also serves for the purposes of technical water supply of the plant and wastewater disposal. Smolensk NPP uses water to cool its reactors. The water is taken from the Desna River and passes through the cooling system before returning back to the river. This helps to reduce the temperature of the reactors and prevents overheating. In addition, the water is also used for other purposes, such as cleaning and maintenance of the station [4].

The method proposed by A. L. Suzdaleva was used to organize observations and assess the ecological state of cooling reservoirs. Sampling sites (stations) in operating cooling reservoirs were selected in such a way that the results obtained fully characterize the conditions in all layers of the water mass. Vegetation development in the Desnogorsk reservoir was more active, since there are a large number of wet habitats in the flooded territories.

By the time of the second phase of studies of the cooling reservoir of the Smolensk NPP (2021-2022), the main changes in the structure of its vegetation were caused by the appearance of subtropical flora – Vallisneria spiralis (Vallisneriaspiralis L.). In a short period of time, this species formed massive thickets in the entire heated section of the reservoir and actually displaced the formations of underwater flora that previously existed there. In the upper area of the Desnogorsk reservoir, where warm water gets only occasionally during windy seasons, the structure of plant associations has changed slightly. There is an opinion that water heating significantly accelerates the beginning of the growing season of higher plants in temperate water bodies. However, as the analysis of the available data shows, this statement is unjustifiably

general and is true enough only for one type of aquatic plants – for underwater flora. However, in the areas of discharge of heated water, there was also a noticeably earlier death of underwater vegetation, already starting from the middle of summer. In areas of extreme temperatures, a significant impact on living organisms can have a temperature increase of only 1-2 ° C. Also an important factor is the time of exposure to extreme temperatures. On this basis, the phenomena that occur with an increase in temperature and have negative consequences for vegetation can be divided into several stages:

1. A short-term increase in temperature to 30-33 °C during the day worsens the physiological state of plants, but does not cause significant changes in the structure of plant collectives.

2. Temporary temperature increases up to 30-35 °C in summer lead to changes in the structure of collectives. However, these changes are not accompanied by the loss of certain plants, despite the fact that there is often a change of dominant species.

3. Long-term temperature rise to 35-40 °C is characterized by the disappearance of certain plant species and their replacement by other species.

4. Prolonged and regular extreme temperature changes, which can reach up to 45-50 °C, lead to complete degradation of plant groups and their replacement by other species capable of surviving in such conditions [5].

The launch of the NPP affects not only the temperature regime of the reservoir, but also significantly changes its hydrological regime [3]. In communities of higher aquatic plants that develop in separate water layers, certain patterns are observed.

The water mass of the circulating flow is dominated by species of underwater flora that can firmly attach to the bottom and have sufficiently hard and flexible leaves, since the movement of water is constant.

As for peripheral autochthonous water masses of the cooling reservoir, in these zones, characterized by less mobile waters, shallow water and proximity to the coastline, surface and floating plants can also grow.

In the case of secondary water masses in the areas of water intake from the sources of recharge of the cooling reservoir, the main characteristics of these water areas are: relatively high water activity, significant changes in temperature and hydrochemical parameters. The composition of the highest underwater flora here is determined to the greatest extent by specific local conditions.

Thus, the distribution of plant communities in cooling reservoirs is determined not only by the temperature regime, but largely depends on the specifics of the structure of water bodies and the hydrological and hydrochemical conditions formed in each of them. The use of reservoirs for the technical needs of nuclear power plants leads to a significant restructuring of the structure and spatial distribution of aquatic phytocenoses, but does not cause the final disappearance of any types of aquatic flora. The intensive spread of species that provoke the emergence of biological obstacles in the NPP water supply system is the result of long-term processes of formation of aquatic plant collectives. In this regard, the development of effective measures to prevent such biological obstacles should be based on the identification of factors that activate their development.

Thus, in order to prevent biological obstacles in the NPP technical supply systems, it is necessary to take into account the following factors:

Temperature regime: The temperature of the water in the cooling pond affects the distribution of plant communities, so it is important to control the temperature of the water and prevent its sharp fluctuations.

The structure of water bodies: The shape and size of reservoirs, as well as the presence of various currents and vortices can affect the distribution of plants and the formation of phytocenoses.

Hydrological and hydrochemical conditions: The level of water mineralization, the presence of nutrients and other chemical compounds can stimulate the growth of certain plant species, which can lead to the formation of biological obstacles.

Technical needs of nuclear power plants: The use of reservoirs for reactor cooling can cause changes in the structure and distribution of aquatic phytocenoses, therefore it is necessary to regularly monitor the state of aquatic ecosystems.

Formation of aquatic plant communities: The process of spreading plant species can be long and complex, so it is important to monitor the development of growing communities and take measures to prevent undesirable species.

In general, in order to prevent biological obstacles, it is necessary to carry out an integrated approach that takes into account all these factors, as well as the characteristics of each specific reservoir and its ecosystem.

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УДК 681.5

PREDICTIVE CONTROL SYSTEM AS ONE OF THE APPROACHES TO ENSURING OPTIMAL PERFORMANCE OF PRODUCTION PROCESSES

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Abstract. This paper examines the importance of predictive control systems and their impact on ensuring optimal process performance. The various methods used in these systems are reviewed and their potential impact on process efficiency, cost optimization, safety improvement, and the challenges faced are identified.

Keywords: predictive control, predictive systems, optimization, MPC, efficiency.

СИСТЕМА ПРЕДИКТИВНОГО УПРАВЛЕНИЯ КАК ОДИН ИЗ ПОДХОДОВ К ОБЕСПЕЧЕНИЮ ОПТИМАЛЬНОГО ПРОТЕКАНИЯ ПРОИЗВОДСТВЕННЫХ ПРОЦЕССОВ

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Аннотация. В данной статье рассматривается значение систем предиктивного управления и их влияние на обеспечение оптимального протекания технологических процессов. Рассматриваются различные методы, используемые в данных системах, и определяется их потенциальное влияние на эффективность процессов, оптимизацию затрат, повышение безопасности, а также проблемы, с которыми приходится сталкиваться.

Ключевые слова: предиктивное управление, предиктивные системы, оптимизация, MPC, эффективность.

In today’s world, technological innovation and automation are penetrating all spheres of human life, and the architecture of process systems has undergone significant changes due to the increasing demand for efficiency and cost reduction in industrial activities.

Previously, traditional production methods were often used, which required significant inputs of manual labor and resources [1, 2].

New technologies make it possible to automate and optimize many production processes, freeing up human power and improving product quality. Robotics, machine learning, artificial intelligence, the Internet of Things (IoT), and other innovative technologies are used in a variety of industries including manufacturing, agriculture, healthcare, transportation, etc.

System architecture has become based on a modular approach, allowing new technologies to be easily introduced and existing processes to be modified without the need for a complete system redesign.

Process systems can automatically optimize processes by taking into account a number of parameters such as temperature, pressure, speed and other factors, resulting in reduced errors and increased productivity.

It is also worth noting that advances in digital technology allow for the creation of virtual models and simulations, which simplifies the design and testing of new systems. This significantly reduces the time and cost of developing and implementing new solutions.

In this scenario, predictive control systems have emerged as one of the most effective methods of process control. These systems utilize advanced algorithms and modern technology to anticipate future events and states, which enables the system or plant management to take proactive actions to ensure optimal quality of output, improved operational efficiency and compliance with all constraints [1 - 3].

Predictive control, also known as Model Predictive Control or MPC for short, is a type of control system that uses mathematical modeling and optimization algorithms to predict future system behavior and process state in real time [4].

A mathematical model is an abstract representation of a real system or phenomenon using mathematical concepts, symbols and operations. It allows representing and studying the interaction of different components of the system, predicting its behavior and making informed decisions.

The main components of a mathematical model are usually:

1. Variables.

2. Equations or inequalities, that is, mathematical expressions that describe the relationships and dependencies between variables.

3. Parameters – values that are fixed and affect the system but do not change within the model.

4. Boundary conditions – conditions that define the initial and final states of the system [4].

A mathematical model can be created by analyzing physical laws, statistical data, experiments, or empirical observations. Determining the properties and parameters of the system, analyzing feedback and relationships allows for the construction of an effective and representative mathematical model.

Obtaining a mathematical model often involves:

1. Identifying the main variables and parameters that are significant to the system.

The main variables and parameters relevant to a particular system depend only on that very system, so it requires the study of its specificity, functionality and target objectives.

2. Ways and means of describing the relationships between variables, such as through algebraic or differential equations.

3. Validation and verification of the model using experiments or data from real systems.

Validation and verification of a model involves testing its accuracy and reliability by comparing its predictions with real-world observations or data from real systems. This process helps ensure that the model is sound and can be trusted for making predictions or informing decisions.

Experiments can be conducted to collect data that can be used for validation and verification. These experiments are designed to simulate real-world scenarios and generate data that can be used to test the model's predictions. By comparing the model's outputs with the observed data, researchers can verify if the model accurately represents the behavior of the real system.

In addition to experiments, real-world data from existing systems can also be used for validation and verification. For example, historical data from a manufacturing process can be compared with the model's predictions to evaluate its performance.

Validation and verification activities are crucial for building confidence in the model's predictions and ensuring its reliability. It helps identify any discrepancies or errors in the model and provides an opportunity for refinement and improvement.

4. Analyzing the simulation results and adjusting the model if necessary.

Generally, predictive control systems consist of the following components:

1. Mathematical models.

2. Optimization algorithms that are used to determine optimal control solutions given various constraints and production goals.

3. Sensors and instrumentation (physical and/or virtual), which are used to collect data on the current state of the system and process parameters.

4. Information systems, which are used to collect, process, store and analyze data, as well as to make decisions based on the information obtained.

In addition, information systems include specialized software for operator interaction with the control system. An integral part of such software is the user interface.

The user interface and its elements provide the operator with the ability to not only monitor the control process, but also to customize the system, select and display the desired process data and optimization results.

5. Regulator, which receives data from the predictive model, calculates control signals sent through actuators to the control object, and controls them.

Often virtual sensors and predictive models are combined into a single concept of "virtual analyzer".

A virtual analyzer is a software or system that is used to analyze and process data in a virtual environment. It can be used for a variety of purposes such as network monitoring and management, performance analysis, threat detection and security

analysis, as well as for analyzing and reporting on large amounts of data. A virtual analyzer is usually powered by virtualization, enabling efficient use of computing resources and simplifying data analysis processes.

The Figure shows a generalized schematic of the predictive control system.

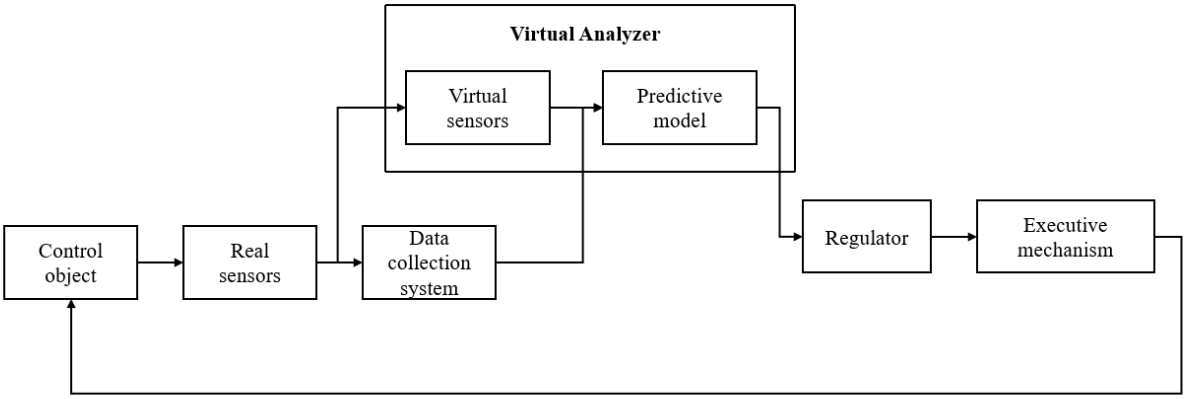


Figure. Generalized scheme of the predictive control system

This type of control systems combines control with state feedback and real-time optimization to organize the process control loop.

The main task of predictive systems is to optimize the future behavior of the process based on current data, thus ensuring the continuous optimal flow of the process and minimizing possible event variations and disturbances [4].

Predictive control systems have found applications in many industries including manufacturing, petrochemicals, renewable energy and transportation. They help minimize production costs, improve product quality, and enhance operational safety. By managing complex interactions and determining the future state of the system, these systems enable proactive and informed decisions, improving overall productivity [5].

To realize the solution of such complex problems in modern MPC systems, a number of techniques are utilized and are presented below.

1. Time series methods, which consist of analyzing and predicting time series of data. Predictive systems use statistical models and analysis of past data to predict future states of the system.

2. Nonlinear predictive control methods that take into account the nonlinearity of the system, providing highly accurate predictions and thus fine-tuning the process control. Predictive control systems also take into account the peculiarities of multivariate systems, optimally controlling them within specified constraints.

3. Machine learning methods, which are used for complex multi-parameter technological processes, in which a human is not able to calculate all the weight relationships between the process parameters. This method consists of training the system on a huge number of data samples so that the system is able to predict future process parameters based on the input parameters.

4. Optimization methods, which are used to find optimal control signals to minimize a predetermined target function. These methods can include, for example,

dynamic programming, which consists in decomposing the initial task into simpler subproblems, the solution of which is stored and used to construct the optimal solution to the entire problem, or search algorithms with strategic planning, the essence of which is to determine the best strategic solutions or action plans within the problem domain [6, 7].

Despite the huge potential of predictive systems, their realization is fraught with certain difficulties. Computational complexity is the main obstacle in the realization of predictive control systems for large multivariate systems. Performing real-time tasks in the presence of a large data stream often requires high computational power.

However, advances in computational technology offer a way to overcome the challenges. For example, the advent of machine learning has opened new opportunities to enhance the predictive capabilities of predictive systems. Neural networks are used to enhance the predictive power of the model, which allows for more efficient and informed control decisions. In addition, research on distributed and cooperative predictive control strategies offers prospects for the control of large-scale industrial systems [8].

Predictive control systems have proven to be an effective approach to optimizing process performance. Their versatility and modeling capabilities provide comprehensive control of complex systems, increasing productivity, reducing operating costs and improving safety.

As a result, companies can increase their profitability, reduce deviations from plan and plan and adapt at a higher level.

As technological advances help to address existing challenges, predictive control systems will continue to be a vital component of the evolution of control systems and the growth of a wide range of industries in the future.

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УДК 37.013.46

SPECIFIC FEATURES OF INTRODUCING BLENDED LEARNING "FLIPPED CLASSROOM" IN THE PROCESS OF LEARNING FOREIGN LANGUAGES AT UNIVERSITY

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Abstract. At present, modern interactive methods of teaching are of great interest to researchers and teachers. Introduction into the educational process of the latest teaching methods contribute to the formation of foreign communication competence. The article presents an overview of the "Flipped Classroom" technology and analyzes the possibilities of its application when teachning a foreign language to students.

Keywords: education, modern educational technologies, "Flipped Classroom", blended learning.

ОСОБЕННОСТИ ВНЕДРЕНИЯ ТЕХНОЛОГИИ СМЕШАННОГО ОБУЧЕНИЯ «FLIPPED CLASSROOM» ПРИ ИЗУЧЕНИИ ИНОСТРАННОГО ЯЗЫКА В ВУЗЕ

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Аннотация. В настоящее время современные интерактивные способы обучения вызывают большой интерес у исследователей и преподавателей. Внедрение в учебный процесс новейших методов обучения способствует формированию иноязычной коммуникативной компетенции. В статье представлен обзор технологии «Flipped Classroom», анализируются возможности ее применения при обучении студентов иностранному языку.

Ключевые слова: образование, современные образовательные технологии, «Flipped Classroom», смешанное обучение.

In the modern world there is a rapid development and transformation of the digital educational space, there are more and more educational resources and Internet platforms. The changes caused by the rapid development of the information society have contributed to the shift of the educational space, the emergence of new requests and demands to the person of modern society [1, p. 90].

The digital society's request to work with the latest teaching methods provides the basis for the implementation of training programs at a higher level. More recently,

the pandemic conditions around the world have enhanced the capacity of educators to use information technology in the learning process. Such important elements as the possibility of remote access to educational resources and the means of Internet communication play an essential role in the organization of the modern lesson. They facilitate the positive transformation of the digital educational environment [2].

Blended learning combines traditional and modern teaching with an emphasis on e-learning, which is based on the new didactic capabilities of information and communication technologies. The basic principles of mixed learning are visuality, continuity, practical application and consistency.

"Flipped Classroom" technology is one of the components of blended learning and is a promising approach to learning, which in recent years has aroused great response and interest among teachers [3].

It is believed that the ancestors of the "Flipped Classroom" technology are Jonathan Bergman and Aaron Sams [4].

"Flipped classroom" is defined as a pedagogical model in which the lecture and homework of the course change places. Therefore, the theoretical material is studied by students individually by watching video lectures recorded by the teacher or downloaded from websites on the Internet, and the classroom study is devoted to practical tasks and discussions with the teacher.

For effective implementation of the "Flipped Classroom" technology the following cycle of actions is observed:

– video lecture, test (self-testing of knowledge);
– working in the classroom (using variable interactive exercises);
– observation – feedback – evaluation activities.

Now let's look at the algorithm of actions of the teacher at the stage of preparation for the lesson organized by the "Flipped Classroom" technology:

– to provide students with detailed instructions for work in a new educational format;
– to form the task and set the terms of its implementation.
– to prepare a virtual educational environment;
– to record a video lecture or find a ready-made one that meets the general requirements and the subject of the lesson;
– to place educational content on the selected online platform and send links to the video lesson;
– to create test tasks corresponding to the subject of the video-lecture;
– to prepare questions on the video for the full-time session;
– to evaluate test results.

The structure of the classroom on the "Flipped Classroom" model includes the following elements:

– a short discussion on the materials of the video lecture, which was set for homework;
– answers to problematic questions that students had during the preparation for the

lesson;

- discussion of ideas on a given topic, working out of communication skills and development of written speech;
- completing various tasks;
- group and individual work;
- tracking the progress of students in learning the lesson;
- monitoring in the form of diagnostic work to track the progress of each student.

During the lesson students receive new knowledge, make mental maps, organize work with tasks from a textbook, workbook or printouts that the teacher issued before the class. Students are encouraged to ask questions to the teacher in a chat room on the Internet platform, or during their classes at the university.

The teacher encourages students to ask questions in a chat on the Internet platform, or while studying at the university. The questions are about what they couldn't figure out, what they want to know, what skills they would like to practice the next lesson. This type of activity motivates students to a more attentive study of the material at home.

As part of the dialogue, students first get acquainted with actual colloquial phrases by watching video lectures in English. Based on the knowledge gained from listening to videos, students try to build dialogues using new speech constructions. The time allotted for the improvement of practical skills will promote creative thinking and freedom of expression.

Thus, students get acquainted with the theoretical material, if necessary, perform tests to understand the content of the video lesson they have just watched. The teacher provides students with detailed instructions for working with the material in a new educational format, formulates the task and sets the deadlines for its completion. It is desirable to opt for one of the educational platforms to adhere to one of the chosen system of learning management.

Application of "Flipped Classroom" technology allows the teacher to distribute the teaching load correctly. The advantage of this technology is that as part of its implementation creates a comfortable pace for the complex study of the educational program, each student, focusing on his own strength, can work at his own pace. With the help of the "Flipped Classroom" technology, the teacher creates conditions for the development of students' skills of self-organization and independence [5].

Thanks to the extra time in the lesson, which has appeared due to the transfer of the study of theoretical material to the home, the teacher can include more creative tasks in the course of the lesson. The use of a relatively larger volume of practical tasks in the classroom leads to increased involvement of students in the learning process. They are beginning to interact with each other.

Application of the "Flipped Classroom" technology during lessons has a positive influence on the psyche of students, consolidation of knowledge contributes to development of intellectual qualities of personality.

The level of effective cooperation is increased due to the joint activity of students when performing many interactive tasks. Interaction of all participants in the

educational process is pushed to a new level, psychological tension is relieved, students see their teacher in the role of a friend and mentor, which motivates them to individual and group work in the classroom.

Regular return to notes and video lectures in English helps students to develop skills of self-selection and systematization of information, which helps them to effectively learn educational programs. In fact, this learning tool is used in English lessons so that students remain organized, can practice more in spoken and written language. Independent keeping notes teaches them to organize order in their records, which affects the growth of responsible attitude to learning.

The clear structure of video lectures allows students to better learn the teaching material, quickly navigate the memo with grammatical rules, work with ready-made lexical constructions.

To sum up, the use of “Flipped Classroom” technology in the learning process contributes to the following objectives:

– improving the efficiency of the educational process through the implementation of individualized, differentiated and personalized training;
– formation of skills of independence and digital competence of students;
– increasing cognitive activity;
– development of metasubject skills;
– broadening of students’ horizons;
– increasing the level of motivation for learning activities through various forms of work in the classroom;
– improvement of independent work of students;
– providing sustainable feedback between the participants of the educational process;
– creation of conditions for teamwork of students;
– development of leadership skills of students.

The applicability to any conditions, as well as the versatility and availability of the “Flipped Classroom” technology can be confirmed by the fact that it is actively used in the organization of the educational process both in Russia and abroad. This learning technology is increasingly gaining momentum, with its help it is easier to bring qualitative changes to the course of the English lesson. In this way, the alternation of educational activities helps to maintain the mental health of the student, improving learning outcomes through additional assistance in video lectures, which makes it possible to regulate the influence of the educational load on the mental capacity of the student.

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УДК 621.314.21

REDUCTION OF ELECTRICAL ENERGY LOSSES IN POWER TRANSFORMERS

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Abstract. This article discusses the main methods of reducing electrical energy losses in power transformers. The authors investigate the factors affecting the level of losses and offer recommendations for their minimization. Such recommendations include optimizing the load of transformers, improving the quality of insulation, using more efficient materials and improving the cooling system.

Keywords: power losses, power transformers, loss reduction methods, load optimization, insulation quality, efficient materials, cooling system.

СНИЖЕНИЕ ПОТЕРЬ ЭЛЕКТРИЧЕСКОЙ ЭНЕРГИИ В СИЛОВЫХ ТРАНСФОРМАТОРАХ

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Аннотация. В данной статье рассматриваются основные методы снижения потерь электрической энергии в силовых трансформаторах. Авторами исследуются факторы, влияющие на уровень потерь, и предлагаются рекомендации по их минимизации. К числу таких рекомендаций относятся: оптимизация нагрузки трансформаторов, улучшение качества изоляции, использование более эффективных материалов и совершенствование системы охлаждения.

Ключевые слова: потери электроэнергии, силовые трансформаторы, методы снижения потерь, оптимизация нагрузки, качество изоляции, эффективные материалы, система охлаждения.

Losses of electrical energy in power transformers occur for several reasons:

1. Heating of the transformer windings: when an electric current passes through the transformer windings, heat is released. This heat is dissipated into the environment, which leads to energy losses [1].

2. Core remagnetization: when the magnetic field changes in the transformer core, energy losses occur for remagnetization.

3. Wire resistance: when current passes through the wires, energy loss also occurs due to the resistance of the wire.

4. Quality of materials and construction: the use of substandard materials or imperfection of the transformer design can also lead to power losses.

5. Incomplete loading of the transformer: if the transformer is not working at full capacity, then the loss of electricity may be higher than when working at full load.

Electricity losses in transformers are one of the types of technical losses of electricity, which are caused by the peculiarities of physical processes occurring during energy transmission. The transfer of electrical energy from its source to its consumer is always associated with the loss of a certain amount of power and energy in the power supply system. This includes electricity losses in power lines and in transformers.

Reducing electricity losses is one of the main tasks in the production of transformers. Losses are about 30 %, so this problem is very relevant [2].

Power losses in power transformers can be reduced in the following ways:

1. Transformer load optimization: load analysis and optimization can help reduce energy losses associated with transformer overload.

2. Improved cooling system: the use of more efficient cooling systems, such as forced air or water cooling, can reduce energy losses due to overheating [3].

3. The use of transformers with improved performance: the use of new technologies and materials in the production of transformers can reduce energy conversion losses.

4. Load management: the use of intelligent load management technologies, which allow you to manage energy consumption depending on the time of day and day of the week, can lead to a reduction in losses [4].

5. Improving the efficiency of distribution systems: improving the quality of insulation, the use of more efficient distribution devices and cables can reduce losses in the distribution network.

6. Transformer modernization: periodic inspection and modernization of transformers can improve their efficiency and reduce losses.

7. Education and awareness: raising awareness of consumers and energy producers about the importance of saving energy can help reduce energy losses [5].

When the transformer is switched on, the occurrence of losses is an inevitable process. Losses in the transformer can be idle or load and occur due to the processes of magnetization reversal of the ferromagnetic core, losses in the windings and additional losses in the metal walls of the tank and other structural elements.

Previously, hot-rolled steel was used in the production of transformers, which was subsequently replaced by cold-rolled steel with an oriented grain structure. The latter is characterized by high magnetic permeability, which ensures low losses in the longitudinal magnetic flux (along the direction of rolling).

With an increase in the capitalized cost of load losses, it seems advisable to increase the induction to reduce the number of turns, which, in turn, leads to a decrease in load losses. Due to these factors, it became necessary to create a type of steel that could function at high induction values and demonstrate low specific losses.

Idling losses were reduced by using improved grades of steel, improving the process of creating a magnetic system and cutting steel, improving sheet joints and core design.

Since the beginning of the use of transformer steel, the quality of the latter continues to improve. This is achieved by improving the orientation of the domains, their purification, reducing the thickness of the sheets and, as a result, improving the characteristics of the steel.

The reduction of load losses, unlike idling losses, is not accompanied by a significant improvement in materials.

Load losses, as is known, consist of additional losses caused by eddy currents in conductors and the surface effect, as well as losses in the metal walls of the tank and structural parts.

To calculate the loss of electrical energy in a power transformer, the following formulas are used:

1. Total Power Loss (P_{loss}):

$$P_{loss} = I^2 \cdot R, \quad (1)$$

where I is the current through the transformer winding, A;

R is the winding resistance, Ohm.

2. Power losses due to eddy currents ($P_{e.c.}$):

$$P_{e.c.} = \frac{B^2 \cdot A \cdot \rho}{2 \cdot \mu_0}, \quad (2)$$

where B is magnetic induction, Tl;

A is the cross-sectional area of the conductor, mm^2;

ρ is electrical resistivity of the conductor material, Ohms·mm^2;

μ_0 is magnetic constant.

3. Power loss by hysteresis (P_h):

$$P_h = \frac{(B_3 - B_1) \cdot V \cdot \rho_0}{2 \cdot \mu_0 \cdot \mu}, \quad (3)$$

where B_3 is maximum magnetic induction of saturation of the core material, Tl;

B_1 is initial magnetic induction of the core material, Tl;

V is transformer core volume, m^3;

ρ_0 is specific electrical conductivity of the core material at zero magnetic induction, Ohms·mm^2;

μ is relative magnetic permeability of the core.

4. Losses on remagnetization (P_r):

$$P_r = n \cdot f \cdot B_{max}^n \cdot V, \quad (4)$$

where n is hysteresis coefficient for a specific material;

f is field frequency, Hz;

B_{max} is maximum induction, Tl;

V is sample volume, m^3;

n is the exponent (within the1,6..2 range).

To calculate the losses of electrical energy in transformers, it is necessary to have the following passport data:

– the rated power of the transformer, S_n, kW;

– no-load losses, ΔP_{xx}, kW and short circuit losses, ΔPshort circuit, kW at rated voltage;

– the amount of electricity (E_a, kWh; E_r, kVAr*h) accounted for during the billing period by meters that are installed on the high voltage side of the step-down transformer;

– the number of hours of operation of the transformer at rated load τslave, which is taken as follows: single-shift operation – 200 hours, double-shift – 450 hours, three-shift – 700 hours per month;

– the total number of hours of operation of the transformer, which is taken for April, June, September, November – 720 hours per month, for February – 672 hours per month (696 hours in a leap year), and in the remaining months – 744 hours per month.

Based on these data, the weighted average power factor cosφ is determined from the following ratio: tgφ = E_p/E_a .

There are cases when there are no reactive energy meters. In such cases, instead of cosφ, the actual coefficient of the degree of reactive power compensation is taken. It is used for calculations for reactive power compensation: $tg\varphi = Q_M/P_M$, which translates to $cosf_n \approx cosf_{sr}$.

Transformer load factor:

$$K_n = \frac{Э_a}{S_n \cdot \tau_n \cdot \cos\varphi_{cp}}. \quad (5)$$

Electricity losses in transformers:

$$\Delta E = \Delta P_{xx} \cdot \tau_n + \Delta P_{кз} \cdot K_n^2 \cdot \tau_{раб}. \quad (6)$$

It should be borne in mind that this calculation applies only to two-winding transformers.

To make a calculation in three-winding transformers, you also need to know the following passport data:

– rated power of the windings of higher, medium and low voltage: S_{NN}, S_{CH}, S_{VN} (given as a percentage of the rated power), kVA;

– short-circuit losses of high, medium, and low voltage windings at their full load: ΔP_{NN}, ΔP_{CH}, ΔP_{VN}, kW.

The actual amount of electricity passed through the windings will be calculated by the formula (3):

$$Э_{ВН} = Э_{СН} + Э_{НН}. \quad (7)$$

The load factor of each of the transformer windings is determined by the following formulas (8-10):

$$K_{ВН} = \frac{Э_{аВН}}{S_{ВН} \cdot \tau_{ВН} \cdot \cos\varphi_{cp}}; \quad (8)$$

$$K_{СН} = \frac{Э_{аСН}}{S_{СН} \cdot \tau_{СН} \cdot \cos\varphi_{cp}}; \quad (9)$$

$$K_{HH} = \frac{Э_{aHH}}{S_{HH} \cdot \tau_{HH} \cdot \cos\varphi_{cp}}. \quad (10)$$

Electricity losses are defined as follows (11):

$$\Delta E = \Delta P_{xx} \cdot \tau_n \left(\Delta P_{BH}^{K3} \cdot K_{BH}^2 + \Delta P_{CH}^{K3} \cdot K_{CH}^2 + \Delta P_{HH}^{K3} \cdot K_{HH}^2 \right) \cdot \tau_{раб}. \quad (11)$$

Improving the functioning of shunt reactors and transformer cooling systems also helps to reduce power losses, which also requires attention. Modern production does not stand still, and microprocessor devices, the production of which has already been established, have reached a high level of development, allowing, depending on the ambient temperature and the oil inside the tank, to regulate the duration and quality of the functioning of cooling systems, while reducing the cost of electricity to power the fans [6].

The range of works performed under voltage is very wide, and performing certain actions in this way helps to reduce electricity losses and increase the efficiency of using the transformer, which depends on the repair mode: in the repair mode, network losses will be higher than during normal operation of the transformer.

Due to the fact that the loss of electricity in the transformer is very significant, it is necessary to pay attention to achieving minimal losses due to a more accurate selection of the number and power of working transformers. This does not require specially trained specialists, since these actions can be performed by working personnel. In addition to quantity and power, it is necessary to take into account the actual load and reduce the idle time at low load [7].

Reducing electricity losses is one of the main tasks in the production of transformers. There are the following ways to reduce them: replacing hot-rolled steel with cold-rolled steel, improving the functioning of the transformer cooling system, choosing the right power and number of transformers.

Since the most optimal mode of operation of a transformer is considered to be the mode of its operation at full load, the most effective way to reduce power losses in power transformers is the correct choice of transformer power at the design stage and the replacement of functioning underloaded transformers with transformers with lower power, which contributes to an increase in their service life.

This article discusses the issue of reducing electrical energy losses in power transformers, and the authors present various approaches to reducing losses, including optimizing the load of transformers, improving cooling systems and increasing energy efficiency.

The article also analyzes the aspects affecting energy losses and suggests strategies to reduce them. These include improving the quality of transformer insulation, using more efficient materials and technologies, and optimizing the functioning of the power supply system.

Thus, the article provides an overview of current approaches to reducing electrical energy losses and may be of interest to specialists in the field of energy, engineers and researchers dealing with problems of energy conservation and energy efficiency enhancement.

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УДК 338.48

BASIC PRINCIPLES OF EDUCATIONAL TOURISM

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Abstract. Educational tourism refers to the youth type of tourism, occupying a certain market niche. Therefore, educational tourism is defined as a niche type of tourism. In this type of tourism the main motivation of tourists is the desire and need to learn. The task of the study is to present the origins and characteristics, as well as the main principles of educational tourism.

Keywords: tourism, educational tourism, educational tours, travel, education.

ОСНОВНЫЕ ПРИНЦИПЫ ОБРАЗОВАТЕЛЬНОГО ТУРИЗМА

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Аннотация. Образовательный туризм относят к молодежному виду туризма, занимающему определенную рыночную нишу. Поэтому образовательный туризм определяется как нишевый вид туризма. В этом виде туризма основной мотивацией туристов является желание и потребность учиться. Задачей исследования является представление истоков и особенностей, а также основных принципов образовательного туризма.

Ключевые слова: туризм, образовательный туризм, образовательные туры, путешествия, образование.

Traveling can be not only a pleasant vacation, but also a useful educational experience. It helps to expand horizons, learn about new cultures and countries, develop skills and get acquainted with various aspects of the world, which makes it a valuable educational tool.

The beginning of educational tourism dates back to the XVII and XVIII centuries. Educational tourism begins with educational and entertainment tours of Europe, known as the “Grand Tour of Europe”. This is a form of travel, where the main goal is to gain new knowledge and experience, master study programs or visit educational institutions. Educational and entertainment tours offer a combination of educational and recreational activities to make the learning process more interesting and attractive. This may include visits to museums, historical sites, cultural centers, universities and other educational facilities, as well as participation in interactive lessons, workshops and excursions.

In the scientific literature, there are many assumptions about the beginning and origin of the “Grand Tour”. Some of these assumptions are related to the development of the Roman Church in 1534, when the transport route began. The purpose of these routes was to connect individual places. These routes make travel shorter, easier and even faster.

The Grand Tour has become a part of formal education and a symbol of evolution from childhood to adulthood. This has become a “normal” part of the aristocracy’s education. The purpose of the Grand Tour is to explore and get acquainted with the culture, history, nature and other aspects of different countries or regions. This allows travelers to gain a deep understanding of different regions and expand their knowledge boundaries. They can also serve as a way to fulfill long-awaited dreams and fulfill great travel desires. The ultimate goal of the “Grand Tour” is to get a full and eventful journey, fulfill your dreams and create an unforgettable experience [1].

In the 1840s, with the development of rail transport, it became clear that the Grand Tour was the beginning of the path to the enlightenment of British society, which has an impact on socio-cultural, political and architectural ideas.

One of the most popular destinations within the framework of the “Grand Tour” are major European cultural cities such as Paris, Rome, Venice, Florence and Naples. There were also trips to other countries such as Spain, Germany, Eastern Europe and the Balkans.

An important educational element of the British aristocracy was familiarity with Roman antiquity. With the development of the idea and purpose of the “Grand Tour”, the foundation of the structure of the modern concept of tourism is laid.

In Europe, with the development of rail transport, travel is becoming increasingly acceptable, which is also becoming affordable for the middle class of society [2].

Educational tourism is most often associated with school trips and excursions.

According to various authors, educational tourism consists of two main elements: the educational component and the tourist component.

The educational component includes activities aimed at educational development and improvement of knowledge. This may include attending educational institutions, participating in courses and seminars, studying history, culture and art, as well as conducting research and practical classes. The educational component is usually based on the planning and organization of specialized programs and activities that contribute to the development of participants.

The tourist component includes traveling and visiting various places. It can be a trip to another country or region, visiting historical sites, natural parks, museums, galleries and other cultural sites. The tourist component allows participants to get acquainted with new places, explore different cultures and traditions, as well as enjoy the beauty of nature and architecture.

Combining educational and tourism components in educational tourism allows participants to gain new knowledge, develop skills, broaden their horizons and enjoy a unique travel experience. This type of tourism is becoming more and more popular because it combines the benefits of the educational component and the pleasure of traveling and discovering new places [3].

According to the World Tourism Organization (UNWTO), educational tourism is defined as a form of tourism that includes visits to places of educational or cultural

significance. The main goal of educational tourism is to gain new knowledge, develop skills and expand horizons through participation in educational programs and activities. As part of educational tourism, tourists can visit universities, museums, historical and archaeological sites, scientific and cultural centers, conduct excursions and participate in courses or seminars. They have the opportunity to study local culture, history, art and science, as well as get acquainted with various aspects of local life and traditions. Educational tourism promotes the exchange of knowledge and experience between countries and cultures, as well as contributes to the personal and professional development of tourists. It stimulates the development of educational institutions and tourism infrastructure, as well as contributes to the preservation and popularization of the cultural heritage of different regions. Tourists who most often practice cognitive tourism are people who are part of the educational sphere. These can be students, teachers, researchers and researchers.

Educational tourism has some important characteristics that distinguish it from other types of tourism. If we consider the educational component, the main features concern it [4].

In particular, consumers have a variety of demands, which also determines the great variety of educational topics. Educational tourism covers a wide range of educational themes, catering to various interests and disciplines. These themes may include language immersion, cultural studies, history, art and architecture, science and technology, environmental conservation, and more.

Let’s consider the main advantages of educational tourism:

- Emphasizing experiential and hands-on learning. Participants are encouraged to actively participate in activities, demonstrations, workshops or hands-on experiences related to the educational topic, which provides a deeper understanding of the subject;
- Providing a flexible learning environment. Educational tourism often takes place outside of traditional classrooms, allowing participants to learn in a dynamic and diverse environment. This may include exploring open spaces, historical sites, or participating in field research relevant to the educational topic;
- Adaptation to the specific needs, interests and requirements of different participants or groups. This customization ensures that the educational experience matches people’s goals and preferences;
- Instilling a love of learning and promoting continuous personal and intellectual growth. Its purpose is to inspire participants to engage in lifelong learning beyond a specific educational trip and to promote a curiosity-driven mindset;
- Offering carefully planned itineraries that prioritize the experience. These itineraries often include visits to museums, historical sites, educational institutions, workshops and other places of educational significance;
- Educational tourism is often led by knowledgeable guides or teachers who provide detailed information and ideas about the destinations and subjects being studied. They play a critical role in facilitating learning and answering questions from participants;
- Promoting interaction between participants and local residents, providing opportunities for cultural exchange and personal experience. These interactions may include staying with a family, talking with local residents, or participating in community projects [5].

A tourist product consists of several components that interact with each other to create a complete and attractive offer for tourists.

1. Transport infrastructure: this includes accessibility and various modes of transport that allow tourists to reach their destination and move within the region. This component includes air transportation, railways and highways, sea and river transport routes, as well as public transport and tourist buses.

2. Placement: this includes various accommodation options such as hotels, resorts, inns, motels, hostels, campsites and rented accommodation. The quality and variety of accommodation options play an important role in attracting tourists and creating a comfortable stay.

3. Entertainment and cultural events: this includes various types of entertainment, cultural events, sports events and festivals that are offered to tourists. These can be excursions, museum visits, concerts, sports matches, cultural holidays and much more.

4. Food and restaurants: this includes a variety of restaurants, cafes, bars and other places where tourists can taste local cuisine and enjoy various culinary experiences.

5. Natural and cultural attractions: this includes natural parks, national reserves, architectural monuments, historical sites, museums and other objects that are of interest to tourists. These attractions are the main attractive points and unique features of the place.

6. Tourist services: this includes various services provided to tourists, such as tourist information centers, transfers, guides and guides, car rental, insurance, booking, etc. They provide convenience and support to tourists throughout their trip [6].

The specificity of educational tourism is that the main purpose of this type of tourism is the educational and cultural development of tourists. Unlike other forms of tourism, educational tourism is focused on gaining new knowledge, expanding cultural experience, as well as developing personal and professional skills.

The combination of all these components creates a tourist product that meets the needs and preferences of tourists and makes the trip attractive and fulfilling.

The development of educational tourism is of great importance for several reasons:

1. Cultural exchange and understanding;
2. Educational opportunities;
3. Raising civic and cultural awareness;
4. Economic development and job creation;
5. Diversification of the tourism industry;
6. Sustainable use of natural and cultural resources.

The development of educational tourism in Russia has many advantages. Since Russia is a unique country with a rich cultural and historical heritage, the development of educational tourism allows foreign and local tourists to explore and get acquainted with this heritage, visit historical sites, museums, art galleries and architectural monuments.

Russia is known for its diverse and beautiful nature, so the development of educational tourism allows visitors to explore and enjoy natural reserves, national parks, lakes, mountain landscapes and other unique natural objects.

Russia also has many high-quality educational institutions, including universities, academies, colleges and language schools. The development of educational tourism allows foreign students and professionals to receive quality education in Russia and expand their knowledge and skills. Educational tourism promotes intercultural exchange and mutual understanding between different countries and cultures. Foreign students and tourists have the opportunity to get acquainted with Russian culture, traditions, language and social life, which contributes to strengthening friendly relations and cultural enrichment [7].

The development of educational tourism makes an important contribution to the economic development of Russian regions. It contributes to the creation of jobs, attracting investment and the development of tourism infrastructure. Educational tourism stimulates the development of the service industry in the country. The increase in the number of foreign students and tourists requires the development of hotels, restaurants, transport services, tour agencies and other related industries.

Tourism is one of the fastest growing economic sectors in the world. Revenues from the tourism sector account for the largest share of GDP in some countries. Tourism is seen as an opportunity to support and accelerate economic growth and obtain economic benefits for the entity that develops it [5].

The development of educational tourism has potential. To achieve good results, it is necessary to combine the educational and tourist product of the destination. This requires cooperation between the education and tourism sectors.

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УДК 376.015.3(470)

CURRENT PROBLEMS OF PSYCHOLOGICAL AND PEDAGOGICAL SUPPORT FOR STUDENTS WITH LIMITED HEALTH CAPABILITIES

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Abstract. This article discusses the problems of inclusive learning in educational organizations at present. Approaches to psychological and pedagogical support for persons with disabilities and determining its main goal are considered. Ways to solve the problems of psychological and pedagogical support and the basis for drawing up its model have been identified.

Keywords: inclusive education, persons with disabilities, psychological and pedagogical support, tutor, teacher, educational organizations.

АКТУАЛЬНЫЕ ПРОБЛЕМЫ ПСИХОЛОГО-ПЕДАГОГИЧЕСКОГО СОПРОВОЖДЕНИЯ ОБУЧАЮЩИХСЯ С ОГРАНИЧЕННЫМИ ВОЗМОЖНОСТЯМИ ЗДОРОВЬЯ

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Аннотация. В статье рассматриваются проблемы инклюзивного обучения в образовательных организациях в настоящее время. Рассмотрены подходы к психолого-педагогическому сопровождению лиц с ограниченными возможностями здоровья и определению его главной цели. Выявлены пути решения проблем психолого-педагогического сопровождения и основы составления его модели.

Ключевые слова: инклюзивное образование, лица с ограниченными возможностями здоровья, психолого-педагогическое сопровождение, тьютор, педагог, образовательные организации.

The existing educational system of the Russian Federation is undergoing a significant number of changes today, including updating standards at all levels of education, creating a digital educational environment, and focusing on personal outcomes for each student, among others. In addition to these processes, the education system pays great attention to modernizing approaches to teaching, upbringing, and

providing additional professional education for students with disabilities (hereinafter referred to as PWD) [1, p. 194].

In 1994, the Salamanca Declaration on Principles, Policy, and Practice in Special Needs Education was formulated, outlining the ideas and principles of inclusive education [2]. This document established provisions on why children with disabilities should be educated in regular schools, namely:

– all children have the right to receive an acceptable level of education;

– all children have unique characteristics, interests, abilities, and learning needs.

The Salamanca Declaration called on all countries to improve the level of education and create an inclusive environment for all students, especially those with special needs. As a result, countries that signed this document have established inclusive schools.

Inclusive education is equal access to education for all individuals without exception. In inclusive education, children with disabilities are educated alongside their peers, allowing them to interact. This feature will help reduce the level of marginalization and isolation of children with disabilities, as they will always be part of society.

Based on Article 27 of Clause 2 of Federal Law No. 273 “On Education in the Russian Federation”, inclusive education exists in Russia, which ensures equal access to education for all students, regardless of physical, mental, intellectual, cultural-ethnic, linguistic, and other characteristics [3]. The law also interprets that parents of students have the right to choose the form of education based on the child’s own opinion, as well as the recommendations of the psychomedical and pedagogical commission. According to statistical monitoring data from the Ministry of Education of Russia, there are approximately 10,000 inclusive schools and 8,000 inclusive kindergartens [4].

Even though inclusive schools have been in existence for a long time, in practice, there are difficulties such as:

– problems with children’s perception and assimilation of information due to lack of specialists working with children with disabilities;

– problems with acceptance of children with disabilities by the surrounding society;

– problems with children with disabilities receiving quality and inclusive education.

To solve these problems, it is necessary to develop a model of psychological and pedagogical support for individuals with disabilities.

The concept of support is multifaceted. In pedagogy, support is understood as activities aimed at creating favorable conditions for the subject of interaction. Pedagogical support is organized education for children with disabilities, which allows the child to adapt in the learning environment, receive education, realize their potential, and meet their needs [5, p. 198]. In pedagogy, the following forms of psychological and pedagogical support are distinguished:

1) consultation;

2) diagnosis;

3) corrective-developmental work;

4) education.

Such specialists as defectologists, tutors, speech therapists, psychologists, social pedagogues, and class teachers engage in this type of activity. These specialists must have the appropriate education that allows them to work with special needs children.

The Salamanca Declaration includes a section “C. Recruitment and Preparation of Teaching Staff”, which states that if teachers have intellectual and physical disabilities, it can serve as a model of behavior for children [5]. In addition to this, this section states that a good teacher should:

1) have good teaching skills;

2) be able to adapt to the content of the curriculum;

3) use assistive technologies;

4) use individual teaching procedures;

5) be able to assess the needs of special children.

In the current times, there is a shortage of specialists in psychological and pedagogical support. This is not due to a lack of professionals working with individuals with disabilities in inclusive schools, but rather because schools are admitting children with various developmental disorders, such as delayed mental development, mild intellectual disability, multiple developmental disorders, etc. The current training of professionals does not equip educators with the knowledge and skills necessary to work with children with these types of disabilities. Teachers do not know how to help a child with intellectual disability understand and process certain information, which leads to a reluctance to continue educating such children.

In addition to this, not all specialists working with special needs children have a arsenal of correctional-developmental teaching techniques. Thus, the teacher should not only provide children with theory but also contribute to their development, realization of their potential and abilities they possess. However, as practice shows, in the current educational environment, teachers lack technologies for correctional-developmental work with individuals with disabilities. At the very least, the teacher should develop a separate program for working with special needs children and find a special teaching aid that the child will be comfortable using to follow the chosen program [6, p. 39]. Additionally, the teacher should contribute to the adaptation of the special needs child in the group, create a positive perception of children with special needs in the classroom, teach the group to interact and help such children.

Another problem is the lack of interaction between the teacher and specialists from the psychological and pedagogical support service. This problem is due to the fact that schools do not have positions for specialists working with children with special educational needs, which means that teachers have to combine the tasks of a tutor with working with regular children. Additionally, schools usually have only one psychologist and one speech therapist, while there are many children with special educational needs, so the work on psychological support by these specialists will proceed slowly and ineffectively.

The most acute problem of inclusive education is the society’s unpreparedness to accept special needs children. Very often, children with special needs become victims of bullying from their peers, which is why parents do not want their children

to attend regular schools and isolate them at home. Educators should engage in educational work with regular children and their parents, monitor the adaptation of special needs children in the group, and organize additional activities to bring peers closer together. This work is necessary because people with disabilities, regardless of age, are often isolated from society, lead marginal lifestyles, and therefore it is necessary to start working on the interaction of different segments of society from childhood.

In addition to the problems listed above, educational organizations also face difficulties in scheduling for people with disabilities, lack of correctional-educational programs that meet the needs of teachers, inaccuracies in medical diagnostics resulting in a lack of results in the correctional process, and others. To solve these problems, it is necessary to:

– improve the regulatory framework and scientific-methodological foundations governing the activities of specialists working with people with disabilities;

– develop a psychological-pedagogical support service in educational organizations;

– address the issue of a shortage of specialists working with people with disabilities in educational organizations [7, p. 23].

In connection with this, it can be concluded that educational institutions do not correspond to the model of psychological-pedagogical support for individuals with disabilities. Previously, children with speech, hearing, or vision impairments entered schools and kindergartens, but currently educational organizations are faced with children who have developmental delays, autism spectrum disorders, sensory impairments, and others. To work with such children, a large number of specialists are required: defectologists, tutors, speech therapists, psychologists, social pedagogues, who will have the appropriate education and set of skills for working with individuals with disabilities.

There is an opinion that inclusive education does not need to be developed because it does not achieve its goals, and society does not accept it. Many also express opinion that inclusive education is:

– expensive;

– ineffective;

– only relevant for disabled individuals;

– not suitable for the current society.

However, it is necessary to note that the goal of psychological and pedagogical support is to provide children with disabilities with a quality and complete education, to reveal their potential and the capabilities they possess, despite the existing problems. In the conditions of an effective system of psychological and pedagogical support, the following tasks are solved:

a) diagnosis of intellectual and personal development of the child;

b) diagnosis of the child’s adaptation in the group;

c) creating favorable conditions for personal development;

d) solving emerging difficulties through counseling;

e) increasing the competence of teachers and parents.

Currently, children with disabilities are not only eligible for general and vocational education, but also for higher education and the right to work in any field. The modern trend in education development worldwide contributes to improving the educational process and enhancing the quality of education at all levels.

In the Republic of Bashkortostan, inclusive education covers 124 educational institutions, including higher education institutions. One example is the Bashkir State Pedagogical University, where individuals with disabilities have the opportunity to receive higher education. People with disabilities have the right to study in bachelor's, specialist, and master's programs in the following specialties:

– Information Systems and Technologies
– Pedagogical Education
– Social Work
– Linguistics
– Psychology
– Physical Education
– Pedagogy and Psychology of Deviant Behavior.

People with the following conditions are educated at Bashkir State Pedagogical University: musculoskeletal disorders, visual impairment, somatic diseases, hearing impairment, etc.

In addition, the education system of the Republic of Bashkortostan has a three-tier structure of psychomedical and pedagogical services:

1) a psychomedical and pedagogical commission that deals with the diagnosis of children in the republic;

2) a psychomedical and pedagogical consultation at the municipal education authority that helps minors with special needs to undergo adaptation;

3) a psychomedical and pedagogical council of an educational institution that is intended to provide psychomedical and pedagogical support to each child.

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УДК 628.4

PROBLEMS OF WASTE RECYCLING AND WAYS TO SOLVE THEM

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Abstract. Over the past decades, not only the qualitative composition, but also the quantitative composition of recycled solid waste has changed. Polymers have entered our lives and become an integral part of it, which has led to a serious problem. The existing waste disposal system is outdated and requires new approaches. This article discusses the problems associated with waste disposal and presents methods for their rational solution.

Keywords: solid household/municipal waste, waste recycling, secondary raw materials, recycling, environmental efficiency.

ПРОБЛЕМЫ ПЕРЕРАБОТКИ МУСОРНЫХ ОТХОДОВ И ПУТИ ИХ РЕШЕНИЯ

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Аннотация. За последние десятилетия изменился не только качественный, но и количественный состав утилизированных ТБО. Полимеры внедрились в нашу жизнь и стали ее неотъемлемой частью, что привело к серьезной проблеме. Существующая система утилизации отходов устарела и требует новых подходов. В данной статье рассмотрены проблемы, связанные с утилизацией отходов, и представлены способы их рационального решения.

Ключевые слова: твердые бытовые / коммунальные отходы, переработка мусора, вторичное сырье, утилизация, экологическая эффективность.

In Russia, one of the most pressing problems of the 21st century is the problem of waste management. Each Russian generates more than 400 kg of waste per year, and more than 70 million tons of household waste are collected throughout the country.

Based on statistics, in the Russian Federation only 7 % of waste is recycled, and 93 % is sent to landfill. The existing disposal and recycling system is outdated and requires significant changes to effectively solve this problem [1].

Before the technological revolution, human waste was usually buried in landfills, where it decomposed naturally without harming the environment. Waste paper, glass containers and scrap metal were most often not thrown into general trash cans, but were handed over to special collection points.

The composition of the waste mainly consisted of organic materials, which contributed to rapid decomposition. The volume of waste mass was significantly smaller, which ensured rapid disposal of solid waste components. Currently, the composition of garbage waste has changed significantly (Figure 1) [2].



Figure 1. Share of different types of waste that are sorted in 2022

Synthetic materials have become an integral part of our lives, creating many conveniences for people. However, this has led to a serious problem, the formation of a new type of waste. Products containing polymers can remain in landfills for decades and centuries, gradually accumulating. Plastic decomposes very slowly, which leads to the formation of huge mountains of garbage.

At the moment, two main reasons for the garbage crisis in Russia have been identified:

1. Population growth in large cities is the main reason for the increase in waste volume. 75 % of the country's population is concentrated in these cities, which creates a significant burden on city utilities. As a result, cities such as Moscow, St. Petersburg, Novosibirsk and others have already faced the problem of the "Garbage Ring". A particularly record number of landfills is observed in the Moscow region [3].

2. Imperfect waste disposal system. These include: untimely waste removal, unauthorized landfills and their uneven distribution, shadow schemes for the removal of solid waste, the lack of specialized bins for separate waste collection, and a low level of recycling of secondary raw materials.

400 factories are engaged in recycling; the resources of enterprises are not enough throughout the country. Last year showed that 74 % of audited companies that call themselves recyclers actually are not. In every region there is a shortage of landfills, processing plants, and equipment [1].

Due to the huge number of illegal landfills, improper burning of garbage, as well as its burial, soil pollution occurs, which leads to poisoning of water, air and the food we eat (Figure 2) [2].

Garbage accumulations under the influence of sunlight emit harmful gases. They spread over several kilometers, poisoning all living things. Hydrogen sulfide and methane react with oxygen and this leads to the formation of thermal energy, resulting in a greenhouse effect.

To solve all these problems, a global reset of the current system and a transformation of the thinking of people who do not give due importance to this need are necessary.

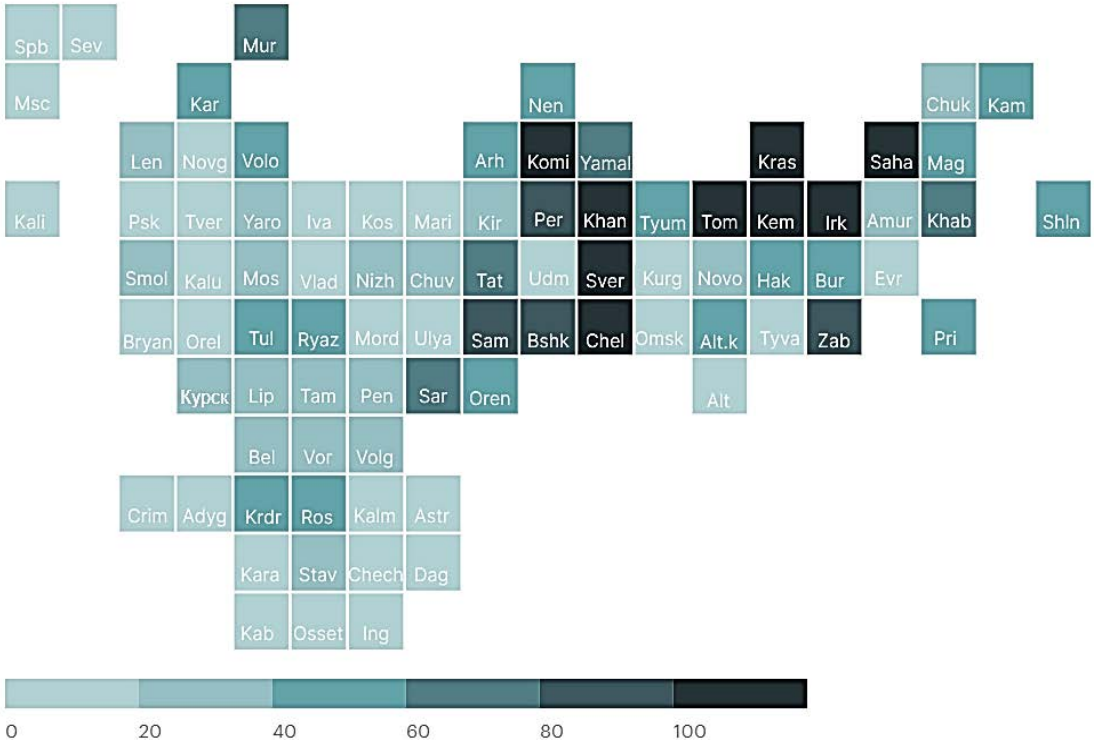


Figure 2. The number of landfills included in the Rospotrebnadzor register

Solutions to the waste problem have already been successfully applied in many European countries, Japan, the USA and South Korea.

Sweden is the leader in waste processing and disposal; almost 99 % of waste is recycled for the benefit of the country. This result was achieved thanks to the “ecological education” of every citizen of the country. Before the garbage is taken for recycling, the Swedes themselves sort it into containers. Most residents have four containers at home for different types of waste: organics, glass, plastic and hazardous waste.

The eco-friendly waste collection system includes underground vacuum chutes that replace traditional garbage trucks. When the container is full, it automatically sends a signal to the system. In response to the signal, the system is activated and simultaneously empties all containers of the same type throughout the residential block. This waste, already sorted, is sent through underground waste chutes directly to local waste treatment plants.

The Swedes separately sort and hand over plastic and aluminum bottles marked with the PANT mark to supermarkets. Essentially, they only pay for the drink, while

the bottle itself has a deposit value. An aluminum can can be returned for 1 SEK, and a plastic bottle for 2 SEK. After returning the bottles to special machines, a receipt is issued that can be used to pay for purchases at the store where the bottles were returned for recycling. In addition to government organizations, commercial companies are actively involved in waste collection and disposal. For example, pharmacies accept medications and syringes, and hardware stores collect their own products for recycling. After this, the materials are reused in production, which helps to save the resources of the companies themselves [4].

Good waste recycling rates are also noticeable in Austria. The country recycles about 63 % of its domestic waste. But it is worth noting the special approach of the Austrians to the construction of waste incineration plants. Vienna is home to the world-famous Spittelau incineration plant. The factory was reconstructed after a massive fire and became a magnet for tourists from all over the world, thanks to the cheerful architectural and artistic techniques of Friedensreich Hundertwasser. The colorful façade, the golden orb in the chimney, the greenery on the roof and the planted trees have made the ordinary industrial plant an unmistakable and significant landmark of Vienna (Figure 3). Such solutions were able to reduce the level of anxiety of the population, as well as create a new attraction that will remind us of the importance of ecology in our time [5].



Figure 3. Spittelau incineration plant in Vienna

The technological line of the Spittelau plant is as follows: before entering the plant, waste undergoes a weighing procedure on scales; it is then sent to a bunker with a volume of approximately 7,000 m^3, from where it is transported to the incineration furnace; the hot gases produced by burning waste pass through a heat exchanger, where steam is generated; steam is used for both central heating and electricity generation; the smoke generated during the combustion process is purified using modern

purification systems; gas emissions are carried out through a pipe located at an altitude of 126 meters. The Spittelau plant processes approximately 250,000 tons of municipal waste per year. The company produces: 120,000 MW*h of electricity, 500,000 MW*h of heat, 6,000 tons of scrap metal, 60,000 tons of ash, etc. The environmentally friendly heating produced in Spittelau is enough for 60,000 homes.

Conclusion.

There are a huge number of options for solving problems associated with waste disposal. But their implementation will require a lot of time and resources. An example diagram looks like this:

1. Reducing waste:
   - Reasonable consumption, avoidance of purchasing unnecessary goods
   - Increased product lifespan
   - Reducing production waste
   - Gradual abandonment of plastic packaging, especially single-use packaging
   - Transition to reusable household items
2. Establishing a waste management system.
   - Organization of separate waste collection in courtyards and in the private sector
   - Providing public services with equipped transport
   - Proper sorting for subsequent disposal
   - Creation of complexes for receiving secondary raw materials
3. “Environmental education” of the population.
   - Transformation of thinking of all sectors of society towards environmental problems
   - Creation of “ecological police” bodies
   - Development of an incentive system for recycling waste
4. Creation of new waste processing complexes.
   - Construction of new factories
   - Improving the waste logistics system
   - Construction of separate waste collection points in cities

At the moment, the problem of waste disposal in St. Petersburg, as well as the Leningrad region, is being dealt with by the Nevsky Environmental Operator. At the end of 2022, NEO opened the first waste processing complex in St. Petersburg at 116 Volkhonskoye Shosse. The capacity of the first stage of Volkhonka is 200 thousand tons per year. The waste arriving here will undergo a sorting procedure, which will allow selecting fractions that can be reused [6].

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УДК 621.313.13

PERMANENT MAGNET SYNCHRONOUS REACTIVE MOTOR

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Abstract. With the development of technology and the constant growth of interest in sustainable and environmentally friendly means of transportation, electric cars are becoming more and more popular all over the world. This paper deals with a new electric motor called permanent magnet synchronous reactive motor. In order to understand its working principle and design, synchronous reactive motors and permanent magnet motors are also considered.

Keywords: electric car, electric motor, permanent magnet synchronous reactive motor, synchronous reactive motor, permanent magnet motor.

СИНХРОННЫЙ РЕАКТИВНЫЙ ДВИГАТЕЛЬ С ПОСТОЯННЫМИ МАГНИТАМИ

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Аннотация. С развитием технологий и постоянным ростом интереса к устойчивым и экологически чистым средствам передвижения электромобили становятся все более популярными во всем мире. В данной статье рассматривается новый электродвигатель, получивший название синхронный реактивный двигатель с постоянным магнитом. Для того чтобы понять принцип его работы и конструкцию, также рассмотрены синхронные реактивные двигатели и двигатели с постоянными магнитами.

Ключевые слова: электромобиль, электродвигатель, синхронный реактивный двигатель с постоянным магнитом, синхронный реактивный двигатель, двигатель с постоянными магнитами.

The modern world is facing the problem of ecological crisis and the need to eliminate environmental pollution. The automotive industry, which is one of the largest air polluters, has started to actively search for alternative technologies that can reduce

harmful emissions. As a result, electric vehicles have come to the forefront in addressing this problem.

Currently, electric cars are gaining popularity, obviously the electric car market is moving forward in huge strides. Most likely in the near future they will squeeze out cars with internal combustion engines. There are many brands and models of electric cars on the market today [1].

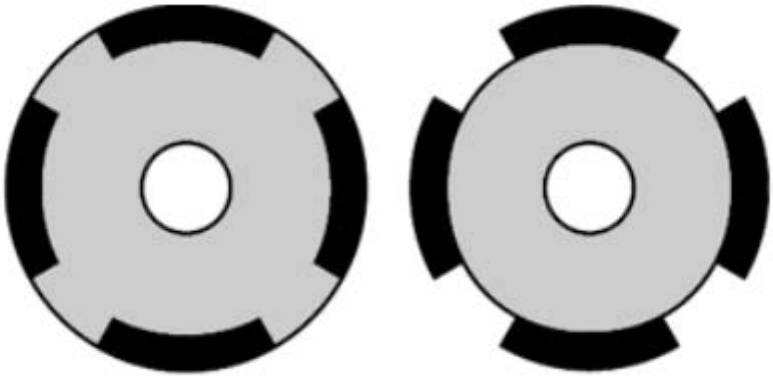
The need for the introduction of electric cars is as follows: the environmental aspect of electric cars is their ability to have no emissions of harmful substances such as carbon dioxide and nitrogen oxides. Switching to electric vehicles will reduce their negative impact on the environment, leading to better air quality and combating climate change. In addition, electric vehicles have high energy efficiency compared to internal combustion vehicles. Thanks to energy recovery systems, electric vehicles can utilize energy that would normally be lost as heat when braking or reducing speed. This makes it possible to significantly increase the driving range on a single charge.

The characteristics required to use an electric motor in electric vehicles include obtaining high torque at low speeds, when starting or climbing uphill and simultaneously high power at high speeds [2].

Asynchronous electric motors are widely used for electric vehicles. An induction motor consists of a stator and a rotor. In such a motor, alternating current is passed through the stator windings to create a rotating magnetic field that induces electric currents in the rotor windings and thus creates an opposing magnetic field, causing the rotor to rotate in the same direction as the magnetic field.

One of the leading companies that are developing eco-friendly cars is Tesla. In 2019, this company has become the world's largest electric car manufacturer in terms of sales. This automaker has managed to roll out three electric car programs: Model S, Model X, Model 3 [3]. The first two models are equipped with conventional induction motors. But Model 3 debuted with a new motor technology that Tesla calls Permanent Magnet Synchronous Reluctance Motor (PMSRM) [4].

Permanent magnet motors have permanent magnets in the rotor instead of rods. Thus, the rotating magnetic field in the outer tube interacts with the permanent magnetic field to create a force and make the rotor rotate. Permanent magnet motors work on the basis of attraction between two magnetic fields. They produce good starting torque when controlled by a controller. Also, they are not prone to energy loss in the rotor. Permanent magnets are installed on the edges of the rotor. This rotor design has no inductive current, which reduces the required input energy and results in higher efficiency than induction motors. In addition to higher starting torque, a permanent magnet motor operates at synchronous frequency. A permanent magnet motor provides good torque when the car makes the first jerk at startup. However, on a long trip, the motor has poor performance, due to the inverse electromotive force. The magnetic field lines created by the permanent magnets connect to the stator windings and generate electromotive force there. The higher the rotor rotation frequency, the greater the back EMF [5]. Figure 1 shows the design of permanent magnet motor rotor (a – smooth rotor, b – explicitly pole rotor).



a b

Figure 1. Permanent magnet motor rotor design

Synchronous reactive motors are a special type of synchronous machines in which the torque is due to the inequality of magnetic conductivities along the transverse and longitudinal axes of the rotor. The key distinguishing feature of synchronous jet motors is that there is no excitation on the rotor side. Instead, the main magnetic flux in these motors is generated solely by the rotating magnetomotive force of the stator winding. By applying alternating current through the stator windings, a rotating magnetic field is created in the air gap of the motor. The resulting torque occurs when the rotor tends to set its most magnetically conducting axis in line with the external magnetic field to minimize the resistance in the magnetic circuit [6, 7]. Figure 2 shows the design of this synchronous reactive motor.



Figure 2. Synchronous reactive motor

The PMSRM motor design is a coupled permanent magnet motor with a synchronous jet motor. That is, the permanent magnets are placed in the grooves of the iron core of the synchronous jet motor. By utilizing the resistance property of iron, Tesla reduced the effect of the magnet on the stator winding and thus reduced the effect

of back EMF [8]. The magnets have a radial pole orientation which is alternating. The system is designed so that at low speeds the magnet field interacts with the rotating stator field to produce torque, and at high speeds it is compensated and therefore does not generate parasitic voltages in the stator windings. Therefore, only the reactive effect is involved at high speeds. This design is shown in Figure 3.

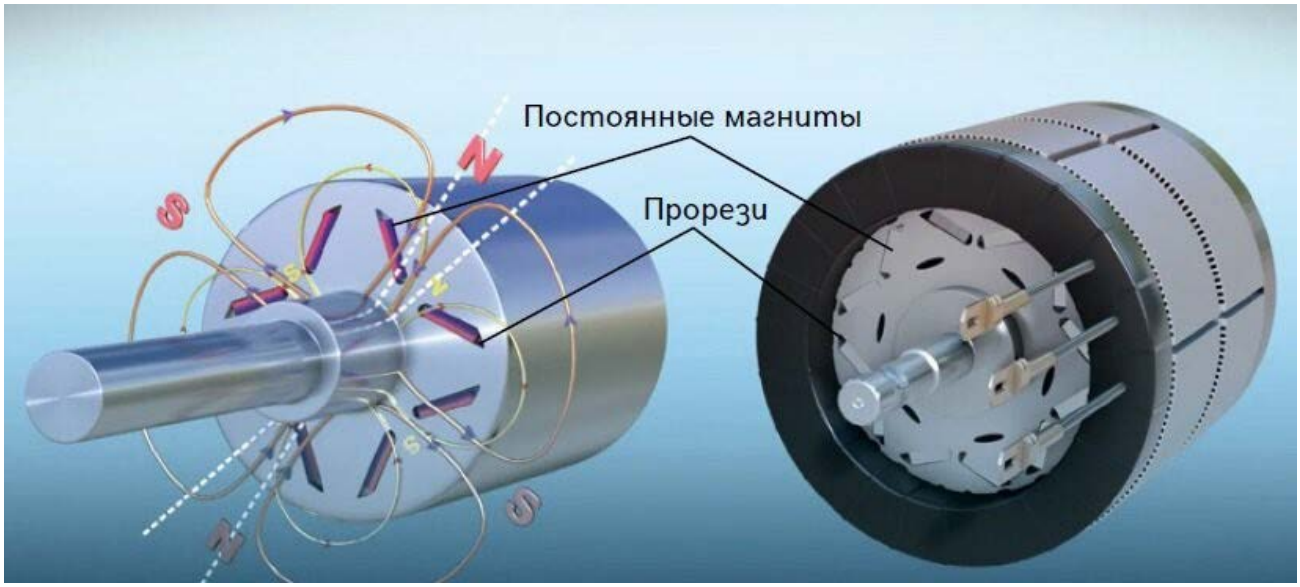


Figure 3. PMSRM motor design

Another specific Tesla innovation is segmented magnets, i.e., four parts instead of a solid magnet. This helps to reduce eddy currents and reduces the risk of magnet overheating [9].

Thus, PMSRM motor provides superior efficiency resulting in longer battery life and increased range of electric vehicles, high power output relative to its size and weight resulting in compact and lightweight electric vehicle designs, fast and accurate torque control, improving acceleration performance and responsiveness. Permanent magnet synchronous jet motors are simpler in design, lacking brushes, and commutators, resulting in lower maintenance requirements and longer life. The design provides better cooling and heat dissipation, minimizing the risk of overheating and ensuring optimal motor performance. These engines produce less noise and vibration than traditional internal combustion engines, resulting in a quieter and more comfortable driving experience.

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УДК 330.341

INCREASING THE EFFICIENCY OF MANAGEMENT OF HIGHER EDUCATIONAL INSTITUTIONS IN THE PROCESS OF DEVELOPING AN ENTREPRENEURSHIP UNIVERSITY

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Abstract. This article discusses the problem of improving the mechanism for managing educational activities. The issue of development of the entrepreneurial model of the university in the context of globalization is revealed, which involves the process of active implementation of educational, scientific-innovative and commercial activities. In the context of the entrepreneurial model, universities become not only centers of education and scientific research, but also active participants in the development of the state, creating and implementing innovative products and technologies.

Keywords: management, scientific and innovative activities, globalization, education, entrepreneurial model.

ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ УПРАВЛЕНИЯ ВЫСШИМИ УЧЕБНЫМИ ЗАВЕДЕНИЯМИ В ПРОЦЕССЕ РАЗВИТИЯ ПРЕДПРИНИМАТЕЛЬСКОГО УНИВЕРСИТЕТА

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Аннотация. В данной статье рассматривается проблема совершенствования механизма управления образовательной деятельностью. Раскрывается вопрос развития предпринимательской модели университета в условиях глобализации, которая предполагает процесс активного внедрения учебной, научно-инновационной и коммерческой деятельности. В условиях предпринимательской модели университеты становятся не только центрами образования и научных исследований, но и активными участниками развития государства, создавая и внедряя инновационные продукты и технологии.

Ключевые слова: управление, научно-инновационная деятельность, глобализация, образование, предпринимательская модель.

The economic recovery of many countries around the world is associated with the development of education. Numerous studies confirm the connection of education

and training with labor productivity and economic growth of the state [1]. In turn, the mechanism for managing the entrepreneurial activity of higher educational institutions is a system of certain measures that are aimed at organizing and regulating the entrepreneurial activity of higher educational institutions. The main goal of this mechanism is to ensure their competitiveness and development in the conditions of the educational services market. It is important to note that in modern society education plays a key role in the formation of a successful and competitive personality [2]. Globalization and international integration in higher education are associated with expanding borders and increasing international competition. Universities, which are the main centers of educational activity, need to constantly improve and adapt the process according to the changing requirements of the labor market and society as a whole. In a competitive environment in the educational services market, the challenge arises not only of ensuring high quality education at universities, but also of creating conditions for the active involvement of students and teachers in entrepreneurial activities. Entrepreneurship is an important tool for developing innovation, developing and implementing educational programs, creating jobs and increasing the competitiveness of the economy.

This promotes the development of critical thinking, problem solving skills and adaptation to rapid change [3]. Additionally, one of the key advantages of this model is the creation of conditions for the commercialization of knowledge and technologies, which allow universities to receive additional sources of funding and improve the quality of education [1].

Increasing the efficiency of management and development of educational activities, in particular educational and scientific-innovative activities within the framework of commercial activities, is an important aspect of modern higher education. This process helps to establish connections between education and the real needs of business and society, and also contributes to the development of a market economy and progress.

Let us consider how the entrepreneurial model of higher education institutions affects educational, research and innovation activities.

Educational activities within the framework of the development of an entrepreneurial university are aimed at preparing students for future professional activities. It includes not only the acquisition of theoretical knowledge, but also the development and acquisition of practical skills that are necessary to work in a market economy.

Research within an entrepreneurial university involves the process of searching and creating new knowledge, technologies and innovations that can be used to create value and generate profit. This process may include conducting scientific research, developing new technologies, as well as creating and implementing innovations. Entrepreneurial universities strive to ensure that their research is aimed not only at solving real-world problems, but also at creating business and economic opportunities.

Innovation activity consists of the development and implementation of new technologies, products and services that increase the competitiveness of the university and its economic performance [4].

Generally, for the development of an entrepreneurial university, a mechanism for managing the educational activities of an entrepreneurial university is needed, which may include the following elements:

– planning and forecasting;
– organization and management;
– quality control;
– efficiency mark.

After analyzing the entrepreneurial model of universities and the mechanisms for improving it, we can come to conclusions. Firstly, universities that adopt an entrepreneurial approach can respond more quickly to social changes in accordance with market demands, that is, they can adapt curricula, introduce new technologies and forms of education [5].

Secondly, an active search for funding, resources, commercial sources of income and active franchising allow universities to invest in modern laboratories, equipment and research projects. This process provides an opportunity to conduct high-quality scientific research [6].

Thirdly, the entrepreneurial model of higher education institutions helps to increase scientific potential and attract talented researchers from multidisciplinary areas. This mechanism contributes to the formation of a favorable environment for the exchange of knowledge, experience, and research results.

Fourthly, universities can create incubators and startup accelerators that will be aimed at developing the entrepreneurial activity of students and researchers. This process can help stimulate innovation and research that is linked to practical business projects.

Based on the above, it is worth noting that the entrepreneurial model of universities can also cause certain difficulties. Among them are changes in research funding in favor of commercially profitable directions, a decrease in academic freedom and dependence on sponsorship.

Thus, in order for universities to successfully realize their potential in the field of entrepreneurship, it is necessary to improve the process of managing entrepreneurial activities. It is necessary to increase its effectiveness, based on the idea of cooperation and interaction between countries. Accordingly, each university needs to set goals, assess its resources, potential and needs of the educational and economic market, in order to select the optimal mechanism to promote development and achieve its goals.

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УДК 004.891.3

INTEGRATION OF ARTIFICIAL INTELLIGENCE INTO THE EDUCATIONAL PROCESS: DEVELOPMENT AND IMPLEMENTATION OF AN INNOVATIVE CHATBOT FOR PERSONALIZED LEARNING

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Abstract. This article is dedicated to the development of an innovative chatbot based on artificial intelligence for the personalization of the educational process. The research focuses on adapting educational content to the needs of each student using data analysis and machine learning. Testing results demonstrate an improvement in student engagement and educational outcomes, underscoring the potential of integrating AI into educational systems.

Keywords: artificial intelligence, personalized learning, chatbot, data analysis, machine learning, educational technology, student engagement, educational outcomes.

ИНТЕГРАЦИЯ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ОБРАЗОВАТЕЛЬНЫЙ ПРОЦЕСС: РАЗРАБОТКА И ВНЕДРЕНИЕ ИННОВАЦИОННОГО ЧАТ-БОТА ДЛЯ ИНДИВИДУАЛИЗАЦИИ ОБУЧЕНИЯ

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Аннотация. Статья посвящена разработке инновационного чат-бота на основе искусственного интеллекта для индивидуализации учебного процесса. Исследование акцентирует внимание на адаптации образовательного контента под потребности каждого учащегося, используя анализ данных и машинное обучение. Результаты тестирования показывают улучшение вовлеченности детей и повышение их образовательных показателей, что подчеркивает потенциал интеграции Artificial Intelligence (AI) в образовательные системы.

Ключевые слова: искусственный интеллект, индивидуализация обучения, чат-бот, анализ данных, машинное обучение, образовательные технологии, вовлеченность учащихся, образовательные результаты.

In the era of digitalization, the educational sector is undergoing significant transformations, demanding innovative approaches to teaching. The integration of AI

opens up new horizons for customizing the learning process, offering unique opportunities to adapt educational programs to the individual needs of students. The effectiveness of such personalization becomes particularly noticeable when using chatbots capable of real interaction and providing feedback during the learning process. This article aims to explore the potential of AI integration in the form of chatbots for personalized learning, emphasizing their impact on student achievement and cognitive development, addressing the growing demands for educational.

Modern advancements in machine learning and data analysis enable chatbots to process large volumes of information, optimizing the educational process and making it more flexible and accessible. These technologies not only enhance student engagement but also contribute to improved educational outcomes, which is a crucial factor in meeting the ever-increasing demands for educational quality.

The aim of this article is to explore the potential of integrating AI in the form of chatbots for individualizing the educational process. The article will present and analyze data collected during the development and experimental testing of a chatbot prototype equipped with AI features for dynamic adaptation of educational materials. The focus is on assessing the impact of this tool on academic performance and cognitive development, allowing us to determine the extent of influence of automated educational technologies on the learning environment.

AI is gaining increasing importance in the field of education, attracting the attention of researchers and practitioners. Over the past years, there has been a steady increase in research in this area, with publications on the application of AI in education growing by 48 % from 2018 to 2022 according to Scopus and Web of Science data [1].

A study on the impact of chatbots on the higher education process in Ghana showed significant results. In an experiment involving 68 students, those who interacted with chatbots achieved better academic outcomes compared to those who interacted solely with instructors. This research contributes to the emerging literature on AI chatbots and their ability to enhance students' academic performance by providing important insights into the application and development of virtual educational assistants using non-programming techniques, which is particularly suitable for organizations with limited financial and human resources [2].

The analysis of the literature reveals that most research in the field of AI in education is related to computer science and STEM disciplines, often utilizing quantitative methods. The primary applications of AI in education include profiling and prediction, assessment and evaluation measures, adaptive systems, personalization, and the development of intelligent learning systems.

The widespread integration of AI in education opens up new opportunities to support learners at all educational stages. However, this development is accompanied by emerging ethical implications and risks, particularly concerning data privacy and security due to the necessity of handling large volumes of data, including user's personal information.

Therefore, the current study aims to analyze the present state of AI development and utilization in the educational environment, assess its potential, and identify opportunities for further advancement [1, 2].

The effectiveness of implementing AI in the education system will be assessed through the “Cognium” project. This unique online resource assists parents and children in developing cognitive skills. The platform offers various interactive games and tests to assess a child’s abilities. The assessment results help to identify strengths and weaknesses and provide specific recommendations for further development. Parents can use the resource to find suitable sections and clubs and have access to an educational library. This project is valuable as a tool to enhance educational opportunities and support family education.

The research methodology of “Cognium” was adapted to assess the impact of an AI-trained chatbot on the cognitive development of preschool and early elementary school children. A mixed-methods approach combining quantitative and qualitative methods was employed to evaluate children’s abilities and teachability in a playful manner. The experimental group consisted of children regularly interacting with the chatbot, while the control group learned without its use. Data collection involved adapted tests on teachability, as well as observations and interviews with educators and parents. The results were analyzed using descriptive statistics and cognitive psychometrics.

The research placed a strong emphasis on ethical considerations when handling data from minors and their confidentiality. Additionally, the chatbot’s interface was tailored to ensure natural and comprehensible interactions with children in the specified age group.

For the “Cognium” project, a chatbot was developed and integrated with an educational platform. Leveraging a cloud-based platform for scalability and data security, the chatbot was equipped with a set of pre-trained machine learning models. These models were configured to recognize patterns in user queries and provide personalized educational materials and assignments.

The development process of the “Cognium” chatbot included several steps.

Platform selection. The optimal platform for the chatbot was selected based on its ability to deeply integrate with various educational app APIs and meet strict data security requirements, which are crucial when handling information related to children. The chosen platform for the “Cognium” project was Dialogflow by Google due to its high-security standards and integration capabilities with a wide range of educational app APIs. Dialogflow provides advanced tools for access management, data encryption, and compliance with privacy policies, essential when dealing with children’s data. Additionally, this platform boasts powerful machine learning features for creating intelligent and scalable chatbots capable of natural and intuitive user interactions [3].

Algorithm design. Natural Language Processing (NLP) algorithm design was conducted using cutting-edge libraries like Hugging Face’s Transformers, enabling a deep understanding of query context. Models were trained on a dataset containing typical questions from preschoolers and elementary school students to accurately extract intents and entities [4].

Interface development. The chatbot interface was created using child-centric design principles, incorporating vibrant colors, animations, and playful characters to make interaction with technology engaging and effortless. The interface design

underwent multiple stages of A/B testing to determine the most effective control elements and visualizations.

Integration aspects. The chatbot was tightly integrated into the educational platform, enabling automatic content updates and individual progress tracking. This integration allowed the use of data on each child's progress for dynamic curriculum adjustment and adaptive learning. The integration of the "Cognium" chatbot with the educational platform was implemented through a RESTful API, facilitating real-time two-way data exchange. Using webhooks and the platform's custom API services, the chatbot could retrieve current educational content and send user interaction data directly to the Learning Management System (LMS). This not only personalized content based on each child's progress and preferences but also enabled educators to monitor and adapt the learning process based on student progress and feedback.

As part of the research, a natural language processing (NLP) model was developed using transformers to automatically respond to students' questions. The model was trained on a dataset containing typical educational queries to optimize the accuracy and relevance of responses. Below is a code snippet implementing this functionality [5,6].

```
«# Importing the necessary library
from transformers import pipeline
# Initializing the transformer model for question answering
nlp_model = pipeline('question-answering')
# Function for handling student queries
def answer_question(question, context):
    # Using the model to answer the question based on the context
    response = nlp_model(question=question, context=context)
    return response['answer']
# Example query and context to demonstrate the model's operation
context = "Chatbots provide interactive learning using gamification elements."
question = "What methods do chatbots use for teaching?"
# Calling the function and printing the answer
answer = answer_question(question, context)
print("Answer:", answer)»
```

This code demonstrates the operation of a system capable of adapting to educational tasks and facilitating interactive dialogue with students. The developed chatbot, "Cognium" was tested in a controlled educational environment with preschoolers and elementary school students. The analysis of the results showed that the use of the chatbot significantly increased the level of engagement and interest in learning among children. More detailed test results are as follows.

1. Cognitive improvements: statistical analysis revealed that the average score on cognitive development tests in the experimental group increased from 65 % to 87 % after three months of using the chatbot. Children demonstrated improvement in areas related to memory, attention, and logical problem-solving.

2. Engagement analysis: observing students' interaction with the chatbot showed that the time spent on educational games and tasks increased from an average of 15 to 25 minutes per day, indicating deeper engagement in the learning process.

3. Teacher feedback: out of 15 surveyed teachers, 11 noted that the chatbot contributed to increased student activity and independence in the classroom, as well as reduced time spent on homework checking thanks to automated feedback.

4. Parental opinion: among 50 surveyed parents, 45 expressed a positive opinion about the chatbot, reporting increased interest in learning and improved academic skills in their children, especially in reading and mathematics.

5. Improved interaction skills: it's worth noting that the chatbot contributed to the development of communication skills in children. Behavioral data analysis showed that the quantity and quality of questions posed to the chatbot increased by 50 % by the end of the experiment. Children not only interacted with the chatbot more frequently but also formulated more complex and structured queries, indicating the development of critical thinking and independent information-seeking skills.

These results highlight the potential of AI-driven chatbots in the educational environment, offering new perspectives for individualized teaching approaches for young students.

Analyzing the results presented in the previous section, one can observe their alignment with theoretical approaches in pedagogy and educational psychology. The improvement in children's cognitive abilities and learning motivation through interaction with the "Cognium" chatbot reflects the principles of active learning and practical application of knowledge, which are supported by modern researchers in the field of educational technologies. The results demonstrate enhancements in cognitive development and educational engagement, in line with constructivist theory, emphasizing active student participation in the educational process. The observed increase in engagement and communication skills correlates with Vygotsky's concept of the zone of proximal development, highlighting the importance of support and interaction in learning [7].

However, it is important to consider the limitations of the study, including its short time frame and limited sample size. Future research should examine the long-term effects of using chatbots and expand the experimental base to include a broader and more diverse audience. Additionally, it is crucial to conduct further research on the ethical and confidentiality aspects of using AI in interaction with a child audience.

The concluding stage of the research on the "Cognium" chatbot demonstrates its significant potential in enhancing the educational process for young learners. The results emphasize that the implementation of AI technologies can be a key tool in developing an individualized approach to education, taking into account the needs and abilities of each child. The data confirms that the use of the chatbot leads to improved academic performance and engagement, particularly crucial for preschool and early elementary school children. However, the study also highlights the need for further analysis of the impact of AI on children's social development and psychological well-being. Recommendations include the development of comprehensive educational programs integrating chatbots as supplementary tools, ensuring data transparency, and adhering to privacy norms. Future research should focus on scaling up experimentation and assessing the long-term effects of chatbots on the educational process, including socialization and emotional development, while also addressing potential negative

consequences of excessive automation and finding a balance between technological innovation and traditional teaching methods.

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УДК 621.3

REVOLUTIONARY TRANSISTOR TECHNOLOGY: TRANSITION TO THE ERA OF ELECTRONICS OF THE FUTURE

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Abstract. In recent decades, the electrical engineering industry has come a long way, leading to the creation of increasingly powerful and compact devices. However, progress in the field of conventional transistors, the main elements of modern electronic systems, is beginning to reach its limits. Limitations related to size and performance make it necessary to search for new approaches to the creation of electronic components of the future.

Keywords: high technology, exciton, nanoexciton, nanoexciton transistor, quasiparticle, lithography.

РЕВОЛЮЦИОННАЯ ТЕХНОЛОГИЯ ТРАНЗИСТОРОВ: ПЕРЕХОД К ЭРЕ ЭЛЕКТРОНИКИ БУДУЩЕГО

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Аннотация. В последние десятилетия индустрия электротехники проделала огромный путь развития, приводящий к созданию все более мощных и компактных устройств. Однако прогресс в области обычных транзисторов, основных элементов современных электронных систем, начинает достигать своих пределов. Ограничения, связанные с размерами и производительностью, вызывают необходимость поиска новых подходов к созданию электронных компонентов будущего.

Ключевые слова: высокие технологии, экситон, наноэкситон, наноэкситонный транзистор, квазичастица, литография.

Nowadays, our world is increasingly becoming digital and is rapidly developing in the direction of high technologies. The requirements for efficient and fast electronic devices are steadily increasing. In this context, interest in new materials and new

methods for creating nanoelectronic components is skyrocketing. Transistors that amplify electrical signals are not perfect: they lose thermal energy and limit the signal transmission rate, which reduces their performance. Therefore, one of the latest achievements in this field is the appearance of a new type of transistors, which promise to significantly increase the throughput and energy efficiency of electronic systems.

A team from the Pohang University of Science and Technology (POSTECH), consisting of Professor Ken-Dak Pak and Yejong Ku from the Faculty of Physics, and a team from ITMO University in Russia, led by Professor Vasily Kravtsov, jointly developed a nanoexiton transistor based on heterostructural semiconductors with excitons inside and between layers (Figure). The discovery of a nanoexiton transistor happened thanks to research in the field of nanotechnology and photonics. It overcomes the limitations of modern transistors [1, 2].

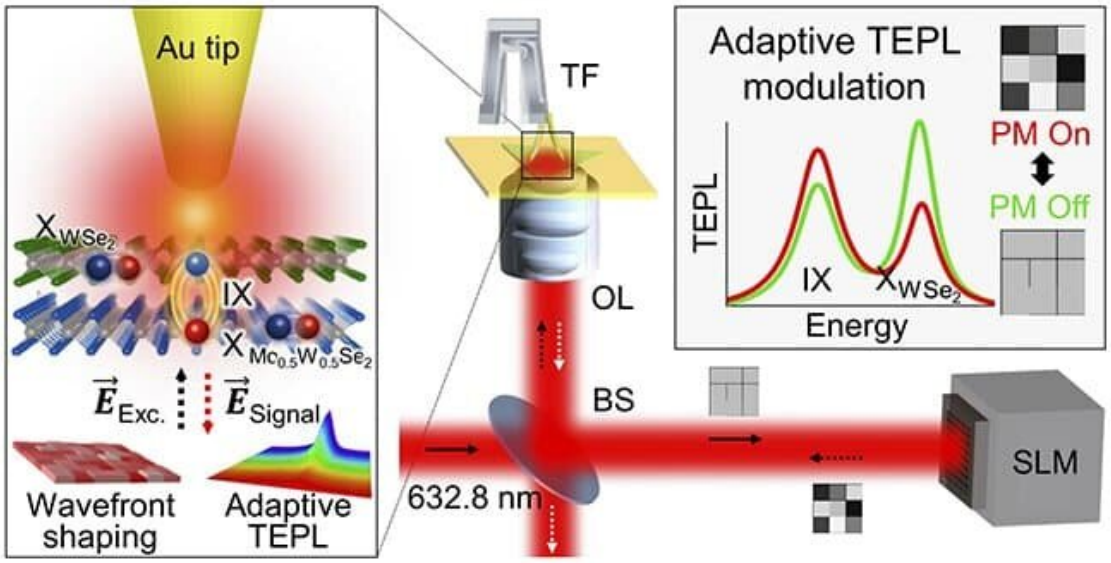


Figure. Method of operation of a nanoexiton transistor

A nanoexciton transistor uses intralayer and interlayer excitons. Scientists emphasize that quasiparticle excitons, responsible for the emission of light in semiconductors, are necessary to create a new generation of emissive elements that generate less heat and have potential for use in quantum technologies in the future.

Thus, the described technique, combining a photonic nanoresonator with a spatial light modulator, not only makes it possible to reversibly control excitons, but also a nanoexiton transistor is capable of processing large data arrays at the speed of light with minimal heat loss [3].

Excitons have become an important topic of study in solid state physics, they are complex quasiparticles representing the bound state of an electron and a hole connected by the Coulomb interaction.

In an attempt to use these phenomena in practice, nanoexitons were obtained – quasi-particles formed as a result of the interaction of photons and excitons in semiconductor systems, which, in turn, make it possible to create high-speed and efficient transistors.

A quasiparticle is an elementary excitation (quantum of collective oscillation) of a set of strongly interacting particles. This is a representation of the behavior and properties of a group of particles, which is similar to the properties of one large particle. There are both similarities and fundamental differences between quasiparticles and ordinary elementary particles. Just like an ordinary particle, a quasiparticle can be localized in space and retain its localization during movement; it can interact with both particles and other quasiparticles. On the other hand, quasiparticles (unlike ordinary particles) cannot exist outside the medium, of which they are, in fact, elementary excitations. According to the internal structure, quasiparticles can be divided into two classes: single-particle excitation, which is a single particle overgrown with a “fur coat” due to interaction with other excitations (for example, a hole surrounded by particle-hole pairs) and collective excitation, which is a complex of equal components, that is, for example, exciton and nanoexiton are quasiparticles, since they behave like one big particle, although they actually consist of smaller elements – electrons and holes [4].

Excitons are responsible for the light emission of semiconductor materials and are the key to the development of a next-generation light-emitting element with less heat generation and a light source for quantum information technologies due to the free transformation of light and material in their electrically neutral states.

In a semiconductor heterolayer, which is a stack of two different semiconductor monolayers, there are two types of nanoexitons: intra-layer excitons with a horizontal direction and interlayer excitons with a vertical direction. It was not easy for scientists to control these particles in nanoscale spaces due to the heterogeneity of the corresponding structures and the low light efficiency of the particles, but specialists managed to solve this problem using remote control of the density and brightness of excitons [3].

Nanoexiton transistors are unique electronic devices based on the use of exciton effects in nanoscale structures.

The process of creating nanoscale structures for nanoexiton transistors involves the use of special methods of lithography and nanofabrication. Lithography is a technique that allows you to create microscopic patterns on the surface of a material with high accuracy.

The first step in the process of creating nanoscale structures is the selection and preparation of the substrate. Nanoexiton transistors are usually based on semiconductor materials such as graphene, boron nitride or quantum dots. These materials are a substrate and have special properties, including the ability to generate and control excitons.

After selecting the material, the lithography stage follows, including several subprocesses.

The first subprocess is coating the substrate with a layer of photosensitive material called a resistor. Resist is a polymer that changes its properties under the influence of light.

Then an exposure occurs, where a pattern representing the desired pattern of nanoscale structures is projected onto the surface of the resist using ultraviolet light. Some lithography methods use electron beams or ion beams instead of ultraviolet light.

After exposure, a manifestation occurs, where the unexposed resist dissolves, and the exposed remains on the surface of the material. This step determines the shape and size of nanoscale structures.

The lithography is followed by the nanofabrication stage, which includes various techniques to create the desired structures. This stage is also divided into several processes.

The first process involves the use of a computer controlled focused ion beam (FIB), which, acting as a microsurgical instrument, locally modifies the object for an in-depth study of its internal structure. This makes it possible not to be limited to viewing only the surface of the object, but to observe its three-dimensional structure.

Next comes electronic balancing or masking. A mask is a template with predefined structures that will be used to transfer a sample to a substrate. This step involves the use of a photolithographic process, where the mask is applied to the substrate and irradiated with ultraviolet light. The light passing through the mask creates a sample on the substrate, which will later be used to create a structure.

After the mask is formed, the material is applied to the substrate to create a nanostructure. This step may involve various methods such as chemical deposition, electrodeposition, physical spraying, or the use of nanostreaming techniques such as atomic force or scanning probe microscope. These methods make it possible to create complex structures at the nanometer level with high accuracy [5].

Obtaining nanoscale structures allows controlling the behavior of excitons in semiconductor materials. This opens the way to the use of excitons in the transmission, amplification and processing of information in nanoexiton transistors. Control over the behavior of excitons is based on careful selection of structure parameters and optimization of effects, such as charge transfer and resonance effects. The result is devices that can be used to create more powerful, faster, and energy efficient electronic systems. These structures provide control over the behavior of excitons, allowing them to be used for transmitting, amplifying and processing information.

One of the most important advantages of nanoexiton transistors is their speed. The high speed of nanoexiton transistors is achieved due to several factors, including optimization of structures and control of exciton characteristics.

One of the key factors is to minimize the time required for the creation and scattering of excitons in the transistor. Excitons have a certain connectivity and lifetime, and the faster they can be created and dispersed, the higher the speed of the transistor.

The control of exciton characteristics also helps to increase the speed of operation. One of the control methods is to reduce the exciton relaxation time – the time required for the exciton to return to its original component particle. This can be achieved, for example, with the help of specially designed materials or the construction of nanoscale structures.

Another important factor is the efficient transmission and amplification of signals through excitons. To achieve a high signal transmission speed, it is necessary to ensure a fast switching mode of the transistor and minimal signal loss during transmission. This can be achieved by optimizing transistor materials and design.

It is important to note that the efficiency and speed of nanoexiton transistors also depend on the use of suitable light sources and detectors interacting with excitons in the transistor. The selection and optimization of optical components also increases the overall performance of the transistor [6].

All these factors together make it possible to achieve high-speed operation of nanoexiton transistors, which makes them potentially attractive for use in fast electrical and optical devices such as quantum computers, optoelectronics and heavy-duty computing systems.

Without any doubt, the advantages of nanoexiton transistors include their potential to increase the speed and efficiency of electronic devices, as well as the ability to process information at the level of individual photons. In addition, they have low power consumption and high stability in extreme conditions.

However, a significant drawback of nanoexiton transistors currently lies in the complexity of their production and control of their parameters, as well as the need for further research and development to fully realize their potential, as well as the cost of nanoexiton transistors is difficult to estimate at the moment, since they are still in the research and development stage. But it is worth noting that, as a rule, new technologies at the initial stage have a high cost, which decreases with increasing production and technological progress. The application of nanoexiton transistors in practice is expected in the coming years, but the exact time depends on the progress in research and development. It is expected that this technology will find its application in various fields, including photonics, optoelectronics, quantum computing and energy.

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УДК 330.34

SHADOWIZATION OF ECONOMIC ACTIVITY AND ITS IMPACT ON ECONOMIC SECURITY

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Abstract. In the article the authors consider the problem of shadow economy and its impact on the existing system of national economic security of the state. The practical and methodological aspects of the research of the shadow sector of the economy are investigated, its structure and scope of activity in the context of various groups of countries are determined, existing approaches to solving problems related to the shadow economy and increasing the level of economic security of the state are systematized.

Keywords: shadowization of economic activity, informal economy, threats, economic security system.

ТЕНЕВИЗАЦИЯ ЭКОНОМИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ И ЕЕ ВЛИЯНИЕ НА ЭКОНОМИЧЕСКУЮ БЕЗОПАСНОСТЬ

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Аннотация. В статье авторами рассматривается проблема теневизации экономики и ее влияние на существующую систему национальной экономической безопасности государства. Изучаются практические и методические аспекты исследований теневого сектора экономики, определяются его структура и масштабы деятельности в разрезе различных групп стран, систематизируются существующие подходы к решению проблем, связанных с теневизацией экономики и повышением уровня экономической безопасности государства.

Ключевые слова: теневизация экономической деятельности, неформальная экономика, угрозы, система экономической безопасности.

The economic security strategy of the Russian Federation, developed and approved for the period up to 2030, identifies that the economic security of the country is the state of protection of the national economy from both external and internal threats, ensuring the economic independence of the State, the unity of its economic space, as well as conditions for the implementation of strategic national priorities. At the current stage of economic development, there are a number of factors that have a direct impact on the state of economic security, one of which is the indicator of the level of the shadow economy in the country.

The shadow economy should be understood as a combination of different types of illegal activities aimed at obtaining income or benefits hidden from the State and outside the State register.

The informal sector of the economy exists in virtually all countries of the world on various scales and manifestations, and this phenomenon is common in both developing and highly developed market economies. Studies carried out by independent international statistical agencies have revealed that, on average, the informal sector in developed countries accounts for up to 5 % of GDP, while for transition economies it ranges from 20 to 25 %, and in developing countries the share of the shadow economy is up to 50 %, while the highest level of the shadow economy in the structure of GDP is observed in the post-Soviet countries – up to 49 % [1, p. 174]. On the basis of these data, it is possible to infer a pattern: in countries with higher levels of development, the “shadow” sector is the lowest.

For the first time, the analysis of the shadow economy was undertaken by the American scientist P. Gutman, who in his 1977 article “Underground economy” argued that unaccounted economic activities distorted macroeconomic indicators and had a negative impact on the State’s financial system. Economists have given different explanations for the origins of the shadow economy. These include legislative imperfections and political and economic instability and market imperfections. Economists of different schools have different definitions of the causes of the shadow economy. So, representatives of neo-institutionalism G. Becker, O. Wiljamson, E. Ostrom considered the main reason high transaction costs that arose due to the actions of firms under the current legislation and the changing situation in the labor market.

In the 1980s, many economists researching various aspects of the shadow economy approached its interpretation rather narrowly, which led to the need to combine different approaches and dates a common assessment of the different elements of the shadow sector and the whole concept of the shadow economy.

Thus, at the end of the 20th century, the problems and questions of the shadow economy were investigated in the works of many famous world-class economists, including A. Dilnoth and K. Hart, M. Carter, and B. Dallago, Tokman, A. Portes, and other scientists. The interest of the scientific community and the scope of the research

led to the planning and holding of an international conference on the shadow economy in 1983. As a result of the Conference, a report was published reflecting the main features and characteristics of the shadow economy, and this segment was recognized as official statistics and the shadow economy was included in the international system of national accounts [2, p. 106].

In modern conditions, there are quite a lot of different interpretations of shadow economy and its characteristics. But most scholars agree that the shadow economy includes all activities that are not accounted for by official statistics or exist outside the legislative field [3]. In the official definition of the shadow economy, which is recommended by the UN System of National Accounts (SNA) it is subdivided into the following types [4, p.747]:

- the "hidden economy" is not actually prohibited by the legislation, but the results of its functioning are not officially reflected in the SNA;
- "informal economy" imlies activities of enterprises and firms without payment of earnings and taxes (work without licenses, cash payment, concealment of income);
- "illegal economy" refers to production and sale of goods and services by illegal means or prohibited goods and services (weapons, drugs, slave trade);
- the "grey shadow economy" is allowed by law, but is not registered as an economic activity (mainly small business) in the production and sale of ordinary goods and services. This is the largest sector of the shadow economy;
- the "dummy economy" is the official economy, which produces fictitious results, which are reflected in the relevant statistics as real. These are postings, embezzlement, speculation, bribery, and all kinds of fraud that involve receiving and transferring money. At present, there is also a certain complexity in the mechanism for calculating the level of the shadow economy in the State. Data on the extent of shadowing vary widely, as there is no single methodology to accurately calculate both the shadow income of different actors and the country's losses from the activities of shadowhunters.

In general, the shadow economy is the activity of individual firms, organizations and institutions, hidden from the control of the state and society. Many areas of life are often integrated into the informal economy. These include the production and sale of prohibited and counterfeit products, income of economic agents, tax havens, corruption in government structures, economic activities carried out without proper licences, etc. [5, p. 83].

Taking into account all the above, it can be concluded that the shadow economy is a complex socio-economic phenomenon that unites the whole system of socio-economic relations, and above all, the socially uncontrolled reproduction sector, where economic benefits and entrepreneurial abilities are produced, distributed, exchanged and consumed are hidden from public authorities. The shadow economy is closely intertwined with the legal and real economy and is an integral part of it. It also uses the services of the State, its material and social factors, labour, etc., without entering into economic relations with the State as an economic entity.

In today's world, the presence of a shadow economy in one form or another is typical of any country. Only the scale and structure of this segment differ. The main threat to the existence of the shadow economy is the undermining of the national security of the country in various spheres and activities. For example, in the financial sector of the economy, shadowing occurs through inefficient allocation of budgetary resources due to illegal lobbying. In the area of public administration, there is a proliferation of illegal concessions and quota allocation, non-transparent tendering and corrupt practices. In the industrial and real sectors of the economy, there is a distortion of the sectoral structure and the withdrawal of some financial and economic resources from the formal economy, thus reducing its level and potential. In the investment sphere, capital flows and withdrawals abroad occur, which leads to a deterioration of the country's investment climate, a decrease in investment activity and high risks. The social threats of the shadow economy can be seen as an increase in income differentiation, an increase in the number of socially vulnerable groups of the population, and evidence of distrust of the population towards power structures.

The Russian economy, along with other problems, suffers from the hypertrophied size of the shadow economy. Even according to official data, its share of GDP is 40-50 % [6]. Such a scale of shadow business hinders the dynamic development of the Russian economy and, moreover, creates a real threat to national security and the existence of Russian statehood. At the same time, funds in shadow circulation could play an important role in the economic growth and well-being of Russians. The Federal State Statistics Service of Russia includes the hidden, illegal and informal economy in the definition of shadow economy.

Currently, one of the main problems of the shadow sector in Russia is the legalization of income, which is determined by a number of factors [7].

First, in modern conditions, the share of the shadow economy is increasing, which is facilitated by a large number of fictitious enterprises and one-day firms, the practice of tax evasion by withholding products and lowering incomes, not very effective government regulation, increased income differentiation.

Secondly, the State currently lacks effective mechanisms to legalize investment processes.

Third, there is little methodology for qualitative and quantitative assessment of investment activity in the shadow economy, and available statistical information does not adequately take into account the scale and structure of investment in the shadow economy.

Thus, in general, the existence of the shadow economy damages the economic security of the state and its subjects. Therefore, the country does not receive a part of the potential national income and gross product produced by agents of the shadow economy. Enterprises and organizations are forced to work in the shadow sector due to imperfect legislation and a high level of taxation. The country's population suffers from criminalization, bureaucracy and corruption [8]. This situation requires the search for new approaches to solving problems related to the shadow economy and increasing the level of economic security of the state. The development of ways and measures to

counter this threat is a complex and time-consuming process. It requires all involved structures to coordinate and interact at the legislative, administrative and economic levels. Only under this condition is a more effective fight against illegal business and all manifestations of the shadow economy possible.

Taking into account all the above, it can be concluded that the shadow economy is a complex socio-economic phenomenon that unites the whole system of socio-economic relations, and above all, the socially uncontrolled reproduction sector, where economic benefits and entrepreneurial abilities are produced, distributed, exchanged and consumed are hidden from public authorities. The shadow economy is closely intertwined with the legal and real economy and is an integral part of it.

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УДК 7.01

THE INFLUENCE OF GRAPHIC DESIGN ON THE BRAND

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Abstract. The article presents the results of the work on the analysis of the role of graphic design in the creation of the company's brand. The key methods of graphic design that influence the perception of the brand are considered.

Keywords: brand, logo, font, graphic design, trademark.

ВЛИЯНИЕ ГРАФИЧЕСКОГО ДИЗАЙНА НА БРЕНД

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Аннотация. В статье представлены результаты работы по анализу роли графического дизайна в создании бренда компании. Рассмотрены ключевые методы графического дизайна, которые влияют на восприятие бренда.

Ключевые слова: бренд, логотип, шрифт, графический дизайн, товарный знак.

In today's world, where information overflows every corner, graphic design becomes a means of standing out from the competition. Its task is not only to attract customers, but also to create a recognizable and trusted brand. At the same time, graphic design must be authentic and effective in order to convey the essence of the advertising message to the target audience. After all, it is the key factor in increasing sales and increasing the number of customers. Therefore, studying the elements of graphic design and their impact on the effectiveness of advertising campaigns is a necessary condition for a successful business in a competitive and technologically advanced environment.

Brand: concept, functions.

Brand is:

- a set of properties, associations and images;
- a holistic image that appears when a company or its product is mentioned.

Functions:

1) For the company that owns the brand, it performs the following functions:

– reduces vulnerability to competitors, since the product is relatively easy to copy, but the brand is impossible. You can only create your own;

– increases stability during crises;

– brings higher profit per unit sold;

– reduces the elasticity of consumer reaction to an increase in price and vice versa increases in case of its decrease;

– facilitates the introduction of a new product to the market, as it allows you to rely on the existing trust in the brand;

– increases the effectiveness of marketing communications, as it levels the randomness of messages for consumers, leads them to a single denominator, which ultimately leads to a cumulative effect of impacts from campaign to campaign;

– provides additional opportunities for brand expansion;

– adds weight in negotiations with partners;

– promotes a higher level of partner support from retail;

– provokes joint branding, which adds a synergistic effect in promotion;

– promotes the involvement of the best specialists in the company and increases team cohesion;

– increases the value of the company's assets [1].

2) For consumers the brand:

– provides serious assistance in making a choice from existing alternatives;

– repeatedly increases the credibility of the product;

– carries the uniformity of the qualitative characteristics of all offers within the same brand;

– saves time on making repeat purchases;

– has a long-lasting emotional effect accompanying the purchase process and the ownership experience.

Graphic design is communication: conveying the right message to your target audience and demonstrating what is special about your brand [2].

The importance of graphic design for the brand

Graphic design allows you to make a great first impression on the target audience of the brand. It sets the tone for how a potential customer perceives your brand. The first impression is very important for the brand, firstly, there is a lot of competition. Graphic design is the consumer's first contact with your brand. Logo, packaging or website – all these creates the first impression of your company. Aesthetics, colors, composition and fonts play a crucial role in forming a positive or negative impression of your brand. A well-designed graphic design can inspire trust, interest and a desire to learn more about your product or service.

Secondly, graphic design helps to strengthen the brand identity. It allows you to tell the story of your brand in a unique, creative way designed to attract the attention of a potential customer. Brands use a series of sequential, interconnected ads to really convey the desired message and form an idea of what a brand is for the target audience. When a design conforms to the brand's values and identity, it helps to establish an emotional connection with consumers.

Thus, graphic design helps to create content that attracts attention and is remembered by a potential client long after it disappears from the screen. Therefore, graphic design can both create a very big impression and bring the brand to the world level, and leave a bad impression [3].

Let’s consider key elements of graphic design that influence the brand.

1. Typography

In graphic design, typography refers to how you place text in your advertising. This is a way of displaying words that allows you to quickly attract someone’s attention and convey your main message.

Typography explains to people why your advertising is important, so it is vital to choose the right words. However, font and text size are equally important.

The font directly affects the atmosphere of your ad. For example, a clear, angular font conveys a strong message (Figure 1):



Figure 1. Clear, angular font

On the other hand, softer fonts create a more relaxed atmosphere (Figire 2):



Figure 2. Soft font

Size and density also matter. Large, thick letters convey a powerful message, while smaller letters are more elegant and timeless.

Finally, the typography determines the text selection. Highlighting some words in bold or italics attracts special attention to them, so people quickly understand which words should pay the most attention.

2. Color

It’s worth noting the importance of choosing a color when developing graphic design for a brand. Whether you choose a bright, rich palette or muted, delicate tones, the choice of color affects the overall mood of your brand campaign. In the design, color schemes can be grouped into categories depending on their location on the color wheel. Here is a simple example of a color circle (Figure 3):



Figure 3. Color circle

Additional colors are located opposite each other, such as yellow and purple. Monochromatic colors, on the other hand, are just different shades of the same color (for example, different shades of blue).

Similar colors are located next to each other, for example, orange and yellow, while triadic colors are evenly distributed in a circle (for example, yellow, red and blue).

Graphic design involves choosing a color palette to create a mood or convey an emotional response. For example, bright colors and warm shades cause vibrations different from cold or softer pastel tones.

You can play around with different color combinations until you find one that suits you. Don't forget to think about which colors to use for all visual elements and how they can be combined. If you choose black and white text, think about how it can be combined with the color scheme of your background and the selected visual elements. An unorganized, fragmented color scheme can ruin the look of your design [4].

3. Trademark

A trademark is a symbol, sign, or combination of signs that are used to identify a company's products and distinguish them from competitors' products. It helps to recognize the brand and associate it with certain qualities and characteristics.

For example, Google, Nestle, Toyota logos are trademarks that can often be identified immediately by their shape and color.

A trademark helps to shape the company's image, associate it with certain values and create awareness in the market.

4. Logo

A well-designed logo can live for decades and overcome language and cultural barriers. For example, we don't need to see the word Nike to find out which brand made shoes with a tick on it. In fact, this is a short designation of your brand, so you should think carefully about creating a logo design. Logos are often graphic signs or verbal (Figure 4).



Figure 4. Example of a graphic and verbal logo

There are also combined logos that consist of a graphic symbol and a word or phrase (Figure 5).



Figure 5. Example of a combined logo

Conclusion

Graphic design plays an important role in the perception of the brand and the formation of its image. High-quality design helps to create a first impression, reflects brand identity, improves visual communication, creates uniformity, distinguishes the company from competitors, strengthens emotional connection and helps to attract more customers [5]. Investing in graphic design is an important part of brand development and can be a key factor in the success of your brand.

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УДК 004.056

FROM CONCEPT TO CRYPTOGRAPHY: THE HISTORY OF HOMOMORPHIC ENCRYPTION AND ITS DEVELOPMENT

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Abstract. This article provides a comprehensive overview of the history of homomorphic encryption research, with a focus on the evolution of concepts and the classification of attacks on these systems. Special attention is given to the analysis of open-text attacks, such as attacks with only encrypted text, attacks with known open text, attacks with chosen open text, and attacks with adaptive chosen open text. The article discusses the historical contexts of research, identifies security risks and potential threats, and offers perspectives for improving the security of homomorphic encryption schemes. Concluding recommendations underscore the need for further research in protecting against open-text attacks to ensure the effectiveness and resilience of homomorphic encryption.

Keywords: homomorphic encryption, cryptography, data security, history of encryption, open-text attacks, attack classification, evolution of encryption.

ОТ КОНЦЕПЦИИ ДО КРИПТОГРАФИИ: ИСТОРИЯ ГОМОМОРФНОГО ШИФРОВАНИЯ И ЕГО РАЗВИТИЕ

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Аннотация. Данная статья представляет исчерпывающий обзор истории исследования гомоморфного шифрования с фокусом на эволюции концепций и классификации атак на эти системы. Особое внимание уделяется анализу атак открытым текстом, таких как атаки только с зашифрованным текстом, атаки с известным открытым текстом, атаки с выбранным открытым текстом и атаки с адаптивным выбранным открытым текстом. В статье обсуждаются исторические контексты исследований, выявляются риски и потенциальные угрозы безопасности, а также предлагаются перспективы для улучшения безопасности гомоморфных схем шифрования. Заключительные рекомендации подчеркивают необходимость дальнейших исследований в области защиты от атак открытым текстом с целью обеспечения эффективности и стойкости гомоморфных шифров.

Ключевые слова: гомоморфное шифрование, криптография, безопасность данных, история шифрования, атаки с открытым текстом, классификация атак, эволюция шифрования.

Homomorphic encryption is a type of encryption that allows computations to be performed on encrypted texts without the need for decryption. In recent years, there has been a growing interest in homomorphic encryption due to its potential to enable secure computations in cloud computing and other applications where confidential data must remain confidential. Several homomorphic encryption algorithms have been proposed, and researchers have been working on assessing their efficiency, security, and applicability.

The history of homomorphic encryption reflects the steady development of this cryptographic field and the increasing interest in its application to real-world challenges. Thanks to homomorphic encryption, new possibilities emerge for processing and analyzing confidential data without compromising their privacy.

Homomorphic encryption enables computations on encrypted texts without revealing the plaintexts. This represents a significant leap forward in the realms of privacy and security.

The concept of homomorphic encryption originated in the late 1970s. Early research conducted by Ron Rivest, Leonard Adleman, and Adi Shamir (collectively known as RSA) demonstrated the feasibility of performing operations on encrypted data. However, their methods had limitations and could not handle arbitrary operations.

In 2009, Craig Gentry [1] introduced a groundbreaking concept known as Fully Homomorphic Encryption (FHE), enabling the execution of arbitrary operations on encrypted data. This innovation opened up new avenues for processing confidential data while preserving their confidentiality throughout the entire processing pipeline.

In 2010, Craig Gentry presented the paper “Fully Homomorphic Encryption Using Ideal Lattices” [2], formalizing the concept of fully homomorphic encryption and proposing the first concrete example of such a cipher.

Following the introduction of the FHE concept, researchers began developing novel methods and algorithms for implementing homomorphic encryption. One notable achievement was the BGV algorithm [3], presented in 2011, which provided the capability for homomorphic encryption using a public key cryptosystem.

By 2012, Craig Gentry, alongside Shai Halevi, Vincent van der Leest, and Shalom Rafeal, presented the paper “Homomorphic Evaluation of the AES Circuit” [4], demonstrating the application of homomorphic encryption to the computation of AES operations.

Continuing in this direction, researchers progressed, and by 2013, Craig Gentry introduced the work “HElib: Homomorphic Encryption Library” describing a library that implements homomorphic encryption based on ideal lattices (Figure 1).

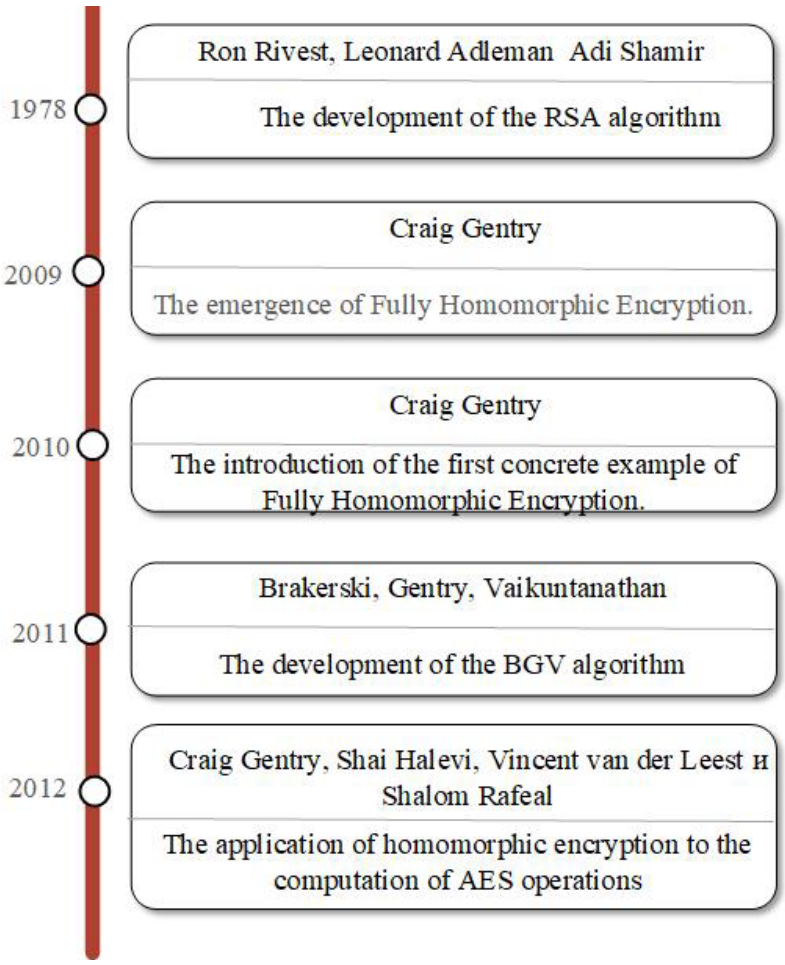


Figure 1. Chronology of Fully Homomorphic Encryption Research

Over time, research in the field of fully homomorphic encryption (FHE) continues, leading to the development of new methods and improvements. Cryptographers are working on devising more efficient algorithms that can process data faster and with fewer computational costs.

However, homomorphic ciphers remain vulnerable to open-text attacks, where an attacker attempts to gain access to plaintext by exploiting weaknesses in the encryption process. Therefore, it is crucial to classify the types of text attacks and analyze their applicability to homomorphic ciphers to enhance their security.

In 1945, Claude Shannon, in his paper “A Mathematical Theory of Cryptography” [5], examined cryptanalysis methods, including open-text attacks. In 1952, the U.S. National Bureau of Standards (NBS) published a report on issues with using the Cipher Disk in military telegraph systems. Open-text attacks refer to a type of attack where an intruder tries to access encrypted data by analyzing the data in the form of open text (unencrypted). If an attacker has access to open text, they may attempt to analyze the relationship between open text and corresponding encrypted data. Possible attacks include those based on known plaintext or statistical analysis of the relationships between open text and encrypted data.

By 1976, Whitfield Diffie and Martin Hellman published the paper “New Directions in Cryptography” introducing the concept of key exchange using discrete logarithm, which later became vulnerable to homomorphic encryption attacks [6]. In his book “Applied Cryptography: Protocols, Algorithms, and Source Code in C” [7],

Bruce Schneier introduces the concepts of weak open-text attacks and chosen open-text attacks.

Attacks on fully homomorphic ciphers (FHE) can be classified based on the type of available information and the goals of the attacker. However, given the peculiarities of FHE, some traditional open-text attacks cannot be directly applied to the security analysis of homomorphic ciphers.

The most fundamental type of open-text attack is a brute-force attack, where an attacker tries all possible combinations of characters to find the open text. This approach can be effective but consumes a significant amount of time and resources. Martin Gardner first mentioned the concept of brute-force attacks in the “Scientific American” journal in 1970 [8]. The description of a brute-force attack emerged in 1996, thanks to Hans Dobbertin, who presented collisions of the MD5 hash function, demonstrating that it is not secure against brute-force attacks [9]. Homomorphic ciphers typically employ complex mathematical operations and long keys, making brute-force attacks unrealistic and ineffective. The extended time required to exhaustively try all possible key or encryption parameter combinations makes this attack practically impossible.

During the 1990s and 2000s, dictionary attacks became actively utilized for password and password hash cracking on the Internet. Early mentions of this attack can be found in various computer forums and resources. Christof Schnorr presented the paper “Efficient Identification and Signatures for Smart Cards” where the method of attacking cryptographic systems using dictionaries was explored [10]. In 2003, Alexey Blokhin and Alexander Pott proposed an enhanced version of the dictionary attack on the MD4 hashing algorithm. A dictionary attack is a type of open-text attack where an attacker uses a precomputed list of words to search for the open text. The word list may include common passwords or phrases typically used by users. This approach can be more efficient than a brute-force attack. However, dictionary attacks can be effective if the keys or passwords used are in a dictionary that can be used to decrypt data. Well-designed homomorphic ciphers should use long and random keys to make dictionary attacks impractical.

In 2003, Philippe Oechslin introduced the idea of rainbow tables in the paper “Making a Faster Cryptanalytic Time-Memory Trade-Off ” [11], allowing for efficient cracking of hashed passwords. A rainbow table attack is a type of open-text attack where an attacker uses a precomputed table of hash values to search for the open text. The table contains a list of hash values and their corresponding open text. This approach can be useful for attacking weak encryption schemes that use hashing. Such an attack may allow the recovery of keys or passwords. Well-designed homomorphic ciphers should use mechanisms like salts and unique hash iterations to prevent successful rainbow table attacks.

The birthday attack in cryptography has been studied for a long time, but it is known that Phillip Rogaway introduced the application of the birthday attack in cryptography in the paper “Cryptographic Hash-Function Basics: Definitions, Implications, and Separations for Preimage Resistance, Second-Preimage Resistance, and Collision Resistance” [12], although the initial ideas were proposed earlier. Christophe De Canni`ere presented the paper “Finding SHA-1 Characteristics: General

Results and Applications", where attacks on the SHA-1 hash function were discussed, including the birthday attack. Christophe De Canni`ere demonstrated that by using the birthday attack, vulnerable keys to the AES cipher can be found using parallel computations (Figure 2). The birthday attack is a type of open-text attack where an attacker generates a multitude of hash values until a match is found. This approach is based on the birthday paradox, which states that with a sufficiently large number of randomly chosen elements, there is a high probability that some pair will have the same value. The birthday attack can be used to compromise hash-based security, which may also impact homomorphic ciphers. It is aimed at finding hash value collisions, which can compromise the security of the system.

In addition to classical open-text attacks, when working with homomorphic ciphers, attention should be paid to attacks related to side channels, such as timing, power, or electromagnetic radiation attacks, which can be used to extract information about protected data or keys. Detecting and protecting against such side-channel attacks is an important aspect of homomorphic cipher security analysis.

Paul Kocher, Joshua Jaffe, and Benjamin Jun published the paper "Differential Power Analysis" [13], describing attacks on cryptographic systems based on side-channel analysis, such as electromagnetic emissions and power consumption.

A side-channel attack is a type of open-text attack where an attacker observes information from the implementation of encryption, such as power consumption or electromagnetic radiation. In the case of homomorphic ciphers, a side-channel attack can be applied at various stages of encryption or computations on encrypted data. Its goal is to reveal confidential information, including keys or data.

During key generation, physical characteristics may arise that can be analyzed by an attacker, such as power consumption or electromagnetic emissions. This can lead to information leakage about the key and compromise the security of the cipher. During encryption, operations on encrypted data may induce various physical or temporal characteristics that can be exploited for analysis. For instance, an attacker could analyze the execution time of operations or power consumption to extract information about the encrypted data or key.

Implementing a side-channel attack requires specialized skills and access to the physical device or environment where homomorphic encryption is performed. The attacker needs to obtain information from the physical characteristics of the device or analyze data obtained during the execution of encryption operations. Various methods can be applied depending on the type of side-channel attack and the specific device or implementation of the homomorphic cipher.

To protect against side-channel attacks, it is crucial to implement countermeasures at all stages of homomorphic encryption. This may involve using algorithms with constant execution time, masking data and keys, improving hardware or software mechanisms to reduce information leakage, and employing other protection methods.

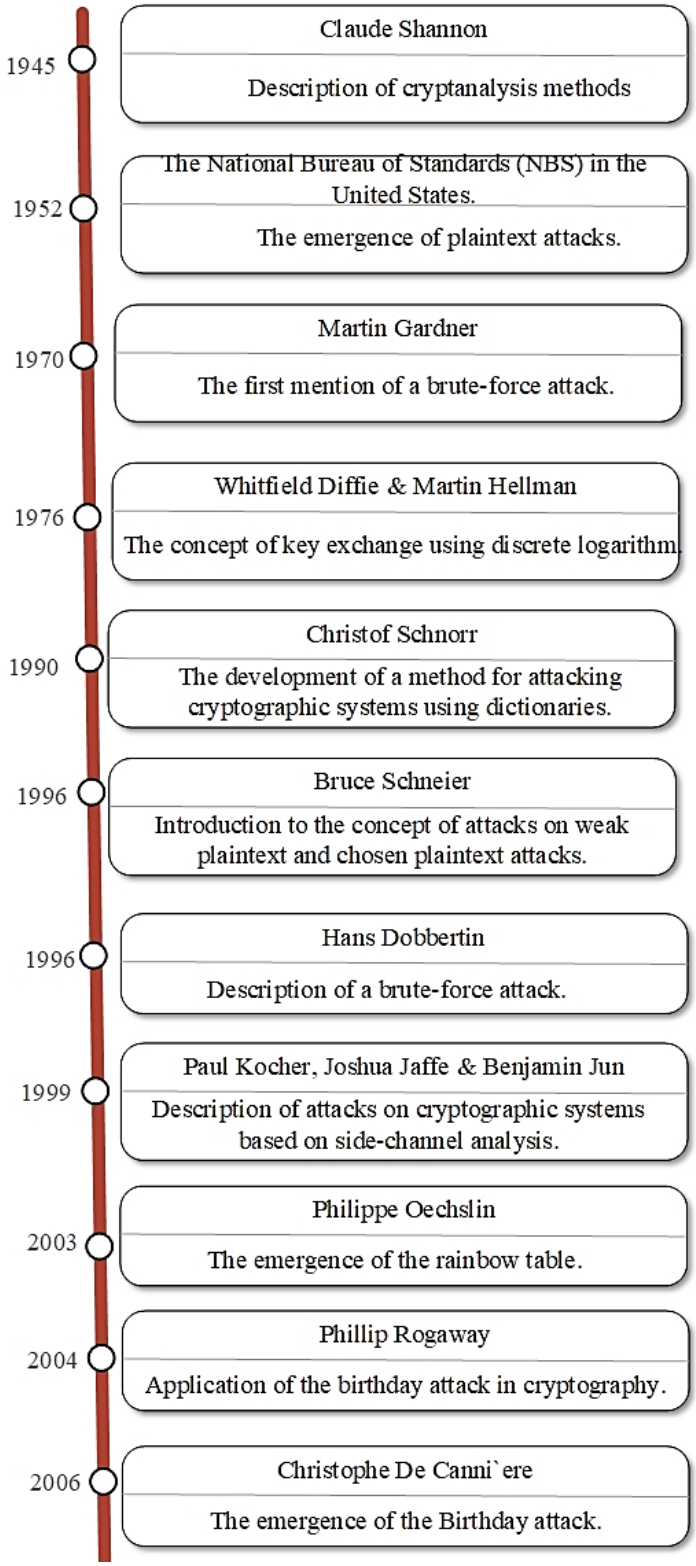


Figure 2. Chronology of Open-Text Attacks Research

It is crucial to emphasize that homomorphic ciphers must be designed with utmost protection against the aforementioned attacks. Well-designed homomorphic ciphers employ complex mathematical operations, utilize long keys, salts, and other protective mechanisms to prevent the successful execution of attacks and ensure the confidentiality of data.

Understanding various types of open-text attacks is pivotal for developing effective defense mechanisms and safeguarding confidential information. The classification of open-text attacks can be applied to analyze the security of homomorphic ciphers by identifying potential vulnerabilities and weaknesses in the encryption scheme.

For instance, if a homomorphic cipher is vulnerable to known open-text attacks, an adversary could exploit a known open text and its corresponding encrypted text to obtain the secret key, thereby compromising the system's security. By analyzing the encryption algorithm and the type of attacks to which it is vulnerable, recommendations can be provided to enhance system security.

Furthermore, the classification of attacks can also be utilized to assess the effectiveness of different homomorphic encryption algorithms in protecting data confidentiality. By comparing the resilience of various algorithms to different types of attacks, it becomes possible to determine which algorithms are better suited for various applications and types of data.

In conclusion, open-text attacks pose a significant threat to the security of homomorphic ciphers. Therefore, it is crucial to classify and analyze these attacks to enhance the security of homomorphic encryption schemes. Several types of open-text attacks have been identified, including attacks with only encrypted text, attacks with known open text, attacks with chosen open text, and attacks with adaptive chosen open text. Open-text attacks and attacks with adaptive open text are particularly applicable to homomorphic ciphers and pose a significant threat to their security.

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УДК 314

DEMOGRAPHIC PROCESSES AND THE MECHANISM OF THEIR INFLUENCE ON THE LABOR MARKET

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Abstract. In the article the authors propose to revise the plans for the development of Russia's territories, believing that the current programs proposed by the Government of the Russian Federation for the development of the country's territory, preservation and increase in the population of cities in Siberia, Altai and the Far East practically do not work. The authors believe that the cardinal changes in the model of economic development of the country in recent years require the formation of new approaches to management, the creation of scientifically based tools for the optimal functioning of the labor market.

Keywords: demography, migration, population, labor resources, demand, supply, cycles.

ДЕМОГРАФИЧЕСКИЕ ПРОЦЕССЫ И МЕХАНИЗМ ИХ ВЛИЯНИЯ НА РЫНОК ТРУДА

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Аннотация. В статье авторы предлагают пересмотреть планы по развитию территорий России, считая, что текущие программы, предлагаемые Правительством Российской Федерации по освоению территории страны, сохранению и увеличению численности населения городов Сибири, Алтая и Дальнего Востока, практически не работают. Авторы считают, что кардинальные изменения модели экономического развития страны в последние годы требуют формирования новых подходов в управлении, создания научно обоснованных инструментов оптимального функционирования рынка рабочей силы.

Ключевые слова: демография, миграция, население, трудовые ресурсы, спрос, предложение, циклы.

The specifics of the formation of the labor market in Russia were predetermined by the consequences of the transformation crisis in the country caused by the change of the model of economic development in combination with the demographic crisis. If in the centralized economy the processes of employment management were based on

the principle of planned distribution of labor resources by industries and economic regions with the predominance of vertically integrated and centralized management processes (which were hypertrophied), then in the new economic model the labor market of Russia needs to create a new management system and the formation of institutions that ensure its effective functioning. Differentiation of the country's territories by the degree of development of demographic processes forms the need to create models of labor market development, to implement new approaches in management and formation of effective socio-economic policy of regional development factors management [1].

The labor market includes economic, demographic and legislative aspects, so its study cannot be separated from the analysis of the demographic situation in the country [2, 3]. The population of a country is, on the one hand, buyers of goods and services and, on the other hand, sellers and buyers of labor for the production of goods and services.

Fertility, mortality and migration are the main demographic parameters that determine the dynamics, population size and the nature of the demographic situation in the country. For example, the Omsk Civil Registry published statistics on birth and death rates in 2022.

In the Omsk Oblast during the year 16225 people were born and 25872 people died [4].

In the city of Omsk, 10933 people were born during the year and 15857 deaths were recorded [5].

The mortality rate exceeds the birth rate (Figure 1).

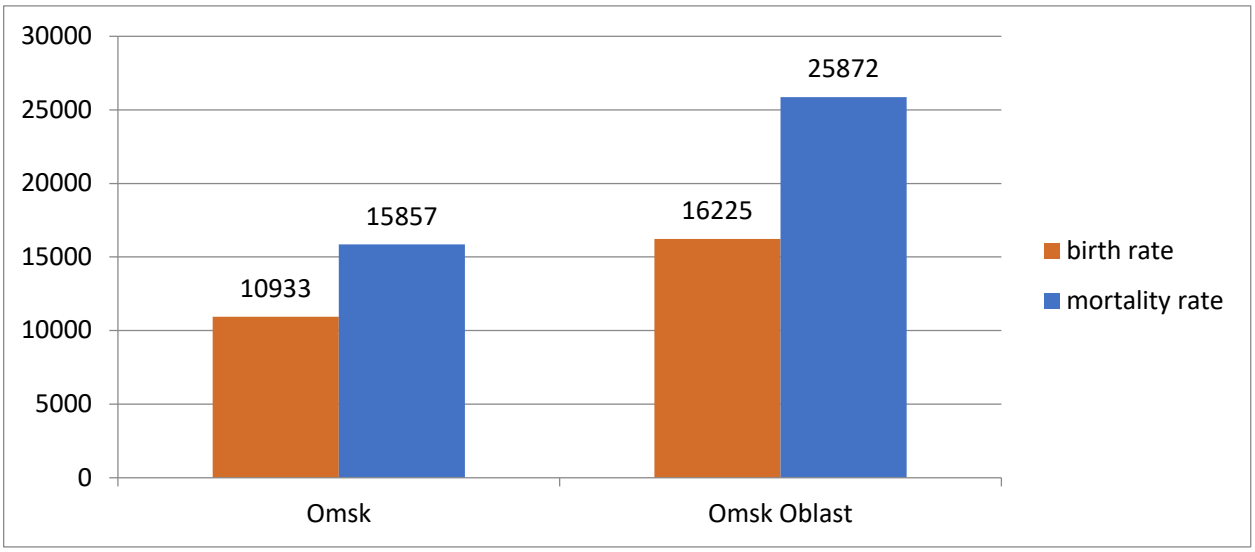


Figure 1. Demographic dynamics of Omsk and Omsk Oblast

The demographic situation shows the general trends of demographic and reproductive behavior of the population in the country at the national level. Reproductive behavior of the population is the leading element shaping changes in the demographic processes of the country, its analysis is the key issue in the study of the demographic situation.

The demographic situation in Omsk according to the “Theory of Demographic Transition” is determined by the narrowed type of population reproduction. Russia is among the countries transitioning from stationary type of population reproduction (declining birth rate and mortality rate) to regressive type of reproduction (birth rate continues to decline, and the decline in mortality rate slows down). This theory explains the causes of population decline in Russia. The first place among the reasons that caused depopulation in Omsk is given to the impact of socio-economic crisis and the decline in the standard of living of the population, which in principle is characteristic of all cities and other settlements in Russia. People move from settlements and villages to cities because there is work and higher wages, while city dwellers aged 25 to 35 move to Moscow, St. Petersburg, Sochi, Krasnodar, Kazan, because both wages and comfort level are much higher. In addition, these cities offer better career prospects and have a much more developed urban infrastructure. The combination of demographic and institutional crisis in the country’s economy has accelerated the processes of transition to a new type of population reproduction. Young people do not marry and do not hurry to have children, although the Russian Government is doing a lot for young families with children. Having analyzed the works of D. Ricardo, D. Keynes, M. Friedman, Locke and other researchers, it becomes clear that the problems of inflation and unemployment have always been considered as something to be avoided at all costs.

Long-term and medium-term cycles are most clearly traced in the development of the country’s demographic situation. Long-term demographic cycles are considered by the American school as stages of “demographic transition”, and by the French school as stages of “demographic revolution”. Medium-term cycles in the development of Russia’s demographic situation are caused by military disasters and cardinal changes in socio-economic life. Long-term and medium-term cycles in the development of the demographic situation in Russia caused modification of trends, forms and deviation from the trajectory of demographic development, traditional for European countries. Short-term cycles in the development of the demographic situation in Russia manifested themselves in the form of intensification of depopulation processes, a sharp decline in the birth rate, a jump in the mortality rate of the working-age population, a decline in the level of culture, health, life expectancy, deterioration of the age and professional structure of the population.

The demographic situation is influenced by factors that can be classified by the degree of importance, scale and controllability. According to the degree of influence, the factors can be arranged as follows: socio-economic (40 %) – 1, migration (18 %) – 2, historical (16 %) – 3, urbanization (13 %) – 4, cultural and ethnic (5 %) – 5, national policy (5 %) – 6, gender (2 %) – 7, globalization (1 %) – 8 (Figure 2) [4]. The factors with the highest degree of controllability include socio-economic factors, migration and national policy.

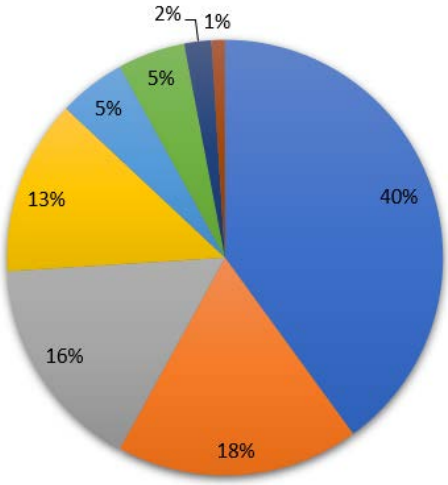


Figure 2. Factors influencing demographic situation

The demographic situation in Russia at the national level looks unfavorable in the short and long term. The pressure of young people on the labor market noticeably decreased in 2006, and since 2010 more people have left the labor market than entered. At the same time, business continues to insist on increasing the number of migrants to work on construction sites, as janitors, etc. At the same time, no changes in working conditions and wages are expected, which makes it impossible to attract permanent residents of Russia for these positions.

For example, in January-November 2022, the migration situation in Omsk Oblast was characterized by the following data:

– arrivals – 36615 people
– departures – 44682 people
– migration loss – 8067 people.

Population density is 13.3 people per square kilometer.

Structural shifts in the labor market under depopulation processes are manifested in a decrease in the level of registered unemployment, a reduction in the number of unemployed: both men and women in local markets. The decrease in the level of social tension in Russian regions is combined with an increase in the migration mobility of the population and a reduction in the duration of the unemployment period.

The average monthly nominal wages accrued to employees for January-November 2022 amounted to 44986.2 rubles and increased by 13.1 percent compared to the corresponding period of 2021 [3].

The growth of wages was due to the increase in the volume of state orders at the enterprises of the defense industry. At other enterprises the level of wages is close to the minimum wage. Unemployment and inflation are two important variables that affect the economic situation in the country and require in-depth study. It is possible to keep the economy at an unemployment rate below the natural level only through constant unexpected cash injections.

The research substantiates the need to manage the supply and demand of labor force in the conditions of depopulation processes through the factors of their development. The heterogeneity of demographic and socio-economic space of Russia predetermines the formation of socio-economic policy taking into account the

peculiarities of labor mobility, economic specialization of the region and territorial segmentation of the labor market.

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УДК 628.1

COMPARATIVE ANALYSIS OF WATER PURIFICATION METHODS BY CHEMICAL AND ULTRASONIC TECHNIQUES

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Abstract. In this article, the problem of scale formation was considered, an analysis of two different installations operating according to different principles of preventing scale formation – chemical and ultrasonic – was performed, the work efficiency and economic efficiency of each of the equipment were calculated.

Keywords: water treatment, impurities, ultrasonic analysis, chemical analysis, scale, boilers.

СРАВНИТЕЛЬНЫЙ АНАЛИЗ МЕТОДОВ ОЧИСТКИ ВОДЫ ХИМИЧЕСКИМ И УЛЬТРАЗВУКОВЫМ СПОСОБОМ

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Аннотация. В данной статье рассматривается проблема образования накипи, приведен анализ двух различных установок, работающих по разным принципам предотвращения образования накипи – химическому и ультразвуковому, рассчитана эффективность работы и экономическая эффективность каждого из оборудований.

Ключевые слова: водоподготовка, примеси, ультразвуковой анализ, химический анализ, накипь, котлоагрегаты.

One of the serious problems in the energy sector is the formation of scale. It occurs on the surfaces of boilers and pipes as a result of insufficient purification of feed water from chemical and mechanical impurities. This process leads to a decrease in the cross-section of the pipes. As a result, the consumption of resources for the transmission of feed water increases significantly, leading to overspending of fuel and electricity. In addition, it leads to the destruction of boilers, resulting in the occurrence of cracks and fistulas due to a decrease in heat transfer in the walls and a decrease in the efficiency of equipment at energy facilities. This leads to additional costs, as regular cleaning and more frequent replacement of equipment are necessary [1].

To prevent the formation of scale, water treatment is used in production facilities. Water treatment consists of several stages [2]:

Stage 1: Purification of water from mechanical impurities using a coarse filter.

Stage 2: Water softening (replacement of Ca, Mg, Fe and other impurities with Na ions) using ion installations, an electromagnet or reagents.

Stage 3: Wastewater pretreatment (correction of wastewater composition in order to comply with regulations), most often using a chemical purification method.

Stage 4: Disposal of dissolved gases using decarbonation systems.

Scale can be removed using aggressive reagents consisting of acids and alkalis. It is necessary to create an aqueous solution of the reagent (the stronger the nature of the contamination, the higher the concentration of the reagent in the solution) and perform washing. It is necessary to start washing with less concentrated solutions in order to minimize the negative impact on the equipment being cleaned.

However, due to the high cost of installing and operating the necessary equipment, and the negative impact on the environment that reagents soluble in wastewater have, an alternative to the use of chemical reagents in descaling and water treatment is needed.

Currently, the replacement of the chemical method of water treatment, ultrasonic one, is gaining popularity. The method includes the installation of equipment destroying scale layers and preventing their new formation using ultrasound [3]. With its help, mechanical vibrations affect hardness salts dissolved in water and the adhesion of scale to metal walls. The salts, as a result, crystallize, forming sludge. The scale particles together with the sludge are removed from the equipment by regular purges. Ultrasonic installations provide degassing of water as well.

Let’s consider the installation of an ultrasonic technological apparatus of the Volna-M series, as an analogue of the chemical method of water treatment (Figure 1) [4].



Figure 1. Ultrasonic technological apparatus of the “Volna-M” series

The manufacturer indicates the main technical characteristics of the device, presented in Table 1.

Table 1 – Characteristics of the device of the “Volna-M” series

Power, VA, no more	1000
Frequency of ultrasonic vibrations, kHz	22±1,65
AC power supply voltage, V	220±22
Radiation intensity, W/cm^2, not less	10
Continuous operation time, h	8
Overall dimensions: electronic generator, mm	400*280*110
Oscillatory system (two-wave), mm	Ø100*280
Diameter of the working tool, mm	40

The set of equipment of the installation includes: an electronic generator with a timer and an output power regulator (30-100 %), a piezoelectric oscillating system in a metal case with forced air cooling. Installation resource (R_y): years, price (p_y): 250 thousand rubles [5].

To compare the ultrasonic method with the chemical one, there is not enough performance in the list – a key characteristic for the current analysis.

However, productivity can be roughly calculated using practical research, for example, this calculation will be based on a specific article by I. A. Sirotkin [6].

In his work, the author examines the effectiveness of the installation of high-intensity directional ultrasonic cleaning of turbine blades. Its technical characteristics are presented in Table 2.

Table 2 − Technical characteristics of the installation of ultrasonic cleaning of turbine blades

Installation capacity	up to 1000W
Resonant frequency of the piezoceramic converter	22 kHz
Oscillation amplitude	up to 50 microns
Cooling of piezo converters	forced
Supply voltage	220V
Processing time	from 2 s and above
Number of converters	3

From here it can be seen that much data (power of the installation, frequency of the converter, cooling of piezoelectric converters, supply voltage, cooling of piezoelectric converters) coincide with the ultrasonic device of the “Volna-M” series.

In order to calculate the productivity, let’s get acquainted with the results of the experiment on cleaning the blades:

The average mass of dirt removed from one blade is 2-3 g with a processing time of up to 2 minutes.

The approximate concentration of salt pollution in natural waters is about 1000 mg/l = 1 g/l [7].

Performance of the installation for ultrasonic cleaning of turbine blades P_L (m^3/h) will be found by the formula (1).

$$P_L = \frac{m}{t} \div C = P \cdot 60 = P \div 1000 = P \quad (1),$$

where m is the mass of removed contaminants, g; t is the time for which the contaminants were removed, min; C is the concentration of pollutants in natural waters, g/l.

$$P_L \approx 0{,}09(\frac{\text{m}^3}{\text{h}}).$$

Taking into account the different number of transducers, we obtain the performance P_v for the ultrasonic device of the "Volna-M" series from formula (2):

$$P_V = \frac{P_L}{3} = 0{,}03(\frac{m^3}{h}) \text{ (2).}$$

Now let's consider a chemical water treatment plant, for example, "Astra-Ferrum" – PRO4 [8] (Figure 2). The technical characteristics of this equipment are presented in Table 3.



Figure 2. "Astra-Ferrum" – PRO4

Table 3 − Main technical characteristics of "Astra-Ferrum" – PRO4

Efficiency	0,25 – 2,0 m^3/hour
Dimensions (occupied area)	2600*800*1800 mm
Working pressure	3 – 5 atm
Power consumption	from 0.5 kW
Material of manufacture	food grade stainless steel
Service life	more than 15 years

Work resource (R_x): 15 years.

Price (p_x): 925 thousand rubles.

Mode of operation: devices of this type usually operate in intermittent mode throughout the day, therefore, the time of continuous operation can be considered the same as that of the ultrasonic device "Wave-M", namely 8 hours.

For clarity, we present an economic comparison of treatment with chemical (p_{ox}) and ultrasonic (p_{oy}) devices according to the formula (3):

$$p_o = \frac{p}{P \cdot 365 \cdot 8 \cdot R} \text{ (3),}$$

where p is the price of the device, in rubles; P is the performance of the device, m^3/h; R is the service life of the device, in years.

$p_{oy} \approx 52 (\frac{\text{rub}}{\text{l}})$;

$p_{ox} \approx 47 (\frac{\text{rub}}{\text{l}})$.

As a result of calculations, it was determined that at some stage of work, without taking into account the replacement of consumables and components, considering specific models of ultrasonic (ultrasonic technological apparatus of the “Volna-M” series) and chemical (“Astra-Ferrum” – PRO4) water treatment devices, the latter, at the moment, is more profitable.

In conclusion, I would like to add that the technology involving the effect of ultrasound vibrations on salts and scale dissolved in water shows excellent results and has great potential, but so far only on a small scale. Therefore, this technology is necessary for further development in order for it to be profitable and applicable at heat and power plants.

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УДК 005.34

EMOTIONAL LEADERSHIP STYLES

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Abstract. Every organization and every leader strives for success. But why do so few succeed? The reason is that leaders often adopt old-fashioned, outdated approaches to leadership. Meanwhile, truly successful leaders not only look at the world differently, they also act differently, applying different emotional styles of personnel management. This article discusses the various styles of emotional leadership and their characteristics, which have a huge impact on management in an organization.

Keywords: management, leadership styles, organization, manager, personnel management.

ЭМОЦИОНАЛЬНЫЕ СТИЛИ ЛИДЕРСТВА

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Аннотация. Каждая организация и каждый лидер стремятся к успеху. Но почему же тогда лишь немногим удается достичь его? Дело в том, что лидеры часто придерживаются старомодных, устаревших подходов к лидерству. Между тем по-настоящему успешные лидеры не только по-другому смотрят на мир, но и действуют по-другому, применяя различные эмоциональные стили управления персоналом. В этой статье рассматриваются различные стили эмоционального лидерства и их характеристики, которые оказывают огромное влияние на управление в организации.

Ключевые слова: менеджмент, стили лидерства, организация, менеджер, управление персоналом.

In any organization there are managers and there are leaders. Leaders can be constructive and destructive. Leaders are not born, but leadership traits are manifested in a person from the very early childhood. A good case can be considered a situation when an officially appointed manager is inherently a leader. In this case, emotional leadership is extremely important for the leader. It is impossible to manage other people

without a high enough emotional level, because 90 % of the manager's activity is connected with communication, delegation of duties, prioritization of tasks [1].

Every person needs to develop not only mental abilities, but also to increase emotional intelligence, because it will determine stress resistance, the ability to understand their subordinates and their capabilities, the ability to establish a common language with customers and partners.

Emotional intelligence is of particular importance for success, allowing to awaken the best qualities, confidence, desire and readiness for action [2].

A leader is a person who enjoys recognized authority and influence over other people, knows how to inspire and lead them. A leader is able to silently lead people as they seek to emulate him/her and trust his/her experience, wisdom, and knowledge [3].

Therefore, emotional leadership is able to influence the state of the team, selecting the optimal management style in a particular situation.

The leader, as a rule, has charisma, which allows him/her to stand out from the crowd, arouses interest and trust in others with the help of features unavailable to others [4]. Figure 1 summarizes the traits of a charismatic leader.

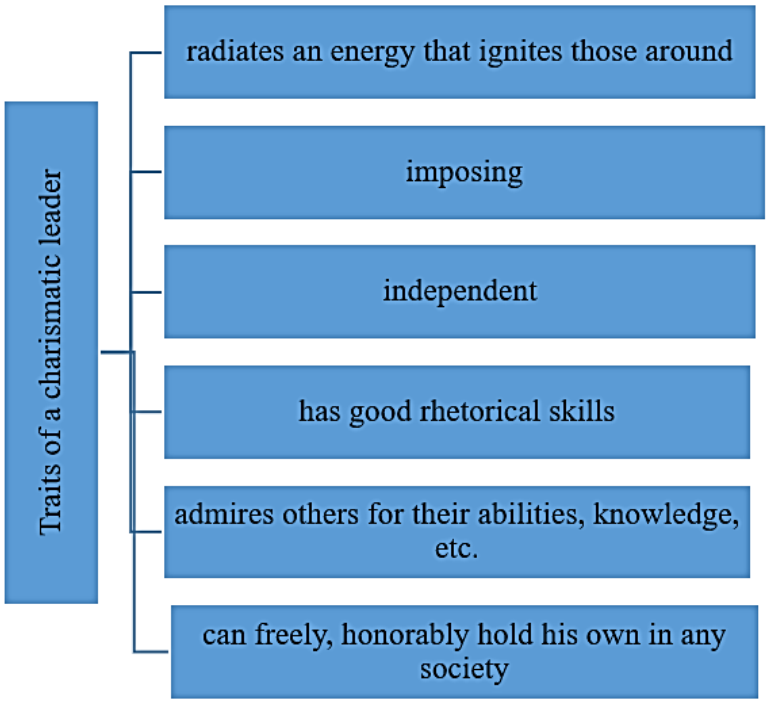


Figure 1. Traits of a charismatic leader

In addition, leaders are divided into two types: resonant (constructive) and dissonant (destructive) ones (Figure 2).

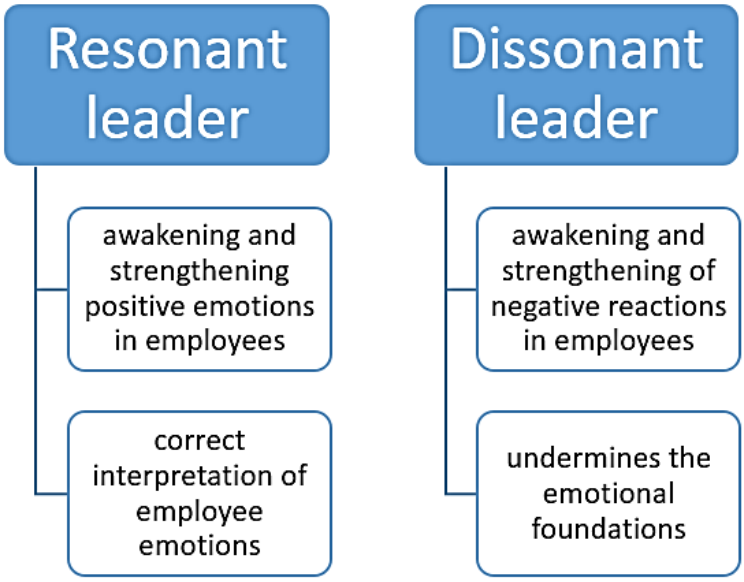


Figure 2. Types of leaders and their characteristics

The manager does not have to be present at the workplace because his/her mood and his/her emotions are sensed by the employees through the information they receive through email or other means of communication.

Dissonance and resonance are the bases for identifying leadership types [5]. Emotional leaders influence emotions in different ways. Figure 3 shows the classification according to the type of the leader and their motto.

Leader - Coach	• Try this!
Democratic leader	• And what do you think about that?
A paternal leader	• Personality above all else!
Guiding leader	• Just do what I said
Achievement Leader	• Do as I do!
Visualization Leader	• Follow me!

Figure 3. Classification of leadership types and mottos

The first to be singled out is the “leader-coach” who operates under the motto: “Try this!”. Leaders of this type are perfectly able to motivate and inspire the team.

Such a leader is always on the same wavelength with his employees, instilling in them not fear but confidence.

The motto of a “democratic leader” is “And what do you think about it?”. The strength of this type of leader is in establishing and developing communications with everyone’s opinion in mind. This style is appropriate when there are many options and one must be chosen, taking into account everyone’s opinions. This leadership style is characterized by teamwork, influence, and management.

“Paternal leader” is a type of emotional leadership characterized by the motto: “Personality above all else!”. Such a leader always prioritizes the creation of a positive mood in the team, as well as comfortable working conditions. This leader sees everyone as a separate person and strives to make his/her work as pleasant and calm as possible. Such a leader is always ready to support his/her subordinates. The main feature of such a leader is empathy for the members of the team.

The main motto of the “guiding leader” type is: “Do only what I say”. Such a leader gives instructions, assigns responsibility and demands full fulfillment of his/her assignments. The main features of this type of emotional leadership are: influence, control, strictness, purposefulness. At the same time, the leader actively uses empathy and emotional control. This type of leadership shows itself well in difficult, crisis situations due to a high degree of rationality in leadership. Such a leader is extremely stress-resistant, he/she is able to control the situation and overcome difficulties more effectively than other types of leadership.

The motto of the “achievement leader” is “Do as I do!”. This type of leadership is very valuable, because by personal example he/she leads the team, transferring his/her knowledge, skills and abilities to them. This is the type of leader who can be called the “pack leader”. He/she is able to instill confidence, as well as to instruct on the path of success. The main tasks for such a leader are development and expanding the horizons of the possible, as well as mastering new opportunities. Such a leader directs all the energies to getting pleasure not from success, but from the journey to triumph.

“Visualization leader” acts under the motto: “Follow me!”. The main tasks of such a leader are to define and visualize the importance of the work of each team member. He/she creates a collective image of success, believes in it and energizes others with this belief when the company is at the stage of strategy development and chooses the further path of development.

No matter what style of emotional leadership is applied to a leader, the basis of leadership will always remain respect and trust of team members, which only a leader with developed emotional intelligence can do. By developing it, one can become a true leader who is supported and followed.

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УДК 620.9

THE IMPACT OF RENEWABLE ENERGY SOURCES ON THE PROSPECTS FOR THE DEVELOPMENT OF THE OIL SECTOR

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Abstract. This article provides an overview of the changes in the energy industry caused by the expansion of the use of renewable energy sources. The effect of this heyday on oil consumption and development strategies of large oil companies is considered. The article analyzes the shifts in investments, technological changes and strategic decisions taken by the oil sector to adapt to the new energy paradigm, as well as the prospects for the future coexistence of oil and renewable energy in the global economy.

Keywords: petroleum products, alternative energy, oil industry, energy transformation, economic consequences.

ВЛИЯНИЕ ВОЗОБНОВЛЯЕМЫХ ИСТОЧНИКОВ ЭНЕРГИИ НА ПЕРСПЕКТИВЫ РАЗВИТИЯ НЕФТЯНОГО СЕКТОРА

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Аннотация. В статье представлен обзор изменений в энергетической индустрии, вызванных расширением использования возобновляемых источников энергии. Рассматривается оказываемый эффект данного расширения на потребление нефти и стратегии развития крупных нефтяных компаний. Анализируются сдвиги в инвестициях, технологические изменения и стратегические решения, принимаемые нефтяным сектором для адаптации к новой энергетической парадигме, а также перспективы будущего сосуществования нефтяной и возобновляемой энергетики в мировой экономике.

Ключевые слова: нефтепродукты, альтернативная энергетика, нефтяная промышленность, энергетическая трансформация, экономические последствия.

Until recently, oil was the undisputed dominant source of energy, shaping the global economy and geopolitical relations. However, recent decades have brought with them a revolution in the field of alternative energy sources, which raises questions

about the future of the oil industry and its development strategy. The rise of renewable energy sources, such as solar, wind, hydropower and bioenergy (Figure 1), has a direct impact on the structure and dynamics of the energy market. These technologies are becoming more and more competitive, thanks to the constant reduction of costs for their production and installation. As a result, oil consumption may decrease, especially in the transport sector, where alternatives in the form of electric vehicles and hydrogen technologies are actively being sought [1].

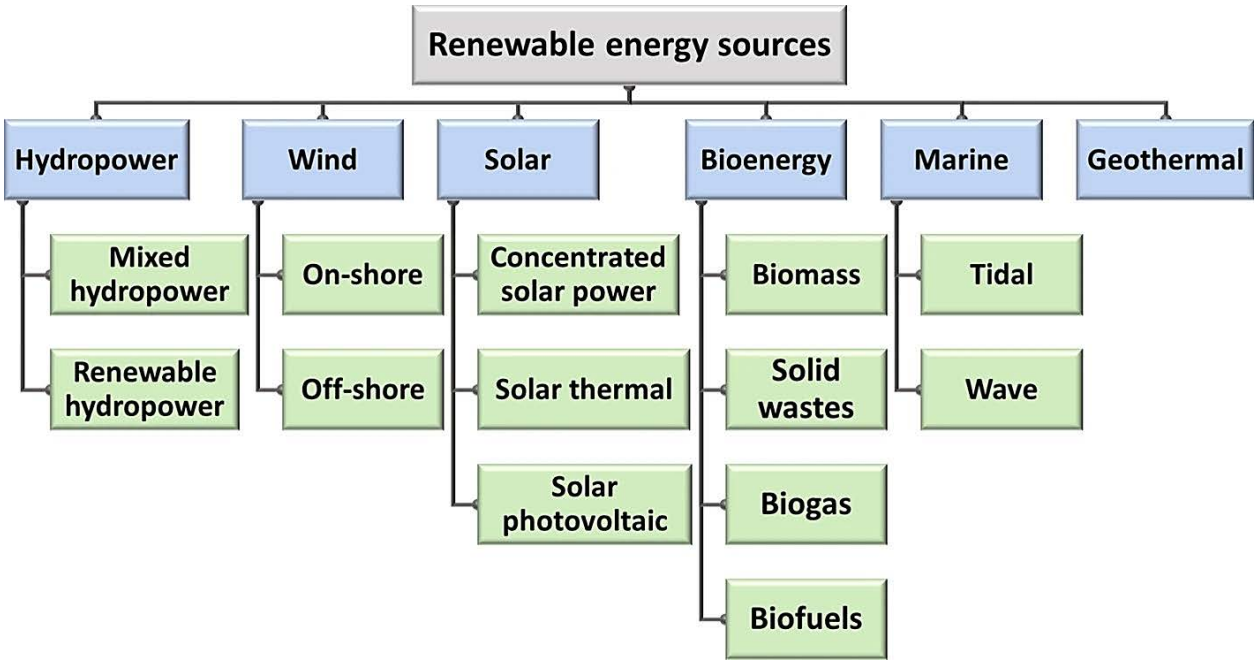


Figure 1. Types of renewable energy

This shift is of key importance for the oil industry. Large companies are forced to rethink their strategies, investing in research and development of alternative technologies or diversifying their portfolios to include more environmentally friendly types of energy. Some companies have already begun to shift from oil projects to investments in renewable sources, seeking to become more sustainable and adapt to the changing market. For example, the largest automakers are gradually abandoning internal combustion engines and moving to the production of electric vehicles. The head of the Audi concern, Marcus Duesmann, said that from 2026 all new Audi models will be electric cars. Automotive companies such as Mercedes-Benz, BMW AG, Nissan, Renault, Mitsubishi, Hyundai Motor, Ford Motor and many others are also engaged in the electrification of cars.

However, the oil sector does not lose its importance. Oil remains an important source for the production of plastics, fertilizers, medicines and other products. In addition, developing countries continue to rely on oil to meet their energy needs. Thus, the oil sector is forced to adapt by improving production and processing technologies, reducing environmental impacts and exploring new markets. The relationship between the development of alternative energy sources and the oil industry may lead to a new form of energy ecosystem. This will require not only technological innovations, but also changes in political and economic strategies. Government regulations,

international agreements and investment programs will play a key role in determining the future energy landscape.

Despite the decline in dependence on oil, it will retain its importance in the global economy for a long time. However, the development of alternative energy sources makes it necessary for the oil industry to reconsider its strategies in order to remain competitive and sustainable in the future energy landscape. The growth and development of renewable energy sources is one of the main elements of energy transformation. As of the end of 2020, there was a global total of 2799 GW of renewable energy capacity available worldwide. The majority of this capacity, 43 %, was from hydropower, with a capacity of 1211 GW. Wind and solar energy comprised equal portions of the remaining capacity, with 733 GW (26 %) and 714 GW (26 %), respectively. The remaining 5 % of energy came from other renewable energy sources, including 500 MW of marine energy, 127 GW of bioenergy, and 14 GW of geothermal energy [2].

Solar energy is becoming increasingly attractive due to technological improvements in the field of photovoltaic panels, which increases their efficiency and reduces production costs. This growth leads to a significant increase in the share of solar energy in the global energy market. According to Figure 2, the growth of solar energy over the past 4 years has amounted to 106 %, which indicates an effective growth of solar energy.

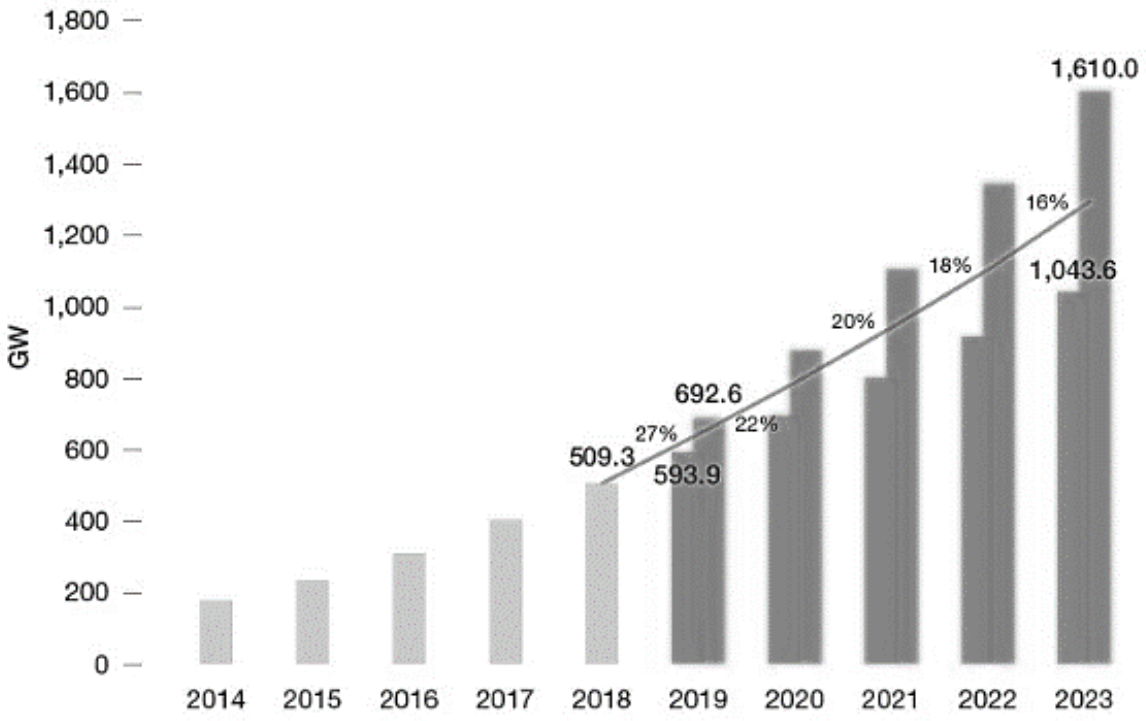


Figure 2. Dynamics of changes in the solar energy market in the world [3]

In addition, wind energy also occupies its niche in this transformation. The use of wind turbines based on advanced technologies contributes to an increase in energy efficiency and economic feasibility of this type of renewable resources. Forecasts of the development of this industry indicate a gradual increase in its share in the overall

energy balance. The volume of investments in the construction of a wind farm using the L100 2.5 MW wind power plant is approximately 130-150 million rubles per 1 MW of installed capacity of the wind farm or 330-390 million rubles per one L100 2.5 MW wind power plant [4]. These data are obtained from the existing projects of NovaVind JSC, the cost includes the costs of construction of access roads and clearing of the territory, construction of the main structures for the operation of a wind farm, manufacture of wind generators and necessary equipment, foundation filling, delivery and assembly of a wind power plant, installation of power lines and fiber-optic communication, testing and commissioning.

Hydropower also remains a significant source of renewable energy. Hydroelectric power plants play an important role in the energy system of many countries, and their advantages and limitations are actively discussed in terms of sustainability and development prospects. For example, China is a leader in the use of hydropower. The country owns the largest hydroelectric power plants, such as Trekhuorotnaya and the Sanxiapin Hydroelectric Power Plant, and occupies a leading place in the world in the production of hydroelectric power. By the end of 2020, Chinese hydroelectric power plants produced more than 1.3 trillion kilowatt-hours of electricity per year, which accounts for a significant share of the country's total energy balance. However, other countries such as Brazil, Canada, the USA and Russia are also actively using hydroelectric power plants. There are more than 200 hydroelectric power plants in the Russian Federation. Many of them are located on large rivers, such as the Volga, Amur, and Yakut, and provide a significant part of the country's energy system [5]. These hydroelectric power plants play an important role in generating electricity and ensuring Russia's energy security.

We should not forget about bioenergy, which is the use of biomass for energy production. Biofuels and other forms of bioenergy are gradually increasing their presence in the energy industry, arousing interest in their potential as an alternative energy source. This segment is also actively developing and undergoing technological changes in order to increase efficiency and economic feasibility. Bioenergy in the oil industry is a promising area of research and development based on the use of biomass for energy production. This includes the use of vegetable oils, biodiesel, biogas, bioethanol, which can replace or supplement traditional petroleum products. Today, despite the potential of bioenergy, the introduction of these technologies into the oil industry is limited by several factors. One of the key constraints is the economic feasibility of biofuel production compared to traditional energy sources.

All these aspects of the diversity of renewable energy sources become fundamental when discussing the prospects for their development and impact on the energy market as a whole. This brings significant changes to the global energy dynamics, affecting especially the oil industry. This shift, although it does not negate the importance of oil as a key energy resource, makes significant adjustments to its future prospects and development strategies. The transition has affected the oil industry, forcing companies to rethink their strategies. The relationship between the development of alternative energy sources and the oil industry raises important questions about the future of the energy landscape. The traditional energy ecosystem is being replaced by an era that requires not only technological innovations, but also

changes in political, economic and environmental strategies. Government regulations, international agreements and investment programs are becoming important tools for determining the future energy landscape.

Environmental aspects occupy an important place in modern strategies for the development of the oil industry. Companies are actively implementing modern technologies to reduce emissions and reduce the carbon footprint of the production of petroleum products. Investments in environmentally sustainable processes and the development of new methods for cleaning up emissions are priority areas of development. The oil industry has a significant impact on the environment and often faces a number of environmental problems. Emissions of oil and petroleum products into water sources, whether seas, rivers or lakes, have a devastating impact on marine life and ecosystems. This can happen due to accidents during the transportation of oil by water or due to industrial processes. The production and transportation of oil, as well as its processing, including the burning of petroleum products, lead to the release of harmful substances into the atmosphere, which worsens air quality and contributes to climate change. Oil burning is one of the largest sources of greenhouse gas emissions, such as carbon dioxide, which contributes to the greenhouse effect and global warming. To solve these problems, it is necessary to introduce more efficient technologies in the extraction, transportation and refining of oil, as well as stricter standards and laws controlling the environmental aspects of the oil industry. It is also important to develop and support alternative energy sources in order to reduce dependence on oil and reduce the negative impact on the environment.

In the context of energy transformation, oil companies are forced to study the prospects for long-term development. This includes not only the desire to adapt to new technologies and markets, but also an active desire to innovate in creating more environmentally friendly types of energy and technologies that can reduce the negative impact on the environment. The growth in the use of renewable energy sources has a significant impact on the geopolitical situation and economic relations between countries. Energy self-sufficiency is becoming more accessible due to the expansion of alternative energy sources, which affects the dependence of states on oil supplies from certain regions of the world. Such changes in the energy balance of countries lead to a revision of geopolitical strategies and affect diplomatic relations between oil exporting countries and their partners. The energy strategy and the degree of dependence on oil play a significant role in shaping the foreign policy of many states.

The economic consequences are also no less significant. The growth in the production and use of alternative energy sources stimulates the economy in this area, creating new jobs and investments in innovation and development. It can also lead to a change in the competition between countries and companies in the energy market, forming new centers of economic activity [6]. In addition, countries with advanced technologies in the field of renewable energy sources are getting new opportunities to export such technologies and skills. This creates new economic ties and forms cooperation between the countries.

In conclusion, energy transformation requires an integrated approach that combines oil and renewable energy into a harmonious system that takes into account economic, environmental and geopolitical aspects. The transition to more sustainable

energy sources is a challenge, but it also opens up new opportunities for innovation and cooperation at the global level in building a more sustainable energy future.

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УДК 004.75

CONTAINER VIRTUALIZATION: REVOLUTIONIZING SOFTWARE DEPLOYMENT AND MANAGEMENT

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Abstract. This paper discusses container virtualization, including its fundamental concepts, advantages, applications, challenges, and future prospects in the ever-evolving domain of software deployment.

Keywords: container, virtualization, containerization, Docker, technology, container orchestration.

ВИРТУАЛИЗАЦИЯ КОНТЕЙНЕРОВ: РЕВОЛЮЦИЯ В РАЗВЕРТЫВАНИИ И УПРАВЛЕНИИ ПРОГРАММНЫМ ОБЕСПЕЧЕНИЕМ

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Аннотация. В данной статье рассматривается виртуализация контейнеров, включая ее основные концепции, преимущества, применение, вызовы и перспективы в постоянно развивающейся области развертывания программного обеспечения.

Ключевые слова: контейнер, виртуализация, контейнеризация, Docker, технология, оркестрация контейнеров.

In today’s rapidly evolving world of software development and deployment, staying at the forefront of technology is essential. Container virtualization has emerged as a transformative technology that has revolutionized the way applications are developed, packaged, shipped, and managed. It has become the go-to solution for many organizations, simplifying the development process, improving resource utilization, and enhancing scalability and portability.

Container virtualization, often referred to as containers, is a lightweight form of virtualization that encapsulates an application and all its dependencies, including libraries and runtime environments, into a single, portable unit. This self-contained

unit, known as a container, can be deployed consistently across different environments, ensuring that the application behaves identically regardless of where it is executed [1].

The most popular and widely adopted containerization technology is Docker. Docker introduced a simple and efficient way to package, distribute, and run applications within containers. Furthermore, Kubernetes, an open-source container orchestration platform, has further popularized the use of containers by simplifying container deployment and scaling across clusters of machines.

Container virtualization offers a plethora of advantages that have made it a game-changer in the software development and deployment landscape:

1. Portability. Containers can run on any platform that supports containerization, which means an application can be developed on one system, tested on another, and deployed on a third, all without modification. This portability reduces compatibility issues and streamlines the deployment process.

2. Resource Efficiency. Containers share the host OS kernel, making them more lightweight compared to traditional virtual machines. This results in reduced overhead and improved resource utilization, allowing for the deployment of more containers on a single host.

3. Isolation. Containers provide a level of isolation between applications, ensuring that they do not interfere with each other. This isolation makes it easier to manage dependencies and troubleshoot issues.

4. Rapid Deployment. Containers can be created and started within seconds, enabling rapid development, testing, and deployment cycles. This agility is crucial for modern, fast-paced development environments.

5. Scalability. Container orchestration platforms like Kubernetes make it easy to scale applications up or down based on demand. This elastic scaling ensures that resources are allocated efficiently, and applications remain highly available.

6. Version Control. Containers can be versioned, allowing developers to roll back to previous versions if issues arise. This enhances the reliability of deployments.

7. Microservices Architecture. Containers are an ideal choice for microservices, where applications are broken down into small, independent components. Each microservice can be packaged in a container, making it easier to develop and manage complex, distributed systems.

8. DevOps and CI/CD Integration. Containers play a central role in DevOps practices and continuous integration/continuous deployment (CI/CD) pipelines. They allow for consistent and automated testing and deployment of applications, enhancing the efficiency of development workflows.

9. Hybrid and Multi-Cloud Deployments. Containers offer flexibility in deploying applications across on-premises data centers and various cloud providers. This ensures compatibility and facilitates easy migration between different environments.

10. Legacy Application Modernization. Containerization can revitalize legacy applications, making them more portable and manageable. This allows organizations to extend the life of existing systems while benefiting from the advantages of modern deployment practices.

11. Community and Ecosystem. Containerization technologies like Docker and Kubernetes have robust communities and ecosystems, offering a wealth of pre-built

container images, plugins, and tools that streamline the development and deployment process.

12. Security and Isolation. Containers provide a level of security through isolation, ensuring that applications cannot interfere with each other or with the host system. Security measures like seccomp profiles and AppArmor or SELinux policies can be employed to enhance container security [2].

Overall, container virtualization offers a flexible and efficient approach to software development and deployment, making it an essential technology for modern application development and infrastructure management.

To grasp the inner workings of container virtualization, it is important to understand the core technologies and components that power it:

1. Docker. Docker is the most well-known and widely used containerization platform. It provides tools for building, packaging, and distributing containers. Docker uses a client-server architecture, where the Docker client communicates with the Docker daemon, which is responsible for building, running, and managing containers. Docker images, which serve as blueprints for containers, are created from a set of instructions called a Dockerfile.

2. Container Runtimes. Container runtimes are responsible for executing containers. Docker initially used its own container runtime called Docker Engine. However, the container ecosystem has evolved to support alternative runtimes such as containerd and rocket (rkt).

3. Container Orchestration. Container orchestration platforms are used to manage and automate the deployment, scaling, and operation of containers. Kubernetes is the most prominent example in this category. Kubernetes provides features for load balancing, rolling updates, self-healing, and automatic scaling, making it a powerful tool for managing containerized applications at scale.

4. Container Registries. Container registries are repositories for storing and distributing container images. The most famous registry is Docker Hub, but there are also private registries like Google Container Registry, Amazon Elastic Container Registry, and Azure Container Registry. These registries play a crucial role in sharing and distributing container images within and between organizations [3].

The versatility of container virtualization has led to its adoption in various use cases:

1. Microservices Architecture: Containerization is a natural fit for microservices, where applications are broken down into small, independent components. Each microservice can be packaged in a container, making it easier to develop and manage complex, distributed systems.

2. DevOps and Continuous Integration/Continuous Deployment (CI/CD): Containers are an integral part of the CI/CD pipeline, as they allow for consistent and automated testing and deployment of applications. DevOps practices are greatly facilitated by containerization.

3. Hybrid and Multi-Cloud Deployments: Containers offer flexibility in deploying applications across on-premises data centers and various cloud providers, ensuring compatibility and easy migration.

4. Legacy Application Modernization: Containerization can breathe new life into legacy applications, making them more portable and easier to manage [4].

While container virtualization offers numerous advantages, it is not without its challenges. Some of the common issues include security concerns, management complexity, and the need for proper monitoring and scaling strategies. Best practices for container virtualization include implementing security measures, managing containers with orchestration tools, and closely monitoring and optimizing resource usage.

Security remains a paramount concern when adopting containerization. Containers share the same kernel, which means a vulnerability in the kernel could potentially affect multiple containers on the same host. To mitigate security risks, organizations should implement best practices like regular patching, image scanning for vulnerabilities, and employing security measures such as seccomp profiles and AppArmor or SELinux policies [5].

Container virtualization has emerged as a transformative technology in the software development and deployment landscape. Its portability, resource efficiency, and scalability have made it a preferred choice for modern application development. As technology continues to evolve, containerization is likely to remain a central player in the future of software deployment, enabling faster, more efficient, and more reliable applications across a wide range of industries. Whether you are a developer, an IT manager, or a business leader, understanding and harnessing the power of container virtualization can be the key to staying ahead in today's competitive and fast-paced tech world.

Container virtualization's trajectory remains promising. As technology continues to evolve, containerization is set to play an increasingly pivotal role in the future of software deployment.

One of the key prospects of container virtualization is the improvement of security. Container security will remain a priority. More advanced security tools, enhanced container scanning, and improved isolation methods are expected to reduce vulnerabilities and meet compliance requirements.

Another key prospect is the containerization of legacy systems. Many organizations with outdated systems are seeking to containerize their existing applications to reap the benefits of container flexibility and efficiency. This trend will remain relevant, leading to a revival of older applications.

Furthermore, the development of integration with artificial intelligence and machine learning is expected. Containers will be used in AI and machine learning workloads, enabling easy deployment and scaling of AI models and services. The combination of containerization and artificial intelligence will be a powerful tool in various domains.

Another key prospect is the containerization of Multi-Cloud and Hybrid Cloud Adoption. As businesses seek flexibility and redundancy in their cloud infrastructure, containerization will play a significant role in enabling multi-cloud and hybrid cloud strategies.

Also, the development of serverless integration is expected. The integration of containers with serverless computing is an emerging trend. Combining the scalability and ease of management of containers with serverless functions can provide a powerful architecture for building and running applications.

Another key prospect is the containerization of quantum computing integration. As quantum computing technologies mature, they may influence containerization in the long term by requiring new approaches to handling security and resource allocation.

Container virtualization has indeed revolutionized software deployment, offering a range of benefits that make it an indispensable technology in today's fast-paced development environment. Its versatility and adaptability to a wide range of use cases, from microservices to DevOps, make it a transformative force in the industry. As organizations continue to embrace container virtualization, the future of software deployment looks brighter and more efficient than ever before.

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УДК 536.2.022

ENERGY SAVING ISSUES IN THE CHEMICAL INDUSTRY

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Abstract. The issues of increasing energy saving by reducing heat loss by determining the critical thickness of thermal insulation of technological equipment in chemical production are considered. From the point of view of minimizing the energy consumption of chemical processes, the critical diameter of the thermal insulation material should be smaller than the outer diameter of the uninsulated pipeline or apparatus.

Keywords: energy saving, chemical industry, specific heat flux, thermal resistance, thermal conductivity coefficient, critical diameter of thermal insulation.

ВОПРОСЫ ЭНЕРГОСБЕРЕЖЕНИЯ В ХИМИЧЕСКОЙ ПРОМЫШЛЕННОСТИ

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Аннотация. В статье рассмотрены вопросы повышения энергосбережения за счет снижения потери тепла путем определения критической толщины тепловой изоляции технологического оборудования на химическом производстве. С точки зрения минимизации потребления энергии химических процессов, критический диаметр теплоизоляционного материала должен быть меньше наружного диаметра неизолированного трубопровода или аппарата.

Ключевые слова: энергосбережение, химическая промышленность, удельный тепловой поток, термическое сопротивление, коэффициент теплопроводности, критический диаметр тепловой изоляции.

More and more attention has recently been paid to energy conservation and more efficient methods of energy use. Energy conservation is a factor of economic development, which shows that it is cheaper to implement measures to save energy than to increase its production. This issue is especially relevant in the context of reducing operating costs for production, due to the rise in price of the main types of industrial heat carriers due to the reduction of their costs. Of particular interest in this regard is the study of the principles of analysis and synthesis (design) of resource-saving chemical and technological systems of industrial enterprises based on the study of the physico-chemical essence of technological processes, consideration of their thermodynamic, technological, environmental and economic features [1, p. 5-6].

To assess the efficiency of energy use, it is necessary to use objective indicators that allow us to compare the actual results obtained with the maximum possible in ensuring energy conservation [2, p. 307].

One of the main issues in the design of any chemical industry production is the issue of minimizing the energy consumption of chemical processes by calculating thermodynamically feasible target energy (or minimum energy consumption) and achieving it by optimizing the heat recovery of the system, energy supply methods and operating conditions. The correct choice of thermal insulation material ensures a given temperature regime of technological processes, reduces heat loss to the environment and prevents unwanted overheating of equipment [3, p. 409]. An important parameter in the technology is the critical thickness of the thermal insulation of the equipment, which depends on many factors, including the characteristics of the device, the characteristics of the thermal insulation material, working conditions and requirements for the safety of the workplace organization. The critical thickness of thermal insulation determines the minimum insulation thickness necessary to prevent unwanted heat loss or cooling of equipment in production [4, p. 541].

The most common method for determining the critical thickness of thermal insulation is based on determining the specific heat flow and heat loss through the wall or surface of the device under specified operating conditions. In this case, such parameters as the thermal conductivity of the insulation material, the temperature regime, i.e. the temperature difference of the hot and cold coolant, the structural parameters of the internal and external environment, as well as the dimensions of the device are taken into account.

The specific heat flow depends on the diameter of the thermal insulation and the thermal conductivity coefficient of the insulating material. The coefficient of thermal conductivity characterizes the ability of a body to conduct heat by thermal conductivity and depends on the nature of the substance, its structure, temperature, etc. The low thermal conductivity of thermal insulation and many building materials is due to a porous structure in the cells of which air is poorly conducting heat [5, p. 11]. An increase in the thickness of the thermal insulation leads to an increase in its outer surface, therefore, with an increase in the thickness of the insulation, heat losses decrease only to a certain value. There is a critical diameter of thermal insulation for each material (Figure 1). At the same time, if the diameter of the insulating layer is less

than this critical diameter, then the thermal insulation material does not fulfill its role and heat losses increase [6, p. 61].

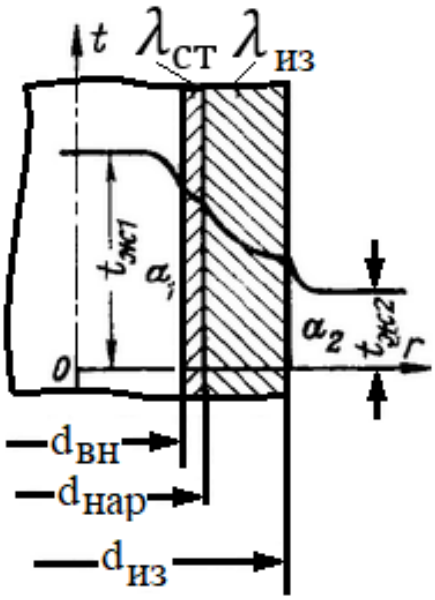


Figure 1. Heat transfer through a multilayer flat cylindrical wall [4, 5]

The thermal resistance of a multilayer wall is determined by the equation [4, p. 542]

$$R = \frac{1}{\alpha_1 d_{вн}} + \frac{1}{2\lambda_{ст}} ln \frac{d_н}{d_{вн}} + \frac{1}{2\lambda_{из}} ln \frac{d_{из}}{d_{нар}} + \frac{1}{\alpha_2 d_{из}} = R_1 + R_2 + R_3 + R_4.$$

where α_1 , α_2 represent the heat transfer coefficient from the coolant to the inner surface of the pipe and the heat transfer coefficient from the outer surface of the thermal insulation to the environment, respectively $d_{вн}$, $d_{нар}$ are the inner and outer diameter of the pipeline, m; $d_{из}$ is diameter of the thermal insulation material, m; $\lambda_{ст}$, $\lambda_{из}$ stand for the coefficient of thermal conductivity of the wall and thermal insulation material, W / (m.K).

With an increase in the total thermal resistance, the value of the heat flux density decreases (the amount of heat transferred per unit of time through a unit of surface). The first term in the formula (R_1) characterizes the thermal resistance to the heat transfer process, the second and third terms (R_2, R_3) refer to thermal resistance to thermal conductivity, the last term (R_4) reflects thermal resistance to the heat transfer process from the outer surface of the insulating material to the environment (Figure 2).

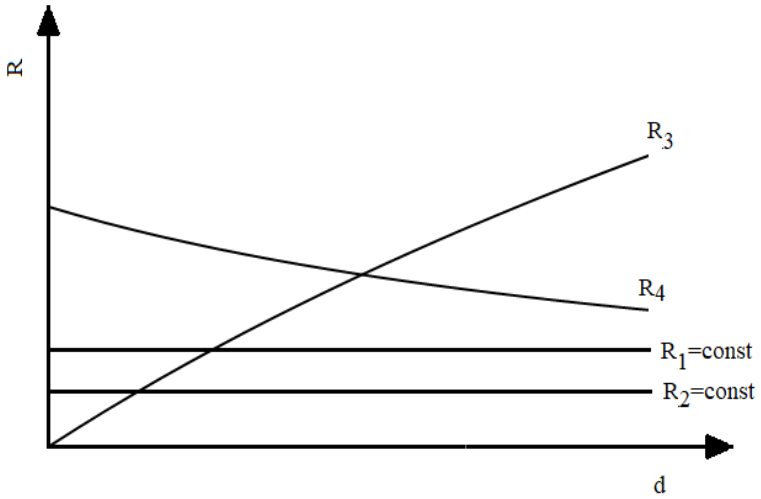


Figure 2. Dependence of the thermal resistance of the multilayer wall on the diameter of the thermal insulation material

The thermal resistance to the heat transfer process from the coolant side of the inner surface of the wall and the thermal resistance of the wall itself do not depend on the diameter of the layer of thermal insulation material. The third term, the thermal resistance of the thermal conductivity of a layer of thermal insulation material with an increase in diameter also increases due to a decrease in the carrying capacity of conductive heat exchange. The thermal resistance to the heat transfer process from the outer surface of the thermal insulation material to the environment decreases with increasing $d_{из}$, which is due to an increase in the throughput of the convective stage due to an increase in the surface in contact with the environment.

Thus, a situation arises when $d_{из}$ (an independent variable) included in the calculated terms R_3 and R_4 has an opposite effect on the value of the total thermal resistance $\sum R$. The solution of the problems of this type consists in determining the extremum of the function, equating the first derivative of $\sum R$ with respect to $d_{из}$ to zero.

$$\frac{d\sum R}{d(d_{из})} = 0.$$

Since the first two terms do not depend on the diameter of the thermal insulation material and knowing the properties of the logarithms, we express $ln\frac{d_{из}}{d_{нар}}$ as the difference $lnd_{из} - lnd_{нар}$, where $lnd_{нар}$ also does not depend on the outer diameter of the thermal insulation material.

$$\frac{dR}{d(d_{из})} = 0 + 0 + \frac{1}{2\lambda_{из}}\frac{1}{d_{из}} - 0 - \frac{1}{\alpha_2 {d_{из}}^2} = 0.$$

$$\frac{1}{2\lambda_{из}}\frac{1}{d_{кр}} - \frac{1}{\alpha_2 {d_{кр}}^2} = 0.$$

Thus, the critical diameter of thermal insulation corresponding to the extremum of the curve $\sum R = f(d_{из})$, is determined by the equation

$$d_{кр} = \frac{2\lambda_{из}}{\alpha_2}.$$

Analysis of the equation at the extremum point shows that $\sum R = f(d_{из})$ passes through the minimum, which corresponds to the maximum value of heat loss to the environment. With an increase in the diameter of the thermal insulation to the value of the critical diameter, the thermal resistance will decrease, a further increase in the diameter of the thermal insulation leads to an increase in thermal resistance, i.e. heat losses first increase reaching the maximum value at $d = d_{кр}$, with a further increase in the diameter they decrease. This type of dependence is determined by the stages of the heat transfer process: conductive and convective heat exchange, namely convection from the thermal insulation material to the environment and conduction through a layer of thermal insulation material. With small values of the thickness of thermal insulation, the intensity of the process is determined primarily by the convective stage, with an increase in the diameter of the thermal insulation material – by the conductive one.

With an increase in the thermal conductivity of the thermal insulation material, the critical diameter increases, which can be observed when using a poor thermal insulation material (a high value of $\lambda_{из}$) as a result, a sufficiently large insulation layer will be required when using this material.

Analysis of the equation for determining the critical diameter of thermal insulation shows that this parameter does not depend on the diameter of the pipeline (apparatus).

When determining the critical diameter, 2 options are possible: 1) $d_{кр} < d_{н}$, 2) $d_{кр} > d_{н}$. The first option is obtained for pipes of very small diameter, the second is used for industrial-sized equipment. For the second option, the problem of determining the critical thickness of thermal insulation loses relevance due to the large surface area of heat exchange and any increase in the thickness of thermal insulation leads to a decrease in heat loss to the environment.

Thus, the critical diameter of thermal insulation corresponds to the minimum thermal resistance and maximum heat flow from the outer surface of the thermal insulation material to the environment, i.e. maximum heat loss.

The paper considers the issues of minimizing the energy consumption of chemical processes by calculating and correctly selecting the thickness of the thermal insulation material depending on the value of the critical value of thermal insulation. When choosing the thickness of thermal insulation, it is necessary to consider the permissible heat loss (wall temperature), taking into account the cost of materials. The task of optimization in the field of energy saving and energy efficiency can be expanded by solving the issue of determining the optimal thickness of each layer of

heat-insulating material of a multilayer wall, depending on the efficiency of use and cost of materials.

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УДК 336.7

FINTECH AND BIGTECH: DEFINITIONS, FEATURES, DIFFERENCES

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Abstract. The article is devoted to the problems of understanding bigtech and fintech companies in the modern world, as well as their differences. Consideration of this topic is an urgent issue due to the variety of approaches to the definition of these terms and the growing role of these companies. According to the results of the study, the concepts of bigtech and fintech companies were formulated, and it was also concluded that the main difference between these companies lies in the direction of their activity and business model.

Keywords: bigtech, fintech, financial services market, ecosystem, bank.

FINTECH И BIGTECH: ОПРЕДЕЛЕНИЯ, ОСОБЕННОСТИ, ОТЛИЧИЯ

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Аннотация. Статья посвящена проблематике понимания bigtech- и fintech-компаний в современном мире, а также их различий. Рассмотрение этой темы является актуальным вопросом в связи с многообразием подходов к определению данных терминов и растущей ролью этих компаний. По итогам исследования были сформулированы понятия bigtech- и fintech-компаний, а также сделан вывод о том, что основное различие данных компаний заключается в направленности деятельности и бизнес-модели.

Ключевые слова: bigtech, fintech, рынок финансовых услуг, экосистема, банк.

Today, one of the busiest and most advanced markets is the fintech market. This market includes a large number of areas: P2P lending, E-wallets, Bitcoins, mobile banking, etc. Financial services provided by fintech companies accelerate and facilitate economic processes for both individuals and business representatives, but are also a growing threat to banks. In addition, such a concept as bigtech companies has recently appeared and has begun to be actively used, which also have competitive advantages over banks and the opportunity to enter the fintech market.

Despite the fact that bigtech and fintech companies have become popular recently and there are a large number of interpretations of these concepts, it is quite difficult to single out a single definition in both cases. In this regard, the purpose of

this work is to formulate definitions of bigtech and fintech companies, as well as their differences from each other.

Let's start by studying the specifics of fintech companies. According to the Bank of Russia, fintech is the provision of financial services using innovative technologies, such as artificial intelligence, machine learning, robotics, blockchain, cloud technologies, biometrics, etc. [1]. According to the Bank for International Settlements (BIS), fintech companies should be understood as organizations that specialize in providing digital financial services to consumers [2]. Also, the definition of fintech companies is present in the PwC study, in their opinion, fintech companies are dynamically developing companies in the financial services and technology sector that introduce innovative, digital products and services previously provided by traditional representatives of the financial sector [3].

It is important to note that fintech companies are not banking structures in the usual sense of banking. On the contrary, they compete with traditional banks for customers, including providing financial services that do not require obtaining a special license for the right to operate, for example, P2P lending, etc. In this regard, the growing popularity of fintech products and services has led to the digitalization of traditional banks (for example, Sberbank).

By the end of 2022, Visa, Mastercard, Tencent, Intuit, PayPal, etc. became the leaders in the global market of fintech companies (Figure 1) [4].

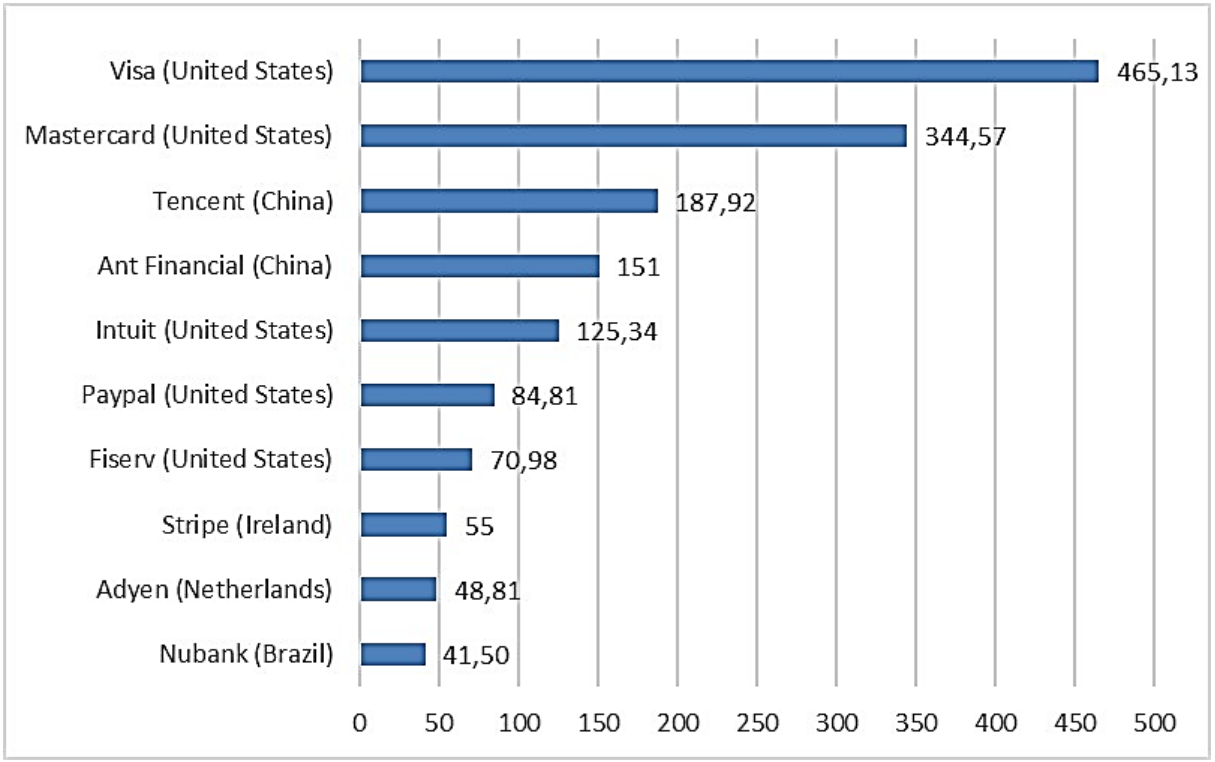


Figure 1. Market capitalization of the largest fintech companies worldwide in 2022, USD billion

After analyzing this list, we can conclude that all these companies specialize in providing financial services: payments, investments, insurance, etc. In addition, statistics on Russian fintech companies also confirm the fact that these are technology

companies providing digital financial services to both legal entities and individuals, as well as banks. For example, according to the results of 2021 and 2022, the market leaders in Russia were such companies as Qiwi, YooMoney, Evotor (Figure 2) [5].

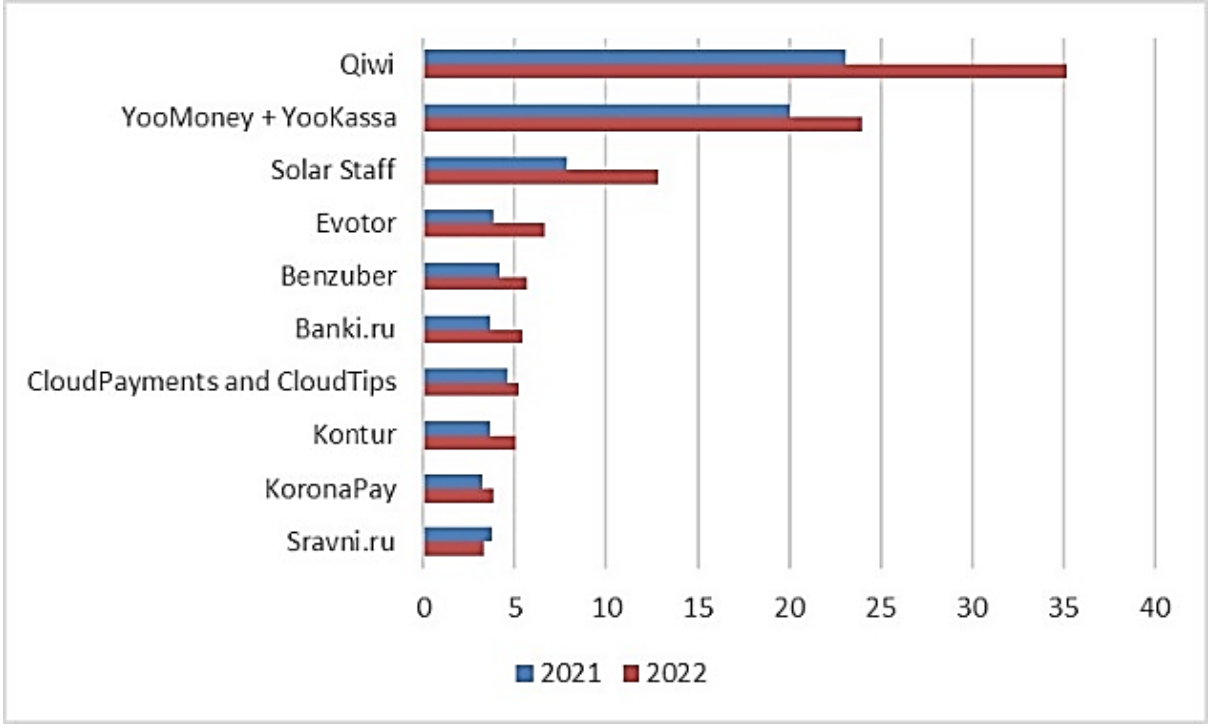


Figure 2. Market capitalization of the largest fintech companies in the world in 2022, USD billion

Thus, in this study we will understand fintech companies as technology companies whose purpose is to provide financial services using information technology.

Now let's turn to the consideration of the concept of bigtech companies. According to a study by the European Securities Market Supervision Authority (ESMA), bigtech companies include large technology companies that have achieved a certain scale of business, market volume and number of users. They have different areas of activity, mainly of a non-financial nature, while generating huge amounts of data and have knowledge of how to manage them [6]. In the article on the transformation of the financial services of the Bank for International Settlements, bigtech companies are the largest companies in the IT sphere, which cover almost all spheres of activity: social networks, marketplaces, software development, search engines and even non-banking [2].

Prominent examples of bigtech companies at the global level are four American technology companies: Google, Apple, Facebook, Amazon and two companies from China: Alibaba and Tencent [7]. In Russia, examples of such companies are Yandex, VK, Ozon, MTS, etc. It is these companies that are currently actively developing (Figure 3) and have a significant influence in the field of IT development in Russia [8].

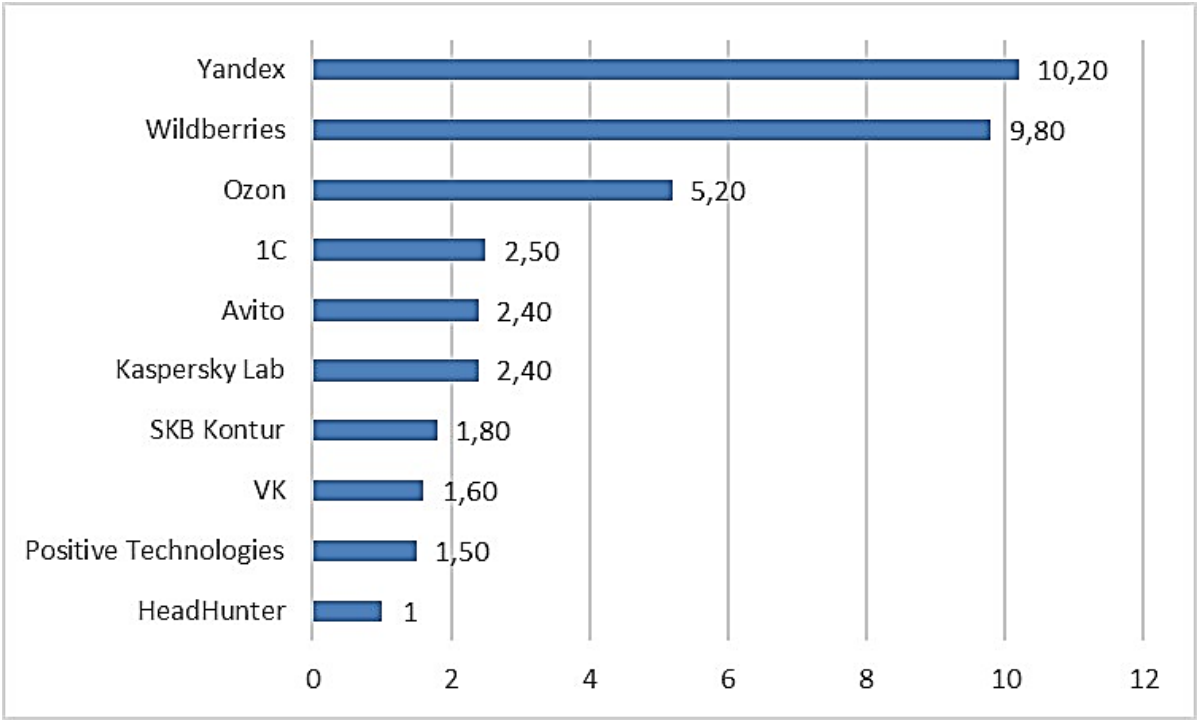


Figure 3. Leading Internet companies in Russia as of February 2023 by value, USD million

Another distinctive feature of bigtech companies is that they not only have a high capitalization and a large customer base, but they also build an ecosystem around themselves. For example, Yandex is not just a search engine, it has its own marketplace, payment system, delivery services, taxi, educational platforms, etc. All this demonstrates a commitment to the brand. Using taxi or delivery services, the client receives bonuses and can spend them on other goods and services within the same ecosystem.

Therefore, it can be concluded that bigtech companies are large IT corporations whose activities are focused on creating digital products and services. In this regard, they have the opportunity to develop in various areas of activity and introduce their products where necessary, creating an ecosystem.

If we talk about the distinctive features of bigtech and fintech companies, then the main criterion is the direction of activity. Therefore, fintech companies initially specialize in offering various digital financial services, whereas for bigtech companies, financial products and services are rather a derivative of the main activity, namely the development and implementation of information technologies. The business model of bigtech companies is based on the use of big data and its analysis, which makes it possible to aggregate the flow of data about users, analyze it and on this basis create new products for those areas where there is a lack of supply or there is an opportunity to upgrade existing products. There is also a practice that bigtech companies actively acquire or absorb fintech startups, embedding them into their ecosystems. For example, Amazon acquired several fintech startups such as Emvantage, Tapzo, Payfort, implemented them into its ecosystem and created its own services Amazon Cash, Amazon Pay, Amazon Lending [9].

Thus, on the basis of the studied data, definitions of fintech and bigtech companies as well as their main features and differences were formulated. We emphasize that fintech companies are organizations that initially focus on the financial sector, its informatization and digitalization. Bigtech companies see their main goal as strengthening their positions in the market regardless of the field of activity, introducing software and information products where they see a profitable opportunity for themselves.

The issues of competition between fintech and bigtech companies and traditional banking structures seem to be promising areas of research.

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УДК 372.881.111.1

DESIGNING AND USING WEBQUESTS TO SUPPORT TEACHING SPEAKING IN PRIMARY SCHOOL

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Abstract. This paper discusses the advantages of using webquests to teach elementary school students speaking. Students' critical thinking, problem-solving, and teamwork abilities can all be enhanced by webquests. They are the perfect teaching tool since they can be tailored to fit various learning preferences and levels of language mastery. Webquests may be an enjoyable and interesting resource for students to practise speaking and may assist them in overcoming obstacles when learning to speak a foreign language.

Keywords: educational webquest, information technologies, speaking, monologue, primary school.

РАЗРАБОТКА И ИСПОЛЬЗОВАНИЕ ВЕБ-КВЕСТОВ ДЛЯ ОБУЧЕНИЯ УСТНОЙ РЕЧИ МЛАДШИХ ШКОЛЬНИКОВ

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Аннотация. В работе рассматриваются преимущества использования веб-квестов для обучения устной речи учащихся начальной школы. Веб-квесты позволяют развивать критическое мышление, умение решать проблемы и работать в команде. Они являются идеальным инструментом обучения, поскольку могут быть адаптированы к различным потребностям и уровням владения языком. Веб-квесты позволяют формировать умения в устной речи в развлекательной форме и могут помочь преодолеть трудности в обучении говорению.

Ключевые слова: образовательный веб-квест, информационные технологии, говорение, монолог, начальная школа.

In today's digital world, technology has become an integral component of education. The more information children can easily get, the more effort teachers should make to attract students' attention and make them interested in a topic. The use of webquests is one way of achieving educational goals. This is a cutting-edge teaching technology that allows teachers to design engaging and interactive learning resources for their students. This article discusses the use of webquests for teaching speaking in primary school.

There are multiple researches on incorporating webquests into the educational process. Initially V. Dodge introduced this activity and T. March, N. Kononets, V. Osadchuk, V. Schmidt, G. Shamatonov, and others have contributed to its development. A webquest is a problem-solving activity with some elements of a role-play and it is supposed to be accomplished by using various Internet resources [1]. A quest is also defined as a game containing tasks of various difficulty that should be completed within a time limit [2].

O. Nemykh and Yu. Zhivova proposed the following algorithm for creating a webquest:

1) choose a subject;

2) choose a platform and a template for the best possible presentation of information in a webquest;

3) create various kinds of tasks; when creating a webquest to teach speaking, a teacher should choose an approach to presenting information (top-down or bottom-up) and arrange the tasks from basic (aimed at practising vocabulary and grammar) to more challenging ones (communication and/or collaborative tasks);

4) develop assessment criteria;

5) choose sources of information that students may use while working through a webquest; when creating an educational webquest for primary school students, it is best to provide all relevant resources in advance for youngsters to plan, organise and manage their work successfully;

6) create the webquest;

7) choose a way of sharing the webquest [3].

As a rule, the structure of a webquest includes the following elements:

1. An introductory section with instructions. This section provides background information, students learn about the plot, get introduced to characters, and familiarize themselves with the rules they must follow. When completing the tasks in a webquest students may earn points in a variety of ways and should know about it in advance.

2. A set of tasks. Each webquest includes a set of assignments that can be arranged according to their difficulty from basic to more complex ones; for primary school students it is essential to create tasks that let them practise different activities (speaking, reading, listening) and take short breaks for movement in order to stay focused and not to lose concentration. The rotation of tasks and activities may also positively influence the lesson's dynamics. Guidance is required when students are working through a webquest; they should be given clear instructions for each activity and hints about effective task-solving strategies, as well as asked instruction checking

questions. A teacher should also adopt the tasks for students with individual needs and offer them additional support to complete the activities if necessary.

3. A set of information resources necessary to complete a webquest. Nowadays there are several educational interactive online platforms that allow embedding tasks created on different websites into one presentation, eliminating the need for students to open additional information resources. We have chosen *Genially* to create a webquest for fourth graders for several reasons. Firstly, the use of this resource does not require teachers to have special IT skills. Coding is not necessary, so teachers can use one of the templates to make their classes more technologically advanced. Secondly, it is a generally free platform for creating interactive animation content.

4. A concluding section. This section is aimed at reminding students of what they have learned and how many points they have received during the webquest. Individual feedback from the teacher is essential, it should be constructive and immediate [4].

Webquests appear to be gaining in popularity, this tool is frequently used for educational purposes and widely praised. Students learn to conduct web search for information and then use it effectively in webquests. Webquests and fundamental principles of student-centred approach are correlated as teachers become facilitators enabling their students to gain knowledge on their own and to become more independent. Teachers can organise work in groups or pairs, students can also benefit from doing individual tasks in a webquest when studying offline or online with remote support from an educator [5].

Using webquests in primary school is beneficial since children learn while playing, and this unconventional activity may result in a better comprehension according to the theory of learning by doing. Students are given a chance to work in groups while improving communication skills and developing creativity. Moreover, the use of this technology promotes students' digital literacy and demonstrates that the Internet can be used for more than entertainment [6]. It should be mentioned, however, that teachers are advised to limit the time of using IT in an elementary class to 20 minutes [7].

The efficiency of using webquests for teaching speaking may increase if an online voice recorder is embedded into the interactive presentation. We created a webquest The Town of Ghosts for fourth graders to teach them how to talk about a place in a town and apply the knowledge of place prepositions our students had previously acquired. As this lesson was taught at the end of October, we linked the plot to Halloween.

We created an interactive presentation using Genially and integrated it with our interactive webquest assignments on Wordwall and LearningApps teaching resources. Students' presentations were recorded using FlipGrid that allows making videos.



Figure. Webquest

In conclusion, webquests can be described as effective technology-supported activities for teaching speaking. Learning may be positively influenced by interactive and engaging tasks in webquests and students can improve their speaking skills while

developing digital literacy. Teachers can design webquests that are tailored to the needs and interests of their students, creating a fun and challenging learning experience in primary school.

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УДК 504.05

THE IMPACT OF PLASTIC ON ECOSYSTEMS: PROBLEMS AND PROSPECTS FOR SOLUTIONS

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Abstract. The paper analyzes the main sources of plastic pollution, such as the use of disposable plastic products, microplastics and plastic waste in marine and river ecosystems. The article also examines the consequences of plastic pollution for various species of animals and plants, including problems related to the food chain, loss of biodiversity and disruption of the ecological balance.

Keywords: plastic waste, microplastics, ecosystems, plastic recycling and sorting.

ВЛИЯНИЕ ПЛАСТИКА НА ЭКОСИСТЕМЫ: ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ РЕШЕНИЯ

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Аннотация. В работе анализируются основные источники пластикового загрязнения, такие как использование одноразовых пластиковых изделий, микропластик и пластиковые отходы в морских и речных экосистемах. В статье также рассматриваются последствия пластикового загрязнения для различных видов животных и растений, включая проблемы, связанные с пищевой цепочкой, утратой биоразнообразия и нарушением экологического баланса.

Ключевые слова: пластиковые отходы, микропластик, экосистемы, переработка и сортировка пластика.

Plastic pollution is one of the most serious environmental problems of our time, which negatively affects both marine and land ecosystems. Plastic as a material is widely used in various spheres of life, but its weak decomposability and a large number of products produced annually lead to the accumulation of a huge amount of plastic waste in the environment.

The urgency of solving the problem of plastic pollution is that it affects the biodiversity of ecosystems and can have serious consequences for living organisms and people. Microplastics, pollution of water resources and destruction of marine animals are some of the consequences caused by plastic pollution.

The purpose of this article is to discuss the problems associated with plastic pollution and its influence on ecosystems, as well as to highlight promising ways to solve this problem. The consequences that arise in marine and terrestrial ecosystems due to plastic pollution will be considered. There will also be an analysis of the problems associated with insufficient measures for the collection and processing of plastic, the inefficiency of existing recycling methods and low awareness of the problem among the population.

Plastic decomposition is a process in which polymer materials break down and turn into smaller fragments under the influence of external factors, such as solar radiation (ultraviolet radiation), high temperature or mechanical impact [1].

However, the decomposition of plastic can take decades or even centuries, depending on the type of plastic and environmental conditions. For example, plastic bags can decompose in about 20-100 years, and plastic bottles made of polyterephthalate ethylene (PET) – about 450 years. When plastic decomposes, microparticles are formed, known as microplastics, the size of which can be from micrometers to several millimeters. These microparticles can accumulate in the environment, including soil, water and air. They can also enter the food chain when animals or humans consume contaminated food or water.

The accumulation of plastic in the environment has serious consequences for ecosystems and the health of animals and humans. Microplastics can lead to intoxication of organisms and premature death of animals, as well as cause various diseases in humans, including allergic reactions, digestive problems and even cancer.

Therefore, it is important to apply effective waste management methods and reduce the use of plastic, as well as methods of recycling and disposal of plastic materials in order to reduce their negative impact on the environment [2].

Let us consider the impact of plastic on marine ecosystems.

The spread of microplastics in seawater and its impact on marine life is a serious problem that is receiving increasing attention from the scientific community and the public.

Marine animals are being threatened by plastic waste all over the world. Seabirds, turtles, marine mammals and fish are often subject to death. Seabirds and turtles can get entangled in plastic wrappers or strangle themselves trying to eat pieces of plastic that resemble food. Marine mammals such as dolphins and whales can die from poisoning while trying to absorb plastic particles that collect in their food chains. Even fish that can eat microplastics end up on our tables, which can have a negative impact on human health.

Microplastics are small fragments of plastic waste less than 5 mm in size, which are formed as a result of the destruction of large plastic objects or the entry of small plastic particles into the environment. These particles can be of various shapes – from droplets to fibers. The spread of microplastics in seawater has a negative impact on marine life. They can enter the digestive systems of animals, causing them problems

with digestion and metabolism. Microplastics also contain toxic artificial chemicals, such as phthalates and polychlorinated biphenyls (PBBs), which can penetrate into the bodies and organisms of marine life and accumulate in their tissues. This can lead to serious consequences for marine ecosystems and human health. Studies show that microplastics can inhibit the immune system of fish and cause inflammatory reactions in marine mammals.

The mass death of marine animals due to plastic pollution is a serious problem that threatens the ecosystems of the oceans and seas. Every year, hundreds of thousands of animals die in the world's oceans due to plastic waste.

Plastic waste enters water systems through several ways. Waste thrown on beaches or thrown into the water from the shore disappears in the ocean current and becomes dangerous for animals. Large plastic objects, such as nets or plastic bags, can strangle or entangle animals, leading to their death. Small plastic particles, such as microplastics, which are formed as a result of washing synthetic materials or decomposition of large plastic objects, can be eaten by animals, which can lead to poisoning or death from starvation.

Plastic is one of the main pollutants of terrestrial ecosystems. Its impact on flora and fauna can be serious and has long-term consequences [3].

One of the main ways of getting plastic into terrestrial ecosystems is waste creation. Large pieces of plastic can cover the soil, which prevents the penetration of moisture and air. This leads to deterioration of the nutrient medium and restriction of plant growth. In addition, plastic waste can trap water, which can cause flooding and destruction of vegetation. Plastic pollution can also cause death and injury to animals. Many animals confuse plastic waste with food and die from a blockage of the esophagus or a violation digestion. In addition, plastic nets and packaging materials can become entangled in the paws and beaks of animals, rendering them helpless and limiting their ability to hunt and defend themselves.

Another important aspect of the impact of plastic on terrestrial ecosystems is its decomposition. Most plastics are not biodegradable and can remain in the soil and aquatic environment for decades or even centuries. This can lead to the accumulation of plastic in the soil and its gradual transfer into the food chain. Eventually, plastic can get into the organisms of animals and humans, causing various diseases and disorders of organs [3].

The causes of plastic pollution of our planet:

1. Insufficient measures for the collection and processing of plastic. Insufficient infrastructure for the collection and processing of plastic waste is one of the main problems that many countries are currently facing. Plastic waste is a serious pollution for the environment and has a negative impact on the animal and plant world, as well as on human health.

The lack of proper infrastructure means that plastic waste is not collected or processed in sufficient volume. Instead, it is irregularly released into nature or burned, which leads to deterioration of air quality and contamination of soil and water resources. One of the reasons for the lack of infrastructure is the lack of funding and resources to create and improve the system of collection and processing of plastic

waste. This may be due to insufficient budgets of governing bodies or insufficient awareness of the need for such infrastructure.

Some countries have a weak system for collecting and recycling plastic waste, which leads to the fact that most of the waste simply ends up in landfills or in nature. Insufficient collection infrastructure means that there are not enough containers for collecting plastic waste, as well as there are no special collection and recycling points.

In addition, the lack of sufficient infrastructure for recycling plastic waste means that a small amount of waste is actually reused or recycled. This may be due to limited plastic recycling capabilities, a lack of specialized installations and technologies for its processing [4].

2. Inefficiency of existing plastic recycling methods. The limited possibilities of processing various types of plastic are associated with their diversity and chemical composition. Some types of plastic, such as polyethylene terephthalate (PET) and polypropylene (PP), can be easily recycled and reused. However, other types of plastic, such as polyvinyl chloride (PVC) and polystyrene (PS), have a more complex structure and require special processing methods.

High costs and environmental problems in plastic recycling are also serious problems. Plastic recycling requires high energy costs and the use of chemicals, which can lead to environmental pollution. In addition, not all types of plastic can be recycled an infinite number of times, which increases the need for the production of new plastic and creates additional environmental problems.

It is also worth noting that many countries have limited opportunities for processing plastic and are often forced to export it outside their territory. This leads to an increase in transportation costs and may lead to additional environmental pollution.

3. Low awareness of the population about the problem and lack of environmental awareness. The lack of public awareness regarding the problem of plastic pollution is one of the main reasons why the problem continues to worsen. Many people do not realize the scale of the problem and do not understand how their own actions can contribute to environmental pollution with plastic waste.

The low level of public awareness about the effects of plastic pollution on ecosystems is also a serious problem. Many people do not know that plastic waste can penetrate into the soil and water, pollute rivers, oceans and threaten the animal and plant world. They do not understand that plastic waste can cause suffocation and death of marine animals, as well as negatively affect human health through the food chain. To change this situation, it is necessary to conduct information campaigns and educational programs that will be aimed at raising public awareness about the problem of plastic pollution and its consequences for ecosystems. It is also important to draw public attention to the need to reduce the consumption of plastic products and encourage the use of alternative environmentally friendly materials.

Prospects for solving the problem of plastic pollution

1. The development of new technologies and innovations to reduce the use of plastic is an important step in solving the global problem of environmental pollution. Plastic is one of the most common materials in our daily lives, but its use also causes serious problems related to its destructive impact on nature, animals and human health.

One of the ways to reduce the use of plastic is the development and use of alternative materials. For example, research is being conducted in the field of bioplastics that are produced from renewable sources, such as corn, potatoes or wood. These materials are more environmentally friendly and decompose much faster than conventional plastic products.

Another approach is the development of new plastic recycling technologies. Traditional recycling methods, such as incineration or landfill disposal, often cause environmental pollution. However, there are new processing methods, such as chemical and biological depolymerization, which allow plastic to be completely decomposed and used as raw materials for the production of new products.

New packaging and product technologies are also being developed to reduce plastic consumption. For example, some companies have started using biodegradable packaging or packaging made of recycled plastic. In addition, many manufacturers are implementing measures to reduce the use of plastic, for example, replacing disposable plastic products with reusable alternatives. Modern technologies also make it possible to reduce the consumption of plastic through various innovations. For example, some countries have introduced plastic waste recycling systems where people can hand over bottles and packaging for recycling. This contributes not only to reducing the use of plastic, but also to creating new jobs and developing the economy [5].

2. Improvement of the plastic collection and disposal system. The introduction of effective systems for sorting and collecting plastic waste is an integral part of the fight against the problem of environmental pollution by plastic. Plastic waste is one of the most widespread and long-lived types of garbage that has a negative impact on ecosystems and human health. However, existing systems for sorting and collecting plastic waste often turn out to be inefficient and unable to cope with the huge volume of plastic that enters the environment every year. This is due to various factors, such as lack of infrastructure, low awareness of the population about the proper collection and disposal of plastic, as well as the lack of effective sorting and recycling mechanisms.

One of the ways to increase the efficiency of the plastic recycling and recycling process is the introduction of new technologies and innovations. For example, the use of automated plastic sorting and selection systems can significantly speed up the process and improve the accuracy of the selection of various types of plastic. Also, the development of new methods of plastic processing, such as chemical processing or the use of bioplastics, can significantly improve the efficiency of the process [1, 2].

An important aspect of improving the efficiency of the plastic recycling and recycling process is also education and informing the public about the correct methods of sorting and recycling plastic. Conducting educational programs, campaigns and events helps to raise awareness and motivate people to properly handle plastic waste.

3. The introduction of strict rules and international agreements to reduce the use of plastic. The adoption of governmental and legislative measures to control the use of plastic is a necessary step in combating the problem of environmental pollution by plastic. Governments can introduce various measures, such as taxes on plastic products, restrictions on the use of disposable plastic products, mandatory labeling of plastic packages with information about the possibility of their recycling, etc. Such measures

will help reduce plastic consumption and encourage the transition to more environmentally friendly alternatives.

In addition, the development and signing of international agreements to reduce plastic pollution is an important aspect in solving this problem. International agreements make it possible to combine the efforts of various countries and create common standards and rules for the use and disposal of plastic. Such agreements may include restrictions on the export and import of plastic waste, the development and implementation of common standards for plastic recycling, as well as cooperation in the field of education and public awareness of the problem of plastic pollution.

4. The importance of increasing environmental education and awareness of the population. The inclusion of environmental issues in educational programs in schools and universities is an important step in the fight against the problem of environmental pollution by plastic. Education plays a key role in the formation of ecological awareness and responsible attitude to the environment among the younger generation.

The inclusion of environmental topics in educational programs will allow children and young people to gain knowledge about the problem of plastic pollution, its consequences and possible solutions. Students will be able to study the principles of sustainable development, realize the importance of sorting and recycling plastic, as well as develop and implement environmentally friendly technologies and methods.

Conducting information campaigns and actions to educate the population about the problem of plastic pollution and its consequences is also of great importance. Through mass events, social networks, television and other media, it is possible to reach a wide audience and raise people's awareness of the problem of plastic. Information campaigns can include various formats, such as exhibitions, lectures, webinars, contests, etc. They will help people realize the importance of proper handling of plastic waste and take an active part in solving the problem of plastic pollution [6].

In order to preserve ecosystems and biodiversity, it is urgently necessary to take measures to solve the problem of plastic pollution. This is one of the most serious environmental threats to our world, and the continued unrestricted use of plastic only reinforces this problem.

One of the important steps in the fight against plastic pollution is to reduce the consumption and use of plastic products by the population. It is necessary to conduct educational campaigns and support the transition to more environmentally friendly alternatives such as paper, cardboard, glass and metal. In addition, involving manufacturers and retailers to solve this problem by introducing more environmentally friendly technologies and packaging is also an important step forward.

In addition, it is necessary to improve the system of recycling and recycling of plastic. Unprocessed plastic, thrown into the seas and oceans, causes great harm to marine life and ecosystems. Therefore, national and international organizations should cooperate to develop and implement an effective plastic recycling system, as well as strictly monitor its compliance.

In addition to measures to reduce consumption and improve the disposal system, it is also necessary to focus on cleaning and restoring already polluted aquatic and terrestrial ecosystems. The process of cleaning up plastic from rivers, lakes, seas and

oceans is a complex but necessary task to restore biodiversity and preserve the habitat for many species of plants and animals.

In general, solving the problem of plastic pollution requires an integrated approach and joint efforts of all sectors of society – governments, businesses and citizens. Only united efforts can lead to changes and prevent further deterioration of the state of our planet. We don't have time to wait – we need to take measures immediately to preserve our nature for future generations.

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УДК 811.131.1

LINGVOCULTUROLOGICAL FEATURES OF ITALIAN TRAVEL VLOGS

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Abstract. This paper discusses the peculiar features of vlogs and how they differ from blogs, special attention is paid to the definition of a travel vlog. Moreover, some lingvoculturological features of Italian travel vlogs posted on Youtube, are distinguished and compared with English-speaking travel vlogs.

Keywords: lingvoculturological features, blog, vlog, travel vlog, Italian language.

ЛИНГВОКУЛЬТУРОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ИТАЛЬЯНСКИХ ВЛОГОВ О ПУТЕШЕСТВИЯХ

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Аннотация. В статье рассматриваются особенности влогов и их отличия от блогов, а также обращается особое внимание на отличительные черты влогов о путешествиях. Выделяются лингвокультурологические особенности влогов о путешествиях на итальянском языке, опубликованных на видеохостинге Youtube, в сравнении с англоязычными травел-влогами.

Ключевые слова: лингвокультурологические особенности, блог, влог, травел влог, итальянский язык.

Modern technologies have changed the way we treat information completely. The creation and development of social networks have made it possible for all people to share their emotions and experiences using the Internet, despite their living in different countries around the world. Having started writing informational posts on their Internet pages, many creators have switched from blogs in written form to vlogs, which is a format similar to blog but in a video format. In the modern world, there is a growing popularity of vlogs posted on social media, for example, via YouTube.

In the article, we will emphasise some distinctive features of the travel vlogs, especially those posted by Italians in Italian [1].

Vlogs, as a form of modern communication model, have their own special features that make them stand out from other forms of communication:

1. Vlogs, presenting information in the form of a video, can use a variety of means to make it interactive (in contrast to a traditional blog in a written format, which, although using photos to illustrate the material, still relies on the author's ability to write a captivating text).

2. Vlogs are usually created by those who do not have vocational education (e.g., in the field of journalism) or high-tech professional equipment. Nevertheless, the more videos are posted, the bigger the audience becomes, and in the process of time, the creator may purchase special equipment to improve the quality of the videos [2].

3. As a rule, videos are posted on social platforms, e.g., YouTube, which are public, which means that everyone can watch the video.

YouTube was created in 2005, and since then it has become the biggest platform for posting videos [3].

The thematic content of vlogs varies according to the genre and problematics of the video: music, entertainment, science and education, travelling, news and politics, etc.

The criteria for dividing video blogs into categories are the following:

– the platform used in distributing the video (which can influence the duration of the video, its maximum quality, accessibility for users, the audience, the means of sharing the video, etc.);

– the technical parameters of the recording itself (duration, video and audio quality, the colours used, etc.);

– the peculiarities of the cinematography/frame construction (camera angles, fixed/moving camera, filming outside/at home/in the studio, the montage, presence/absence of special effects, etc);

– the sound in the video (presence/absence of voice/music in the background, etc.);

– the presence of the vlogger and their actions (their absence in the video frame with no comments/their absence in the frame but with background comments/their presence in the frame with comments; the number of people in the frame; documentary/staged filming, etc.);

– the thematic focus (entertaining or scientific pop videos, travel vlogs, discussions, informative videos, reviews, etc.) [4].

According to the criteria, we can distinguish such a genre as travelblog (travel vlog) – a type of video blog that focuses on a traveller's personal experience of a new place or country. The creators present their content vividly, using footage filmed during their trip. The purposes of the travel vlog can vary from sharing positive or negative experiences to making a paid advertisement of a place. Travel vlogs usually consist of video material filmed with the use of a camera (a smartphone or some professional equipment) and are accompanied by the creator's comments. In the article, we discuss vlogs posted on YouTube, where the duration of the video is not limited and the video itself is accessible to all users of the platform in high quality (if the quality of the original video permits).

Considering lingvoculturological studies, some categories can be distinguished [5]; and we will discuss particular features of Italian travel vlogs applying those categories and see whether they are different from English-speaking vlogs.

One of those categories is speech etiquette, which is closely related to the social conversational rules of a particular country or nationality. Speech etiquette affects language and speech means used in communication. For example, the YouTube channel THE PILLOW is dedicated to videos about interesting people all around Italy – the creators of the channel choose fascinating stories and conduct interviews with the Italians. Listening closely to their speech, one can notice some peculiarities there – for instance, the predominant use of an informal pronoun 'tu' (instead of the formal 'Lei' that would be more suitable in a conversation between strangers). However, the use of such an address can be explained by the creators' wish to make the interlocutors comfortable during the interview. Such a feature is not prominent in English-speaking vlogs, as in English there is no difference in using 'you' in formal and informal terms of communication.

As the creators usually comment on the video on the spot and it is oral speech, the structure of sentences tends to be quite simple, complex sentences are rare to be found; instead, shorter and simpler sentences are used. For example, an extract from a travel vlog by Momoka Banana:

"I leoni in Cina sono considerati di portare fortuna. Posti davanti gli edifici hanno il compito di scacciare la sfortuna. Per questo motivo si trovano spesso davanti ai templi e alle banche" [6].

Ethnocultural stereotypes also influence the language used in travel vlogs.

Italians are believed to be quite expressive in their speech, they use:

- diminutives (il campanellino);
- superlative adjectives (bellissimo, dolcissimi, piccolissima, gentilissimo);
- exclamations (Fantastico!);
- reduplication (piccoli-piccoli, feriti-feriti, subito-subito),
- and other figures of speech that make them sound emotional and expressive.

Moreover, they not only talk a lot, but they also gesticulate – one can notice such a detail of Italian behaviour while watching travel vlogs by THE PILLOW as both the creators and the guests appearing in their videos use their hands and body language to accompany their speech. Using these means, Italians emphasise their national identity.

Another feature that is important to highlight is that in the Italian vlogs one can often hear the vloggers speak English – they can use English words and phrases even when there are equivalents in Italian. For example, while watching the videos on the channel CALLMEDIDI, one can hear the creator, Diletta Begali, mixing phrases in Italian and English. For example:

– "Penso sia stato uno dei viaggi più semplici della mia vita. Easy-breezy. Veramente è stato molto easy"

- "vedere a little bit more…"
- "Siamo fuori dalla university…"
- "Sono vestita con questo pantalone che non c'entra molto con questo giallo però

we don't care”

- “Abbiamo un photographer qui…”
- “Io e questo crew gireremo insieme per tre settimane”
- “...per stanno un po' di pictures”
- “It comes without saying che Londra sarà bellissima…”
- “...l'estetica di questo building over here”
- “...per cena abbiamo curry, l'insalata ai pomodori e, of course, water”
- “Questo momento sono all by myself…”.

The cause of such a phenomenon lies in the rapid globalisation – speakers of Italian are greatly influenced by the English-speaking community on the Internet. Due to globalisation phases and expressions of the speech, and the whole format of Italian vlogs resembles the ones in English.

Some particular features can be distinguished in the montage of these videos. The audience of the videos is usually from other, non-Italian-speaking countries; the viewers can be non-fluent in Italian. That is the reason for travel vloggers to make subtitles for their videos – in Italian, English, and other languages – in order for non-Italian speakers to understand the content of the videos (e.g., the channels Earth to Hannah, THE PILLOW, Learn Italian with Lucrezia, etc. provide their audience with built-in or YouTube subtitles) [7].

Another trait of the montage that is quite common among travel vlogs is the cinematography of the video: vlogs are usually filmed with the use of cameras on smartphones, which can make the picture quite shaky (e.g., travel vlogs of Momoka Banana on YouTube). However, some vloggers can use professional equipment (cameras and stabilisers) that ensures high quality and makes the videos look smooth (e.g., THE PILLOW). As a rule, in travel vlogs there are usually shots of places, nature, and architecture; they are quite long and take up the majority of the video; while the vlogger appears less frequently and makes comments on what is happening.

Democracy and freedom of speech also affect travel vlogs. Strictly speaking, the whole format of travel videos, no matter what country the creators are from, implies openness and tolerance towards other people, countries, and opinions. That is why travel vloggers encourage their audience to answer the questions asked in the video and share their ideas in the comments. Moreover, such a strategy helps the video to be recommended to other people and increases coverage and popularity of the vlogger.

To summarise, we can say that even though the Italian vlogs have their own special features connected with peculiarities of speech and culture, the impact of globalisation is too strong to bypass, and the format of Italian vlogs is cognate with the ones from English-speakers, especially if we touch upon the topic of cinematography, content of the video, and interaction with the audience.

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УДК 625.768.5

USE OF LOW-POTENTIAL HEAT FOR SNOW UTILIZATION IN STATIONARY SNOW MELTING PLANTS

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Abstract. Many Russian cities face the problem of snow disposal in winter every year. Snow cover can reach significant volumes, and its utilization becomes an important task for maintaining cleanliness and order on the city streets. One of the ways of snow utilization is the use of stationary snow melting plants based on low-potential heat energy.

Keywords: snow melter, sand, snow, sand traps.

ИСПОЛЬЗОВАНИЕ НИЗКОПОТЕНЦИАЛЬНОЙ ТЕПЛОТЫ ДЛЯ УТИЛИЗАЦИИ СНЕГА В СТАЦИОНАРНЫХ СНЕГОПЛАВИТЕЛЬНЫХ УСТАНОВКАХ

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Аннотация. Многие города России ежегодно сталкиваются с проблемой утилизации снега в зимний период. Снежный покров может достигать значительных объемов, и его утилизация становится важной задачей для поддержания чистоты и порядка на улицах города. Один из способов утилизации снега – использование стационарных снегоплавильных установок, работающих на основе низкопотенциальной тепловой энергии.

Ключевые слова: снегоплавильная машина, песок, снег, песколовки.

In modern large cities with a long winter period the problem of utilization of snow masses collected from roads and sidewalks is acute. The removed snow should be stored on specially designated sites until the arrival of positive temperatures for its natural melting process. Arrangement of such sites in urban areas is practically impossible due to the need for a large area. Snow transportation outside the city requires additional fuel and maintenance costs for dump trucks. In addition, the transportation time increases, and thus the speed of street cleaning. Snow removal also has environmental problems – snow mass storage on unprepared sites leads to

contamination of water bodies and groundwater with reagents and petroleum products, and snow removal outside the city increases exhaust emissions from trucks transporting snow.

Snow collected from the streets, squares and roads of the settlement, in most cases is dumped into the nearest water bodies without treatment or stored in unequipped places, because until recently it was treated not as waste of the settlement, but as conditionally clean natural precipitation.

In big cities, the volume of snow is very large, so the removal and storage of snow in specially designated landfills is not rational, so in such cities, since recently, environmentally friendly snow recycling has been practiced. The essence of this process is the use of special complexes that are designed to effectively melt snow, for example, nowadays snow melting units (SMU) are used – devices that melt snow forcibly, by supplying heat from the outside [1].

There are several stationary snow melting plants in St. Petersburg that use low-potential heat energy. For example, there is a stationary snow melting plant located on the territory of the State Unitary Enterprise Vodokanal of St. Petersburg, which uses wastewater heat energy to melt snow. This plant allows utilizing a large amount of snow that is collected on city streets and using the excess heat of wastewater to heat this wastewater before it is discharged into water bodies.

Thus, GUP Vodokanal St. Petersburg not only solves the problem of snow utilization, but also provides efficient use of wastewater heat energy, which reduces heating costs and improves the environmental situation in the city without using snow melting machines.

Another unit operates at the heat outlet from the boiler house of GUP TEK SPb. The boiler house of GUP TEK SPb is a large heat and power complex located in the city of St. Petersburg. One of its activities is snow utilization using waste heat from the boiler house.

The boiler house of GUP TEK SPb uses heat energy from natural gas combustion to heat homes and industrial enterprises. However, this generates a large amount of waste heat, which is usually released into the atmosphere.

Snow utilization utilizes a stationary snow melting plant located on the territory of the boiler house. This unit uses waste heat to melt snow that is collected from the adjacent territories. The resulting water is then discharged into the sewer system and sent to a treatment plant [2].

At present, snow melting machines can be divided into self-propelled, mobile and stationary ones. Mobile and self-propelled machines are combined by the term mobile. Self-propelled units consist of a vehicle (truck, special self-propelled chassis) and a snow melting machine installed on it. This design makes it possible to avoid additional transportation costs, reduce the number of service personnel, and is more convenient for urban travel due to smaller dimensions. In addition, such units have a greater cross-country ability and it is easier to deliver them to the place of work in conditions of poor road surface (or lack of road surface). A self-propelled snow melting machine is presented in Figure 1.



Figure 1. Self-propelled snow melting machine

Mobile units do not have a power unit and the ability to move on their own. However, this can have its advantages. Such units are mounted on trailers, railroad platforms or are made in the form of a container transported on a trailer and installed on the site by a crane [3].

Stationary snow melting machines, as a rule, are made in the form of an underground reinforced concrete bunker and provide for the possibility of loading snow directly from dump trucks. An example is shown in Figure 2.


Figure 2. Snow melting station

Self-propelled snow plows, also known as snow blowers, are effective tools for clearing snow and ice from roads and sidewalks. They have their advantages as well as some disadvantages. Their advantages are:

Efficiency: these machines are capable of clearing large areas of snow and ice in a short time. They are equipped with special brushes to meet snow and other obstacles on the road.

Safety: the snow melter increases road safety, especially in heavy snowfall or icy conditions. It removes snow and ice from the road surface, preventing skids and accidents.

Convenience: self-propelled snow melters are easy to maneuver and controlled by the operator. Specific equipment allows various ways to overcome obstacles such as trees, fences and vehicles.

We can also note such disadvantages as:

High cost: snow melters are expensive purchases, especially for small communes or individuals. Their operating costs can also be significant.

Weather dependent: snow melting machines are ineffective at low temperatures or during heavy frosts. In such conditions, ice can be difficult to remove and the machine can consume a lot of time and energy.

Trained personnel required: snow melters require trained personnel to use them effectively. Operators must know how to properly operate the machine and utilize its features for best results. In general, self-propelled snow melters are useful tools for snow and ice control on roads and sidewalks [4].

However, during its melting the main polluting elements in snow masses are sand and granite crumbs. To catch these solid particles it is necessary to provide sand traps.

Sand traps are used to remove insoluble suspended mineral compounds (mainly sand) from melt water. Sand entering the municipal sewerage system can disrupt its operation and block sewers. In addition, during the subsequent treatment of sewage water from organic sludge, sand will significantly complicate the operation of settling tanks and digesters. Sand traps operate on the principle of natural settling of solid particles by gravitational forces. The design of sand traps should allow for the settling of heavy mineral particles, but should not allow for the settling of organic pollutants. According to the character of movement sand traps are divided into horizontal – with circular and rectilinear movement of water, vertical – with water movement from bottom to top, and sand traps with helical (translational-rotational) movement of water. The latter are subdivided into tangential and aerated depending on the method of creating helical motion. Horizontal sand traps with rectilinear water flow are elongated rectangular tanks constructed of prefabricated reinforced concrete elements of uniform dimensions. In order to create uniform velocities in the sand trap, the entrance to it is made in the form of a smooth expansion, and the exit is made in the form of a smooth contraction [5].

Sand traps are designed with a sloping bottom to facilitate cleaning. It is also possible to provide for hydro-cleaning. At the end of the sand trap there is a pit for sand accumulation. It is possible to fully automate the cleaning process by installing sand pumps, hydro-elevators or augers.

Aerated sand traps are designed as horizontal tanks. Along one of the walls, aerators are installed along the entire length of the unit. Under the aerators a trough with a slope to the pit for sand collection is installed. Thus, the water moves along the

canal progressively and centrifugally in the secant plane of the canal. The total character of the water flow can be called spiral. Such installations, in addition to collecting sand, perform the function of washing sand from organic contaminants [6].

Summarizing the above we would like to say that snow melting machines are an effective technology of snow utilization, which makes it possible to get rid of large volumes of snow masses quickly and economically. However, for ideal results it is necessary to buy additional equipment, such as snowplows, and to ensure regular maintenance of the machines. In addition, the possible environmental consequences of using snow melting machines should be taken into account due to the release of chemicals and salts contained in snow into the environment.

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УДК 332.1

THEORETICAL ASPECTS OF CREATING AN ENABLING ENVIRONMENT FOR INNOVATION IN THE AGRICULTURAL SECTOR

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Abstract. Innovation in agriculture is the process of creating, introducing and disseminating new and improved methods, technologies and products in the agricultural sector. Such activities could increase agricultural productivity and efficiency, enhance product quality and safety, and improve living conditions in rural areas. For innovation to be effective, an enabling environment must be created. Such an environment should take into account the technical, economic, social and cultural aspects of agricultural development.

Keywords: innovation, information technology, agriculture, modern technologies, sustainable development.

ТЕОРЕТИЧЕСКИЕ АСПЕКТЫ ФОРМИРОВАНИЯ БЛАГОПРИЯТНЫХ УСЛОВИЙ ОСУЩЕСТВЛЕНИЯ ИННОВАЦИОННОЙ ДЕЯТЕЛЬНОСТИ В СЕЛЬСКОХОЗЯЙСТВЕННОМ СЕКТОРЕ

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Аннотация. Инновационная деятельность в сельском хозяйстве – это процесс создания, внедрения и распространения новых и улучшенных методов, технологий и продуктов в сельскохозяйственном секторе. Такая деятельность может повысить производительность и эффективность сельского хозяйства, улучшить качество и безопасность продукции, а также привести к улучшению условий жизни населения в сельских районах. Для того чтобы инновационная деятельность была эффективной, необходимо создать благоприятные условия для ее осуществления. Такие условия должны учитывать технические, экономические, социальные и культурные аспекты развития сельского хозяйства.

Ключевые слова: инновационная деятельность, информационные технологии, сельское хозяйство, современные технологии, устойчивое развитие.

Recent years have seen an increase in the use of innovative technologies in agriculture, including digital platforms, big data collection, processing and analysis technologies, and cloud services. These technologies play an important role in

improving the efficiency and sustainability of agricultural production, as well as in optimizing the management of all aspects of economic activity [1].

Digital platforms provide unique opportunities for communication and interaction between different stakeholders in agriculture, such as farmers, seed and fertilizer producers, agricultural consultants and distributors. They allow for the effective exchange of market information, current prices, technologies and recommendations, thus facilitating informed decision-making in the production process and reducing risks.

Big data collection, processing and analysis technologies are becoming a significant technology in modern agricultural production. With various sensors, remote sensing technologies, modern agricultural technology and other devices, enterprises can collect significant amounts of data on soil, climate, plants and animals [2]. Then these data are processed and analyzed using specialized algorithms and tools, which make it possible to identify patterns, optimize production processes, predict yield and make individual decisions for each field or livestock unit.

Cloud services provide access to computing power and software applications via the Internet. This allows agricultural enterprises to use sophisticated models and algorithms for data analysis, forecasting and resource planning without requiring significant investment in their own infrastructure. Cloud services also facilitate collaboration and information exchange among agricultural stakeholders, allowing for better management of all processes [3].

A steady increase in the use of innovative technologies is possible if certain factors affecting the development of technological processes in agriculture are taken into account. One of these factors is the existence of a research base. It can be provided by research institutes and research laboratories. Formation of the scientific environment, study of new methods of processing, selection and cultivation of agricultural crops contribute to the development of the industry and increase of quality of products [4, 5]. This factor is an integral part of development in the field of precision agriculture, development of algorithms for data processing sensors and efficient use of resources.

Laboratory research is a necessary tool for the study of biotechnologies, development of new fertilizers, plant breeding, the study of diseases and pests and other research. These, in turn, have the potential to improve crop yields and sustainability, as well as to assess the safety, quality and feasibility of introducing advanced technologies.

Scientific conferences, seminars and educational courses are the main source of information and advanced technology, not only in the agricultural sector. Since they not only provide access to modern technologies, but also promote networking; and the formation of an organized community among participants of such events is also a factor of development, it allows for the exchange of experience and networking, the upgrading of skills and the attraction of new ideas for the sustainable growth of the agricultural sector [6].

State support should not be overlooked, which has a great impact on the development of the agricultural sector, especially necessary in times of crisis and sanctions pressure [7]. Governments can work out development strategies that include

various subsidies and grants to introduce innovative technologies into production. The development of programmes for the development of rural infrastructure, programmes for attracting young professionals and upgrading skills, programmes for the development of transport infrastructure, access to energy resources and public services are also of primary importance.

For example, in the Republic of Tatarstan there are various state programmes to support agricultural enterprises:

- Support for small businesses;
- Technological modernization, innovative development;
- Sustainable rural development;
- Development of agricultural land reclamation and other [8, 9].

It is also important to consider the socio-economic dimension that can influence innovation in agriculture. An important factor is the availability of qualified personnel that can implement innovative projects. Skilled personnel can help in the creation of new technologies and methods, as well as their introduction into production. Access to education and training is necessary to ensure the availability of skilled agricultural labour. To this end, various educational programmes, courses and trainings on innovative technologies in agriculture can be organized.

It is also important to ensure that the skills of agricultural workers are improved. This can be achieved through internships, participation in seminars and conferences, as well as assistance in training courses. Training and capacity-building of workers can contribute to the dissemination of knowledge and experience, as well as to the promotion of innovation in agriculture.

Creating an enabling environment for innovation in agriculture requires taking into account various aspects of the development of the industry. The technical aspect includes the development and implementation of advanced technologies such as precision farming systems, sensors, remote sensing, which improve the efficiency and quality of agricultural processes. The economic dimension encompasses financial support and incentives to attract investment and ensure sustainable profitability for agricultural enterprises. The social dimension includes support for education, training and dissemination of knowledge among agricultural workers, as well as the creation of conditions for the exchange of experience among various stakeholders.

Only by working together in all these dimensions can an enabling environment be created that promotes innovation and development, improves the sustainability and productivity of agriculture and contributes to the well-being of agricultural communities.

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УДК 698

THERMAL INSULATION MATERIALS IN AEROSPACE INDUSTRY

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Abstract. The article considers the advantages and disadvantages of thermal insulation materials and their main types. The testing process is covered. The Russian and European standards for thermal insulation materials used in the aerospace industry are described. Special attention is paid to the prospects for the development of thermal insulation.

Keywords: thermal insulation, thermal insulation materials, temperature, material, spacecraft.

ТЕПЛОИЗОЛЯЦИОННЫЕ МАТЕРИАЛЫ В АЭРОКОСМИЧЕСКОЙ ОТРАСЛИ

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Аннотация. В статье рассмотрены преимущества и недостатки теплоизоляционных материалов и их основные виды. Освещается процесс тестирования. Описаны стандарты РФ и Европы к теплоизоляционным материалам, используемым в аэрокосмической отрасли. Особое внимание уделяется перспективам в развитии теплоизоляции.

Ключевые слова: теплоизоляция, теплоизоляционные материалы, температура, материал, космический аппарат.

Thermal insulation in the aerospace field refers to the use of special materials and technologies to ensure the protection of spacecraft from extreme temperature conditions during their operation in outer space or during entry into the atmosphere of the planet.

Thermal insulation is required to maintain optimal operating conditions for systems and instruments on board the spacecraft, as well as to protect them from damage caused by overheating or hypothermia. While entering the atmosphere or entering orbit, spacecraft are subjected to high temperatures caused by friction with the atmosphere or solar radiation. Thermal insulation materials can withstand these temperatures and prevent overheating of the apparatus, they can be represented by various substances such as aerogels, ceramic fibers, graphene oxide and carbon nanotubes. These materials are able to maintain a stable temperature inside the spacecraft and minimize heat loss.

Thermal insulation plays an important role in the aerospace industry, ensuring that spacecraft are protected from extreme temperature conditions during their work in outer space.

Thermal insulation materials provide optimal operating conditions for systems and devices and have the following advantages:

1. High thermal stability.

2. Low thermal conductivity is necessary to prevent the internal components of the spacecraft from heating and maintain a stable operating temperature.

3. Low density. Thermal insulation should be lightweight to minimize the mass of the space system. Low density plays an important role in ensuring the efficiency and maneuverability of the spacecraft.

4. Resistance to vacuum. Heat insulation materials in vacuum shall retain their properties and shall not be subject to degradation.

5. Fire resistance to prevent fire propagation in case of fire.

6. High chemical resistance, which allows thermal insulation materials to maintain their properties even when in contact with aggressive chemicals that can occur in the environment.

7. Resistance to vibrations and impacts that may occur during spacecraft launch and flight.

8. Initial hardening.

All these advantages provide reliable protection of spacecraft, components and electronics against thermal and radiation impacts in extreme outer space conditions [1].

Thermal insulation materials specifically designed for the aerospace industry may have the following disadvantages:

1. Such materials are often expensive because they require special design and production, as well as high safety and reliability standards that are imposed on the aerospace industry.

2. The use of special thermal insulation materials may require special skills and equipment during installation, maintenance and replacement, which may entail additional costs and difficulties.

3. Certain thermal insulation materials may have environmental or operational limitations. For example, some materials may be sensitive to moisture, while others may require special surface preparation prior to their installation.

4. They may form dust or fibers that may be hazardous to health when ingested by humans or the machinery of the apparatus. This may require additional precautions and special material handling conditions.

5. Thermal insulation materials can have limited production volumes or market availability, which can create difficulties in scaling their use in large projects or in mass production [2].

The main types of thermal insulation materials used in the aerospace industry include:

1. Tile (also called heat-protective tiles) are special ceramic coatings that are used to protect against high temperatures during the entry of spacecraft into the Earth’s atmosphere. The tile has a high degree of thermal stability and is able to withstand extreme conditions.

2. Heat protective films are thin film materials that are used to insulate spacecraft components, have high thermal characteristics, and provide protection against radiation heat and other heat sources.

3. Multi-layer insulation materials are materials consisting of several layers with different thermal characteristics, have high thermal insulation and are used to protect against extreme temperatures in the aerospace industry.

4. Fibrous materials such as ceramic fibers and glass fibers have low thermal conductivity and high thermal stability.

5. Aerogels are nanostructured materials with very low density and thermal conductivity, they are used to heat insulate spacecraft components and are highly efficient in preserving heat [3].

Testing of thermal insulation materials in the aerospace industry is carried out in order to check their compliance with the requirements and reliability in real operating conditions. The testing process may include the following steps:

1. Laboratory tests. At the beginning, laboratory tests are carried out, including the measurement of various properties of the material. These can be tests for thermal conductivity, exposure to high and low temperatures, thermal expansion, mechanical tests, including compression, tension, bending, etc. Laboratory tests allow evaluation of the physical and chemical characteristics of the material and its performance under controlled conditions.

2. Thermal bench test. Various thermal loads and test benches are used to check thermal insulation materials on the benches, which create conditions that are as close as possible to real operation. This may include exposure to high temperatures, thermal variability, vibration, aggressive environments, and other conditions. Based on the test results, the ability of the material to maintain its thermal insulation properties and provide the necessary protection is assessed.

3. Testing at the training ground and in flight. In the case of aerospace, field tests involving testing of materials in real-world facilities or in-flight conditions are conducted. This could be testing on spacecraft, rockets, satellites, aerospace ships and other facilities. In the field, the durability, efficiency and reliability of the material in real operation are tested.

4. Data monitoring and analysis. During and after each stage of testing, data is collected and analyzed. The results of the tests are evaluated, the requirements are checked and the material performance is understood in real conditions. Based on the results of the analysis, adjustments and optimization of the material or the process of its application can be made.

The entire process of testing thermal insulation materials in the aerospace industry is strictly regulated and subject to inspection by regulatory authorities and safety standards. This ensures that materials will be able to withstand the extreme conditions of the space environment and ensure the safety and effectiveness of space missions [4].

The use of thermal insulation materials in the aerospace industry is regulated by regulatory documents and standards that ensure the safety and efficiency of materials. One of the main ones is GOST R 55926-2014 “Thermal Insulation Materials and Products” which establishes the requirements for thermal insulation materials used in the aerospace industry.

This standard regulates the basic parameters of thermal insulation materials, such as thermal conductivity, operating temperature range, density and strength. The standard also specifies methods for testing and quality control of these materials.

The regulation of thermal insulation materials in the aerospace industry is also influenced by other standards, including GOSTs on fire safety, environmental safety and other relevant aspects.

In addition to Russian standards, the use of thermal insulation materials in the aerospace industry may also fall under international standards, such as US National Standards (ASTM) or European Standards (EN), depending on the country of manufacture or country of application.

One of the main European standards governing the use of thermal insulation materials in the aerospace industry is the SAE ARP 1962 standard. It defines the requirements for thermal insulation materials and their installation on aircraft.

Another regulatory standard is ASTM C518, which defines methods for testing thermal insulation materials for strength and thermal insulation properties.

ISO 5782 is a standard developed by the International Organization for Standardization (ISO) that defines test methods for assessing the thermal properties of thermal insulation materials, including thermal conductivity, contact resistance and density [5].

Examples of successful application of thermal insulation materials in the aerospace industry are as follows:

1. Use of thermal coatings on the surface of spacecraft and satellites to protect against high temperatures caused by friction with the atmosphere when entering the Earth's atmosphere.

2. Application of thermal insulation materials in the space shuttle to protect the crew from extreme temperatures during launch and return to the Earth’s atmosphere.

3. Use of heat shielding materials on the outer surfaces of rocket engines to protect against high temperatures that may occur during engine operation.

4. Use of heat protective materials in space thermal protective suits for astronauts providing protection against thermal impact during spacewalk [6 - 7].

5. Use of heat shielding materials in heat shields and insulation inside spacecraft to prevent overheating of electronics and ensure optimal operating conditions for equipment.

These examples demonstrate the importance of thermal insulation in the aerospace industry to ensure crew safety, equipment protection, and the normal operation of spacecraft.

The use of thermal insulation materials in future space missions presents several perspectives and challenges:

1. One of the main prospects for the use of thermal insulation materials is to achieve higher efficiency in protection against high temperatures, radiation and other external factors [8].

2. An important prospect is the constant attempt to reduce the weight and volume of spacecraft to increase their performance and reduce launch costs.

3. Future space missions will focus more on the efficiency and environmental sustainability of materials. Thermal insulation materials shall be environmentally

friendly, free of harmful substances or release toxic gases when interacting with the environment.

4. Given sustainable development and resource savings, it is important to develop thermal insulation materials that can be easily recycled and reused after the end of the mission. This will help reduce waste and cut the cost of producing new materials for each space mission [9].

In general, the future of thermal insulation materials in the space industry depends on the development of new materials that will have higher efficiency, lower weight and volume, resistance to extreme conditions and environmental stability. The development and application of such materials can significantly improve the safety and efficiency of space missions.

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УДК 620.9

VARIABLE FREQUENCY ELECTRIC DRIVES AS A FOUNDATION FOR ENTERPRISE ENERGY SAVING

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Abstract. Variable frequency drives can reduce energy consumption and are also capable of providing high reliability in production, therefore they are widely used in industry. In this article the description of variable frequency drives is presented, examples of manufacturers are given, variations of configurations are considered, and advantages of variable frequency drives are discussed.

Keywords: energy saving, electric drive, industry, electric power, voltage, power.

ЧАСТОТНО-РЕГУЛИРУЕМЫЕ ЭЛЕКТРОПРИВОДЫ КАК ФУНДАМЕНТ ЭНЕРГОСБЕРЕЖЕНИЯ ПРЕДПРИЯТИЯ

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Аннотация. Частотно-регулируемые электроприводы позволяют снизить энергопотребление, а также способны обеспечить высокую надежность на производстве, в связи с этим они широко используются в промышленности. В данной статье представлено описание частотно-регулируемых электроприводов, приведены примеры производителей, рассмотрены вариации комплектаций, а также представлены преимущества частотно-регулируемых электроприводов.

Ключевые слова: энергосбережение, электропривод, промышленность, электроэнергия, напряжение, мощность.

Currently, in various industries that use ventilation and pumping equipment, thermal power plants, hydroelectric power plants, state district power plants, conveyor plants and similar energy consumers, there has been a constant trend towards the introduction of frequency converters or variable-frequency electric drives (Figure 1). These converters make it possible to change the frequency and amplitude of the three-

phase voltage supplied to the electric motor, which makes it possible to achieve the most flexible change in operating modes of control mechanisms.



Figure 1. High Voltage Variable Frequency Drive

The design of the frequency converter (FC) consists of an input transformer unit, a multi-level inverter and a control and protection system unit with an input and information display unit. All blocks are functionally interconnected.

The input transformer block is responsible for transferring energy from the three-phase power supply to the multi-winding input transformer, which distributes the reduced voltage to the multi-level inverter.

The multilevel inverter itself structurally consists of an indefinite number of unified cells called converters. Their number is determined by the specific requirements for the operation of the installation. Each converter includes a rectifier and a DC link filter with a bridge voltage inverter using modern IGBT transistors.

First, the input AC current is rectified. A semiconductor inverter helps convert it into alternating current with the ability to regulate frequency and voltage.

The voltage phase is formed by the resulting sources of controlled alternating voltage by connecting them in series into links. Using the “STAR” circuit, it is possible to turn on the links in the required way and build a three-phase output power system for an asynchronous motor.

The control and protection unit is presented in the form of a multifunctional microprocessor unit with a power supply system. Also, in the control cabinet there are devices for input and output of information and primary sensors of the electrical operating modes of the converter. The use of a frequency drive allows you to save significant amounts of electricity by regulating the speed of the electric motor [1].

At Russian manufacturing enterprises, most energy-consuming devices are electric motors; they consume more than 50 % of all electricity. Often, the size of the electric motor is designed with a large margin for the maximum power of the equipment. However, peak hours occur for less than half of the entire plant’s operating

time. Because of this, as a rule, the electric motor consumes a significant part of the energy in vain.

In order to ensure that electricity is spent mainly on useful work, it was decided to use variable frequency electric drives. Their task is to smoothly change the engine speed, depending on the actual load. The use of this technology makes it possible to reduce energy consumption by 30-50 % by regulating the speed of the electric motor.

Along with the growth of technological progress, the Russian market of frequency converters is growing and developing. This trend is attracting the attention of a number of both large and little-known manufacturers. The following paradox can currently be observed on the Russian market. Despite the fact that it is segmented and there are more than 30 manufacturers, a significant market share lies in the hands of only 7-8 companies, and no more than two brands can be called clear leaders [2].

JSC Schneider Electric, which represents the interests of Schneider Electric in Russia, has significantly increased the number of models and expanded the product catalog. Thus, the ATV61-ATV71 family began to include a modification for a voltage of 690 V, numerous variations with a degree of protection IP54. Also available is a specialized model with one-of-a-kind synchronous motor control technology for the ATV71*383 elevator and crane drive. In addition, among the Altivar models, a device with a power of 2400 kW at 690 V appeared. This created the ability for the Altivar 61 to work in circuits with a step-up transformer.

The latest budget Altivar 21 series is designed specifically for heating, air conditioning and ventilation systems in public and residential buildings. Altivar 21 controls motors from 0.75 to 75 kW at voltages of 380 V and 200 ... 240 V.

Altivar 21 has many application functions:

- built-in PI regulator;
- “pick up on the fly”;
- sleep/wake function;
- protection and alarm management;
- resistance to network interference, operation at temperatures up to +50°C and voltage drop -50 %.

Thanks to the introduction of new capacitor-free technology, this model eliminates harmonic-reducing devices. This measure, combined with the use of more modern and powerful semiconductors, made it possible to increase the operating time [3].

Schneider Electric has achieved leadership in the frequency converter market through serious work aimed at improving the fault tolerance of converters. The MTTF for some models is up to 640,000 hours. The line of converters discussed above is capable of operating correctly with a significant voltage drop of up to -50 %, temperatures of up to +50 %, and is also resistant to chemically aggressive environments. These indicators are serious arguments for the initial and repeated selection of equipment.

If we talk about the most current models, it is worth mentioning the PowerFlex 7000 series drives (Figure 2), which represent the third generation of medium voltage

drives from Rockwell Automation. They perform functions to regulate the speed, torque and direction of rotation of asynchronous and synchronous AC motors. The drive itself is a unique and patented design under the PowerCage brand of power blocks, which include the main power components of the drives. This design is relevant and ergonomic in all directions; it is represented by a small number of components. Key functional benefits of medium voltage drives worth knowing are as follows:

- reduced operating costs;
- possibility to start large engines from small power sources;
- improving the quality characteristics of the controlled technological process and the equipment used.

Depending on the output power, the drives are available in three sizes [4]:

– housing A – Power range 150-900 kW with supply voltage of 2400-6600 V;
– housing B – Power range 150-4100 kW with supply voltage 2400-6600V;
– housing C – Power range 2240-6770 kW with supply voltage 4160-6600 V;

The PowerFlex 7000 family of drives are available in a variety of configurations, such as 6-pulse or 8-pulse. In addition, one of the possible design options, allowing the user to gain significant flexibility in the problem of reducing the influence of power supply harmonics, is with a PWM converter. It is worth noting that this also allows you to set direct sensorless vector control, which helps improve regulation in the low-speed zone [5].



Figure 2. PowerFlex 7000 AC Drive

Modernization of production using variable-frequency electric drives is relevant in all cases for mechanisms that operate for some time with a reduced load – machines, pumps, elevators, fans. This will not only reduce energy costs, but also the number of equipment failures and maintenance costs. It is worth noting that this also increases the service life of the electric motor itself.

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УДК 811

FEATURES OF TRANSLATING LITERARY TEXTS FROM RUSSIAN INTO ENGLISH

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Abstract. The article discusses various approaches to translating literary texts from Russian into English. The difficulties and features of this type of translation are described.

Keywords: translation, literary translation, the English language, translation equivalence, literariness.

ОСОБЕННОСТИ ПЕРЕВОДА ХУДОЖЕСТВЕННЫХ ТЕКСТОВ С РУССКОГО ЯЗЫКА НА АНГЛИЙСКИЙ

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Аннотация. В статье рассматриваются различные подходы к переводу художественных текстов с русского языка на английский. Описываются трудности и особенности данного вида перевода.

Ключевые слова: перевод, художественный перевод, английский язык, эквивалентность перевода, литературность.

Translation is the process of transferring information from one language to another. Literary translation is considered to be the most complex, and this complexity lies in the specifics of the literary text, which I will talk about later.

First, there is a need to understand the difference between non-literary and literary texts. If the first ones are addressed to human logical thinking, the second ones, that is, artistic ones, are built not on logic, but on images.

Translation and localization of the literary text are rightfully considered among the most difficult. A specialist is required not only to make a translation without losing its original meaning, but also to do it in a literary language. You will be surprised, but there is even a special section of linguistic science that explores the difficulties of translating fiction – the theory of literary translation [1].

The highlighting of the theory of artistic translation as a separate scientific direction is possible on the basis that the text of fiction can be typologically opposed to all texts of a non-literary nature [2].

Scholars involved in the theory of artistic translation talk about the equivalence of translation, which means the maximum possible linguistic proximity of the texts of the original and translation. Although sometimes two concepts are distinguished: potentially achievable equivalence, which is defined as the maximum commonality of the content of two multilingual texts, due to the differences between the two languages in which these texts are created, and translation equivalence, which means the real semantic proximity of the texts of the original works and translation. Depending on the approach to the translation of the text, the concept of equivalence may change, but these changes are not so critical in the context of understanding the essence of this concept.

The artistic equivalent translation is considered to meet the following requirements:

Accuracy. The thoughts expressed by the author in his work should be fully communicated to the reader in translation. Moreover, the translator should avoid various kinds of additions and explanations, which also distort the text of the original to a certain extent.

Briefness. The translator should not be verbose, he must convey the main idea of the text in the most concise and compact form.

Clarity. It should be remembered that the conciseness and briefness of the translation, however, should not go to the detriment of the clarity of the presentation of the text and the ease of understanding it. The translated text should be presented in the simplest and clearest possible form of language. The translator needs to avoid complex, ambiguous constructions that make it difficult to perceive the text.

Literariness. The translated text must meet the generally accepted norms of the Russian literary language. Due to significant differences in the syntactic structure of English and Russian, it is very difficult to preserve the form of the original expression when translating. Moreover, for the maximum accuracy of transmitting the meaning of the original text, sometimes it is necessary to change the structure of the translated sentence in accordance with the generally accepted norms of the Russian literary language, that is, to rearrange or completely replace individual words and expressions. This is due to the differences between the systems of the two languages, which are distinguished by a special structure of speech – the order of words in the sentence, the lexical composition of languages (Figure).

Thus, it can be concluded that the translation of the literary text makes it necessary for the translator to take into account all the characteristic features of the text of the artistic work, not limited to just one task, but to use together all the available techniques to achieve the highest quality translation [1, 3, 4].

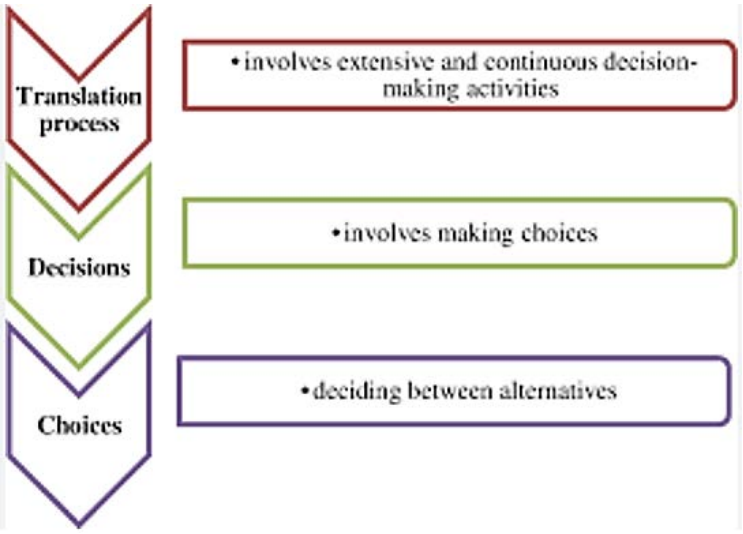


Figure. What is literary translation

There are three approaches to the translation of literary texts. The first is the acquaintance of readers with the work of the writer, whose works they cannot read themselves due to ignorance of the author's language. That is, the translator must acquaint the reader with the author's works, with his creative manner and individual style. The second approach of artistic translation is the acquaintance of readers with the peculiarities of the culture of another people, the transfer of the originality of this culture. The third approach is to introduce the reader to the content of the book.

Having set himself the first goal, the author of the translation will try to translate the literary text in such a way as to create for the readers of the translation the same "atmosphere" and the same artistic impression that the reader of the original receives. To do this, the translator will have to "smooth out" certain national-cultural differences, carefully monitor that the text of the translation is perceived by the reader as naturally as the text of the original, he should not concentrate the reader's attention on unfamiliar realities, which the reader of the original, in turn, does not notice when reading, since they are very familiar to him. In this case, the reader will be able to get a fairly complete idea of the writer's work, his individual writing style, but he will not receive a complete idea of the culture that the writer of the literary text represents.

The second approach implies that the translator seeks to fully preserve compliance with the text of the original and explain to the reader all the realities encountered when reading the text, the author of the translation tries to convey all the features of the culture that the author presents in the work. In terms of country studies, this kind of translation will be quite informative, but it will make a completely different impression on the reader than the original work on its reader. Moreover, due to the significant departure from the text of the original, the translator will not be able to convey the individual style of the author and his main idea.

In the third case, the translator does not try to find functional analogues of certain expressive means used by the author of the original, he neglects the national specifics and the main form, completely focusing on the content of the work of art. Probably, in certain cases, such a translation can be called justified. However, it can hardly be called artistic. Unfortunately, recently, non-artistic translation of literary texts is becoming

more widespread, and more and more translators are using this method when translating fiction.

Working with literary text causes difficulty both when translating from English into Russian and from Russian into English.

Thus, using the example of the works of A. N. Strugatsky and B. N. Strugatsky “Noon, XXII century”, “The Martian Chronicles”, as well as the work of A. S. Pushkin “Eugene Onegin”, it is clearly shown what difficulties may arise when translating Russian literary texts into English.

1. Interjections

А ну-ка. – Now then.

Елки-палки! – How about that!

Фу ты. – Oh, for God’s sake.

Ей-богу! – Believe me!

Бог мой! – Dear me!

It can be seen that the translation is carried out in accordance with the realities of the translated culture, or in meaning.

2. Neologisms

мимикродон – mimicrodon

смелфидер – olfactor

птерокар – pterocar

озонатор – ozonizer

Местные охотники называли их [рыб] «блямбами». – The local hunters called the fish bliamb.

… и которое они называют, скажем, тирьямпампацией. – …and which they call, say, trimpazation

васисдас – wasistdas

To translate neologisms, either transliteration or semantic transmission of meaning is used.

3. Abbreviations

Программное управление МХФ – механо-хромосома фишера. – FMC program control – the Fischer mechano-chromosome

КРИ – коллектор рассеянной информации – CODD – Collector of Dispersed Data

УКМ-207 – UKM-207

If an abbreviation is given in the text, the translator designates it according to the initial letters of the translation phrase. If there is no decryption, transliteration.

4. Diminutive forms of words

«Стрекозочка», – произнес он. «Стрекозулечка». – “A dragonfly!” he said.

Since English has fewer diminutive suffixes than Russian, the translator omitted this means of emotional coloring.

5. Rhymed phrases

Без Копылова жизнь не та, люблю, привет от Лианта. – Kopylov fills my life with blisses / So from LIANTO, love and kisses.

Меж ими все рождало споры И к размышлению влекло: племён минувших договоры, Плоды наук, добро и зло. – Each topic’s argued at the meetings: To

meditate they were in mood / On real price of ancient treaties, On evil, good, on science fruit.

Гляди – в тени болотные огни. – Mark! In the dark – The swampfire's glimmering spark!

Кибердворник дядя Федя силой ровно в три медведя, – сообщил Поль. – "Well, Uncle Fedor, the litter robot is as strong as three bears," Pol reported.

As you can see from the above contexts, in most cases translators manage to preserve both rhyme and meaning. In some cases, the rhyme is lost or translated with loss of meaning.

6. Realities of culture

This type of translation difficulties is of particular interest, because the realities of the culture of his country, known to every person since childhood, are not only difficult to convey in another language – they are sometimes difficult to recognize. In certain cases, the translator does not find it necessary to include the translation of some of them in the text that almost does not influence in any way perception of the text by the reader because their sense is not clear to the carrier of other culture, or the translator should explain any given feature of language.

Высаживаемся, исследуем, трали-вали семь пружин, как говорит мой дед. – We land, we do research, see the seven sails, as my grandfather says.

Костыль [от фамилии Костылин]. – Kostyl for short (and understandably so, for "kostyl" means "crutch") [1, 5].

Summing up, we can say that artistic translation is a combination of many tasks of different orientation, where each of the tasks must be solved so that it is not harmful to other aspects of the translation, otherwise the integrity of the text will be violated.

And this is certainly very difficult, but insanely important – especially when it comes to translating Russian works rich in beautiful speech, features of Russian culture and other linguistic specifics, the translation of which is necessary for a holistic and complete understanding of the text.

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УДК 698

COMPARISON OF PIC, AVR AND ARM MICROCONTROLLERS

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Abstract. The article analyzes the main characteristics and capabilities of three popular microcontroller families used in electronics and embedded systems – PIC, AVR and ARM. The main advantages and disadvantages are highlighted, the features of microcontroller programming are considered, support in the form of documentation, the developer community and the availability of ready-made libraries and drivers is investigated.

Keywords: microcontrollers, PIC, AVR, ARM.

СРАВНЕНИЕ МИКРОКОНТРОЛЛЕРОВ PIC, AVR И ARM

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Аннотация. В статье проведен анализ основных характеристик и возможностей трех популярных семейств микроконтроллеров, используемых в электронике и встраиваемых системах – PIC, AVR и ARM. Выделены основные преимущества и недостатки, рассмотрены особенности программирования микроконтроллеров, исследована поддержка в виде документации, сообщества разработчиков и наличия готовых библиотек и драйверов.

Ключевые слова: микроконтроллеры, PIC, AVR, ARM.

In today’s world, microcontrollers are widely used in many industries, from the production of household appliances to the automotive industry. However, the most popular among developers are PIC, AVR and ARM microcontrollers.

When choosing a microcontroller model, it is necessary to take into account the requirements and specifications of the project, as well as assess the compliance of the microcontroller characteristics with respect to the necessary capabilities and limitations of the project (Table 1).

Table 1 – Comparison of basic characteristics of PIC, AVR and ARM microcontrollers

	PIC	**AVR**	**ARM**
Architecture	Harvard, 8-bit with variable command length	Harvard, 8-bit fixed command length RISC	RISC can be either 8-bit or 32-bit, depending on the model
Frequency of operation	depending on the model, the frequency of work from several kilohertz to several megahertz	depending on the model, the frequency of work from several kilohertz to several tens of megahertz	depending on the model, the frequency of work can reach from several tens of megahertz to several gigahertz
Memory	limited memory, usually have several kilobytes of program memory and several hundred bytes of RAM	more memory, often have several tens of kilobytes of program memory and several kilobytes of RAM	depending on the model, often have from several tens of kilobytes to several megabytes of software and RAM
Set of peripherals	quite a wide set, including analog-to-digital converters (ADC), timers, PWM and UART	diverse set including ADC, timers, PWM, UART and SPI	multiple peripherals such as ADC, timers, PWM, UART, SPI, I2C and Ethernet
Reliability	high reliability and stability of operation	good reliability and durability	high, especially branded models from large manufacturers
Resistance to electromagnetic radiation	often require shielding measures or protection in conditions of strong electromagnetic noise	may require additional protective measures when operating in conditions of strong electromagnetic noise	specially designed to take into account the high resistance to electromagnetic radiation and noise
Resistance to temperature changes	are usually capable of operating in a wide temperature range, but it is recommended to choose models with the desired temperature range	able to operate under different temperature conditions, but require careful analysis of possible operating conditions and correct model selection	most models offer high resistance to temperature changes

When choosing a microcontroller for the project, it is necessary to pay attention to its reliability and compliance with the requirements for resistance to environmental factors such as temperature and electromagnetic radiation [1].

It is important to remember that the power consumption of PIC, AVR and ARM microcontrollers depends on the specific models and their configurations. In general, the characteristics shown in Table 2 can be distinguished.

Table 2 – Comparison of Energy Efficiency of PIC, AVR and ARM Microcontrollers

Energy efficiency	**PIC**	**AVR**	**ARM**
In the active mode of operation	low (approximately 11 mA/MHz when operating at 40 MHz)	average (approximately 1.5 mA/MHz when operating at 8 MHz)	high (about 100 μA/MHz when operating at up to 200 MHz)
In standby mode	low (about 0.6 mA)	low (about 0.1 – 0.5 mA)	average (approximately 1 μA)
In sleep mode	average depending on the model	approximately equally low power consumption (about 1 – 3 μA)	

Taking into account the above data, for projects where long-term autonomous operation is important, the ARM microcontroller is the most efficient microcontroller, since it has the highest energy efficiency both in active mode and in standby and sleep modes [2].

The cost comparison between PIC, AVR and ARM microcontrollers includes several aspects. General trends and factors that may affect the cost of each type of microcontroller are as follows:

1. Cost of the microcontroller itself. Typically, PIC and AVR microcontrollers are relatively inexpensive and available to a wide range of developers. Prices for different models start at a few dollars and can reach tens of dollars depending on functionality and performance.

ARM microcontrollers have more power and functionality, so they are usually more expensive than PIC and AVR. ARM microcontrollers start at a few dollars and can reach hundreds of dollars depending on model and manufacturer [3].

2. The cost of designing and manufacturing a board depends on the complexity of the project, the number of components, performance requirements, and other factors. However, usually developing and manufacturing a board based on a PIC or AVR microcontroller will cost less than ARM. This is due to the fact that PIC and AVR platforms are more popular and more accessible to developers.

Developing and manufacturing an ARM-based microcontroller board may require higher costs due to the complexity and power of this platform. However, there are many platforms and boards that can reduce development and production costs.

3. Programming and debugging costs depend on the complexity and requirements of the project, as well as the experience and qualifications of the developer. Typically, programming and debugging PIC and AVR microcontrollers is

cheaper and more affordable for beginner and mid-tier developers. ARM microcontroller costs may be higher due to the flexibility and complexity of this platform. However, there are many integrated developments and debugging environments that can reduce costs [4].

So, since the cost of microcontrollers and their development can vary greatly depending on the specific project and requirements, it is difficult to give an unambiguous answer to the question of the most favorable price-function ratio. However, usually PIC and AVR microcontrollers are more affordable and widely used, especially for novice developers, while ARM microcontrollers have more power and functionality, but can require large development and production costs.

For simple tasks such as LED control, button operation, sensor signal processing and other basic operations, all three types of microcontrollers – PIC, AVR and ARM – can be suitable and have sufficient power and functionality to solve such problems.

For more complex tasks, including greater processing power and capabilities, ARM microcontrollers are recommended. They have high performance and an advanced set of functionality. Quite popular and affordable models of ARM microcontrollers are STM32 from STMicroelectronics.

PIC microcontrollers, manufactured by Microchip, are also popular and have a wide range of functionality. They can be a good choice for simple or medium complexity tasks.

Thus, for simple tasks, all three types of microcontrollers can be successfully applied, and the choice will depend on individual preferences, availability and specific requirements of the project.

PIC, AVR and ARM microcontrollers are popular in the embedded industry and have various features regarding the availability of documentation, support for the developer community, and availability of ready-made libraries and drivers (Table 3).

Overall, all three microcontroller ecosystems have extensive documentation, developer community support, available off-the-shelf libraries, and drivers. However, the choice of a specific microcontroller depends on the specific requirements of the project, as well as the preferences of the developer and his experience with a certain ecosystem.

PIC, AVR, and ARM microcontrollers have some major differences in programming, debugging capabilities, and customization flexibility [5].

The difficulty of programming a PIC microcontroller can be significant, as it requires knowledge of assembler and C programming. The AVR platform is popular for its well-documented instructions and ease of programming in C. Programming on ARM controllers can be more complex, as they are usually used in more complex systems and require more in-depth knowledge of the processor architecture [6].

Most PICs have limited debugging capabilities, such as a JTAG-based debugger and emulators. Newer PIC microcontroller models have greater debugging capabilities, such as the built-in MPLAB X IDE debugger, which supports trace and breakpoint functions. AVR controllers have good debugging capabilities, such as JTAG and debugWIRE debugging interfaces, as well as support for high-level debuggers. ARM controllers typically have greater debugging capabilities, such as JTAG and SWD

debugging interfaces (Serial Wire Debug), as well as integrated debugging modules in various integrated development environments [7-8].

Table 3 – Comparison of documentation, support, out-of-the-box libraries, and drivers

	PIC	**AVR**	**ARM**
Documentation	Microchip provides extensive documentation about its products, including technical guides, reference materials, and code samples	Microchip, which acquired Atmel, provides extensive documentation on AVR products, including technical guides, reference materials and code samples	ARM Holdings, provides extensive documentation on various microcontrollers, including technical manuals, reference materials and code samples
Developer Support	There is an active community of PIC developers, including the official Microchip forum, where users can ask questions and share experiences	There is an active community of AVR developers, including the official Microchip forum and independent forums where users can ask questions and share experiences	There is an active community of ARM developers, including an official ARM forum and independent forums where users can ask questions and share experiences
Out-of-the-box libraries and drivers	Many ready-made libraries and drivers for various external devices and protocols that are developed by the PIC community	A wide selection of ready-made libraries and drivers for various external devices and protocols developed by the AVR development community	Many ready-made libraries and drivers for various external devices and protocols, which are developed both by the ARM development community and by other companies

PIC controllers have good configuration flexibility, as Microchip provides a wide range of microcontrollers with different characteristics that allow you to choose the most suitable model for a specific project. AVR controllers usually have limited configuration options, as they are manufactured only by Atmel. However, there is a wide range of AVR controller models on the market of varying complexity and functionality. ARM controllers offer greater customization flexibility thanks to a variety of manufacturers providing different models with different characteristics [9].

Ultimately, we can say that each of the microcontrollers considered – PIC, AVR and ARM – has its own advantages and disadvantages, as well as its own applications.

PIC is usually attractive for its simplicity and availability, AVR – for its high performance and reliability, and ARM – for its wide functionality and usability in high-performance applications. The choice of microcontroller depends on the specific requirements of the project, and there is no universal “best” microcontroller for all cases. Developers should carefully examine the characteristics of each microcontroller and address their unique needs to make the most informed choice.

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УДК 621.3

COMPARISON OF SOFT-START METHODS FOR HIGH-VOLTAGE MOTORS

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Abstract. High-voltage motors are widely used in many industries. However, for more successful operation, they need a soft start. This article compares methods of soft starting of high-voltage motors. The methods of soft start using thyristor voltage converter or reactor start or frequency converter are considered. The principle of their operation and advantages are described. A comparative analysis of these methods is carried out in order to determine the most effective method of soft start of high-voltage motors.

Keywords: soft start methods, thyristor voltage converter, reactor start, frequency converter, high-voltage motors.

СРАВНЕНИЕ СПОСОБОВ ПЛАВНОГО ПУСКА ВЫСОКОВОЛЬТНЫХ ДВИГАТЕЛЕЙ

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Аннотация. Высоковольтные двигатели получили широкое распространение во многих отраслях промышленности. Однако для более успешной работы им необходимо обеспечить плавный пуск. В данной статье сравниваются методы плавного пуска высоковольтных двигателей. Рассмотрены методы плавного пуска с использованием тиристорного преобразователя напряжения или реакторного пуска, или частотного преобразователя. Описаны принципы их действия и преимущества. Проведен сравнительный анализ данных методов с целью определения наиболее эффективного способа плавного пуска высоковольтных двигателей.

Ключевые слова: способы плавного пуска, тиристорный преобразователь напряжения, реакторный пуск, частотный преобразователь, высоковольтные двигатели.

High-voltage electric motors, which are synchronous and asynchronous motors with voltages of 3000, 6000 volts and higher, are widely used in many industries. Such electric motors are used in metallurgical, mining, chemical industry [1].

High voltage motors are electromechanical devices designed to convert electrical energy into mechanical energy. They have a significantly higher supply voltage than conventional low-voltage motors and are used in a wide range of industrial and commercial applications.

The principle of operation of high-voltage motors is to use an electric field to create a rotating magnetic field. The motor consists of stator windings, which create a permanent magnetic field, and rotor windings, where electromagnetic induction occurs. When electric current flows through the stator windings, a magnetic field is generated which interacts with the rotor magnetic field and causes the rotor to move.

The need for soft starting of high-voltage motors is due to several factors. Firstly, direct starting results in an abrupt switch-on of the electrical supply, which can lead to a sudden increase in current and voltage, as well as mechanical stresses on the system. This is often accompanied by shock loads and motor wear. Secondly, soft start helps to reduce electrical and mechanical stresses, which increases motor life and improves the energy efficiency of system operation.

Smooth start of a high-voltage motor is achieved by means of thyristor voltage converter, reactor start, frequency converter.

Thanks to progress in the development and mass production of power semiconductor devices, their cost is reduced and the scope of use of various devices based on them is significantly expanded. Thyristor high-voltage converters (TVC) are more and more widely used as soft-start devices for high-voltage electric drives [2]. The voltage converter includes two thyristors connected in parallel, each of which operates in different half-periods of the mains voltage. To regulate the voltage at the converter output, the switching time of each thyristor is changed with respect to the base point, where the current passes from one thyristor to the other. This is achieved by applying a control pulse to the thyristor, which allows the duration of its operation to be varied during the half-period. Thus, the voltage applied to the load, in this case a motor, can be regulated and non-sinusoidal [3].

Principle of operation of TVC: The main flow of electric energy from the power supply source of power circuits to the electric motor is controlled by means of a thyristor voltage converter. For this purpose, powerful thyristor keys are used in the valve stages of the converter. These stages contain high voltage thyristors as well as protection and dividing elements. Modern available microelectronic technologies including microcontrollers, programmable logic integrated circuits and fibre optics are used to implement the inverter’s sensing, diagnostics and control system. Figure 1 shows a schematic diagram of the TVC.

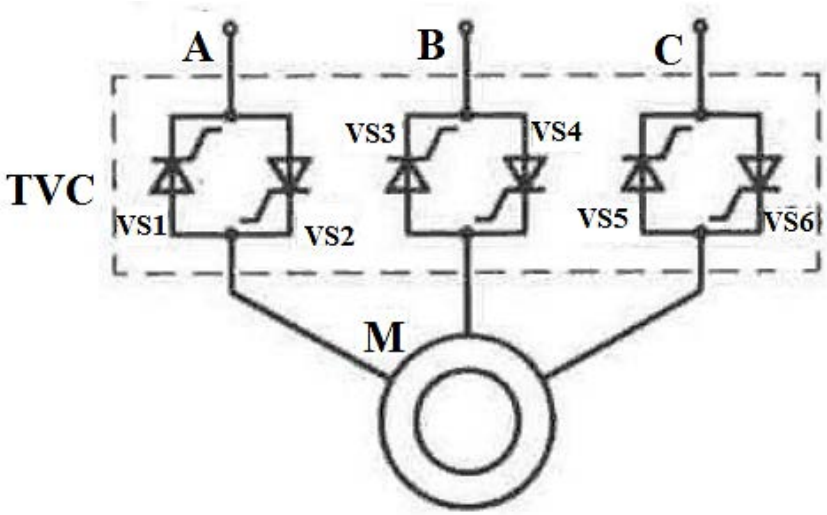


Figure 1. Schematic TVC

The thyristor voltage converter provides 30-60 % reduction of starting currents, which significantly reduces the load on the power grid and equipment, prevents sudden load changes and shock loads on the mechanical system due to smooth voltage changes, increases motor reliability by reducing overheating and wear mechanisms, it also provides ease of control and the possibility of feedback to monitor the starting parameters [4].

Advantages:

- Smooth motor starting and the possibility of current and voltage control at start-up, which reduces stress on electromechanical components.
- Reduced starting current and mechanical loads on mechanisms and system.
- Increased motor efficiency due to reduced mechanical shocks and thermal losses at start-up.

Disadvantages:

- Higher cost compared to other soft-start methods.
- Additional devices and components are required for thyristor converters to function.

Reactor starting or under-voltage starting is achieved by including elements with active or inductive resistance in series in the circuit. With reactor starting, the mains voltage is first applied to the stator winding of the electric motor via a reactor (Figure 2). The starting current is limited by the reactance of the reactor. After motor acceleration, the stator winding is connected directly to the mains [5]. Reactor starting can be realised by including a reactor in the motor supply circuit. Reactors usually have multiple taps that allow different values of inductance or resistance to be set and hence the starting currents to be adjusted. Reactors are usually connected in series with the motor and the power supply.

During start-up, the reactor creates an impedance in the circuit, limiting the current. This impedance reduces the voltage across the stator winding, reducing excessive current and preventing damage to the motor. As a result, the motor gradually accelerates, minimising mechanical stress on its components.

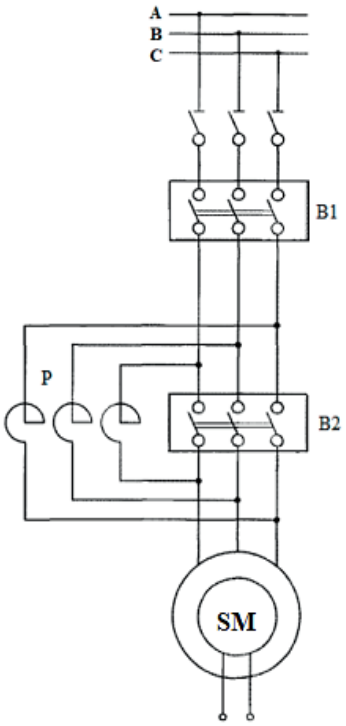


Figure 2. Reactor motor start diagram

The reactor is usually designed with a certain impedance value to provide optimum starting conditions for the high voltage motor. The impedance is carefully selected to achieve a balance between limiting inrush current and providing sufficient torque to start the motor smoothly.

This method reduces inrush currents by 30-50 %, extending motor life and provides the motor with protection against voltage overshoot. Also, reactor starting has simple installation and low cost. This method of starting is convenient because it makes it possible to change the reactor resistance by changing the number of turns in the process of setting up the drive. However, the reactor current limitation causes a sharp decrease in motor torque [6].

Advantages:

- Affordable and economical soft-start method.
- Reduction of starting current and mechanical loads on mechanisms and system.
- Increased motor life by reducing mechanical shocks and thermal losses at start-up.

Disadvantages:

- Less flexibility in controlling starting parameters, compared to thyristor converters or frequency converters.
- Larger size and weight of reactors, which can have an impact on installation and equipment space.

High voltage motors in frequency start are connected to the mains through a high voltage switch and a frequency converter (FC). This method is considered more expensive and is only used in applications where speed control is required. Figure 3 shows a schematic with a soft starter.

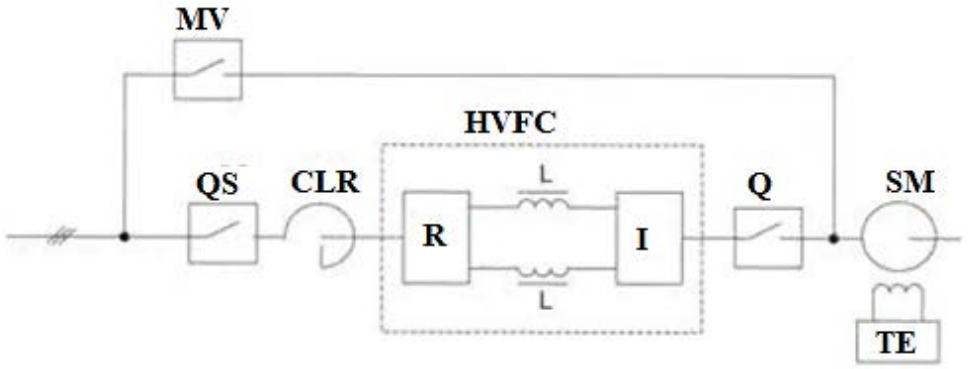


Figure 3. Start-up diagram with a frequency converter

Frequency start is widely used due to its advantages. A symmetrical three-phase voltage is gradually applied to the motor stator at a frequency lower than the rated frequency, which is gradually increased to the rated or desired value. The inrush currents are not significantly higher than the rated current, approximately (1.2-1.4) INOM [7]. The current is also limited due to the limited overload capability of the transistors comprising the IF. The start-up time increases, but approaching the rated current, the motor is not subjected to increased thermal wear.

Modern frequency converters also offer a motor pick-up function for short-term power failures. The frequency converter adjusts the voltage frequency to the changed shaft speed in the event of a power loss. It then accelerates the motor to its initial speed, with current limitation. This prevents voltage drops when motors self-start in the substation.

The frequency converter provides smooth starting without jerks and shock loads on the mechanism, speed and current control, increasing the reliability and service life of the motor. Frequency start allows limiting the starting current without reducing the overload capacity of the motor [8].

Advantages:

- Precise and flexible control of motor speed.
- Reduction of inrush current and mechanical loads on mechanisms and system.
- High efficiency and energy efficiency in variable frequency operation.

Disadvantages:

- Higher cost compared to other soft-start methods.
- Careful tuning and programming are required for optimal operation.

It is important to note that using a frequency converter only as a soft starter may not be economically viable, since such a device utilises double power conversion. In addition, the use of thyristor voltage converters and reactor starting is mainly driven by the technological requirements of production machinery such as conveyors, pumps, fans, lifts, conveyors and others that require soft starting and limitation of shock, acceleration and jerk. The reactor method of starting can be used in applications where the required excess of motor starting torque over the tripping torque of the mechanism can be achieved with current limitation. It is recommended to use reactor starting for drives that are started at idle speed.

In conclusion, frequency converters are the most efficient method of soft starting of high voltage motors. They provide smooth frequency variation and speed control,

which reduces starting currents, saves energy and increases motor reliability. Thyristor voltage converters and reactor starting are also effective methods, but provide less opportunity for precise adjustment and control of starting parameters.

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УДК 62-503

MODERN MONITORING SYSTEMS FOR REDUCING DOWNTIME OF PUMP STATIONS IN THE OIL INDUSTRY

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Abstract. The oil industry plays a key role in the modern global economy, and reliable operation of pump stations is important for ensuring continuous oil and petroleum product extraction and transportation. This research paper provides an overview of modern monitoring and diagnostic systems, examines their applicability and effectiveness in preventing accidents and reducing downtime of pump stations in the oil industry. The main focus is on analyzing existing solutions, developing new diagnostic and monitoring methods, and researching practical aspects of implementing these systems in production.

Keywords: optimization, analysis, reliability, oil industry, analytics, automation, diagnostics.

СОВРЕМЕННЫЕ СИСТЕМЫ МОНИТОРИНГА ДЛЯ СОКРАЩЕНИЯ ПРОСТОЕВ НАСОСНЫХ СТАНЦИЙ В НЕФТЯНОЙ ПРОМЫШЛЕННОСТИ

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Аннотация. Нефтяная промышленность играет ключевую роль в современной мировой экономике, и надежная работа насосных станций важна для обеспечения непрерывной добычи и транспортировки нефти и нефтепродуктов. В данной статье проводится обзор современных систем мониторинга и диагностики, исследуется их применимость и эффективность в предотвращении аварий и сокращении простоев насосных станций в нефтяной промышленности. Основное внимание уделяется анализу существующих решений, разработке новых методов диагностики и мониторинга, а также исследованию практических аспектов внедрения этих систем в производство.

Ключевые слова: оптимизация, анализ, надежность, нефтяная промышленность, аналитика, автоматизация, диагностика.

The oil industry is undoubtedly one of the most crucial sectors in the global economy. Our modern life heavily relies on petroleum products, starting from transportation and ending with plastic goods. This sector provides energy and chemical products necessary for the functioning of various industrial sectors, but its work is not without serious challenges and risks. One of the most critical aspects in the oil industry is the operation of pump stations, which play a central role in the transportation and processing of raw materials. However, despite their importance, pump stations are prone to the risk of accidents and downtime, leading not only to environmental damage but also to significant economic losses [1]. In the light of this, exploring the possibilities of implementing modern monitoring and diagnostic systems in the oil industry represents a relevant and strategically important task.

Modern monitoring and diagnostic systems are technological solutions designed to provide comprehensive and continuous control over the operation of pump stations. They encompass a wide range of sensors and detectors, data collection and analysis systems, as well as intelligent algorithms capable of detecting anomalies and potential issues. These systems enable pump station operators not only to monitor the current status of equipment but also to conduct diagnostics, analyze data, and take immediate measures to prevent accidents [2]. A key aspect of employing such systems is their ability to predict future events and malfunctions, allowing for optimal planning of maintenance and repairs.

While modern monitoring and diagnostic systems offer numerous possibilities, their implementation is not always a straightforward task. This is due to the necessity of integrating new technologies into complex and highly loaded production processes.

Let’s consider a list of systems currently aiding oil companies in maintaining the required reliability and efficiency of pump stations, as well as predicting accidents and reducing downtime, which is crucial for safety and productivity.

Schneider Electric EcoStruxure is a comprehensive solution that integrates sensors, analytics, and control systems for real-time monitoring and diagnostics [3]. It enables operators to track parameters such as temperature, pressure, and vibration, providing opportunities for data analysis and process optimization. The system represents a digital platform that plays a significant role in the digital transformation of the oil industry, ensuring the optimization of production processes and enhancing operational resilience. This platform is based on the Internet of Things (IoT) architecture and includes connected products, enabling the creation of integrated solutions for oil fields.

EcoStruxure allows for the integration of executive devices, production automation systems, and information technologies, contributing to increased efficiency and improved management in the oil industry (Figure 1).

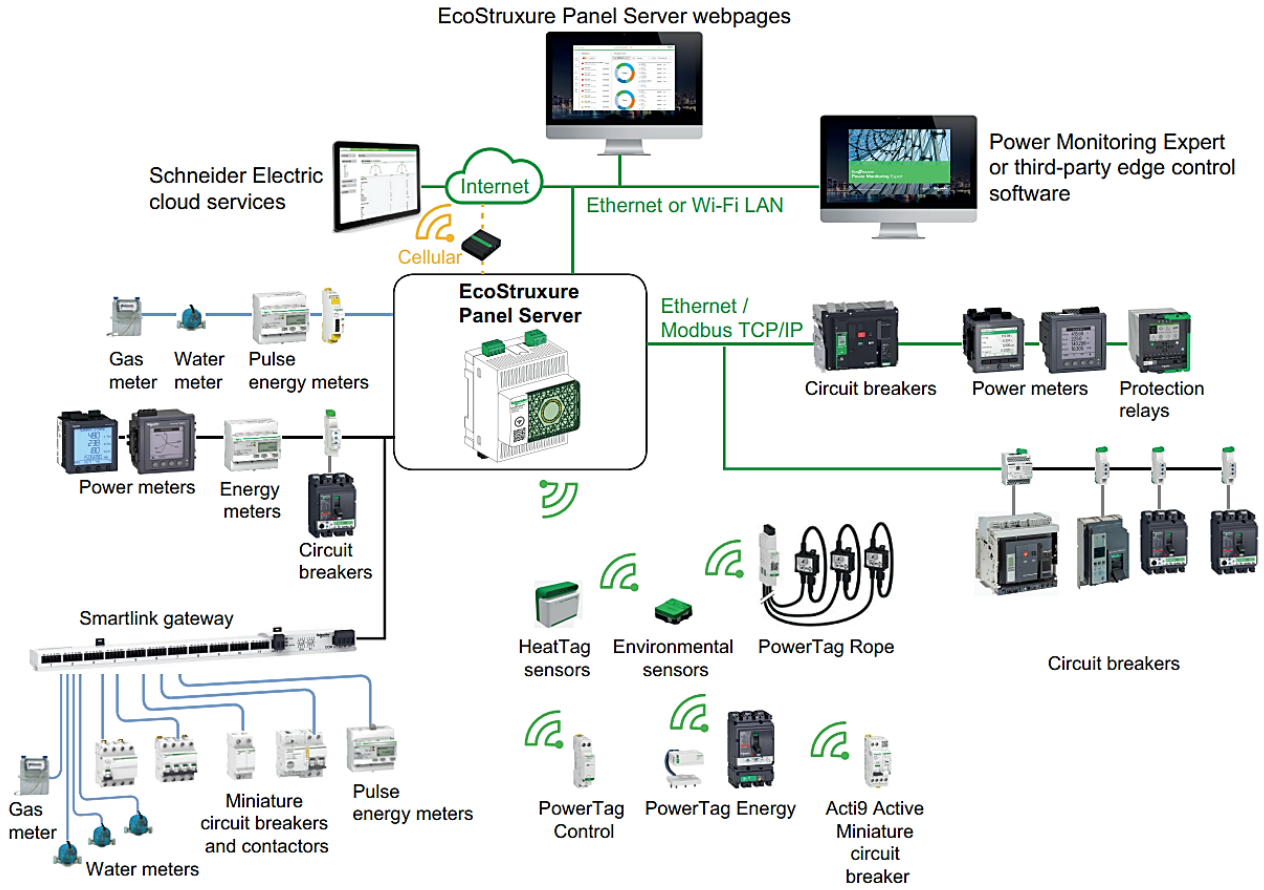


Figure 1. Schematic diagram of Schneider Electric EcoStruxure

Pros:

- Integration of various application areas (buildings, industry, energy).
- A wide array of tools for data collection and analysis.
- Capability to optimize energy consumption and enhance process efficiency.

Cons:

- Not always straightforward setup and implementation due to the diversity of capabilities.
- Depending on the configuration, it may require significant investments.

Thus, Schneider Electric's EcoStruxure is a powerful digital platform that plays a crucial role in the digital transformation of the oil industry, ensuring the optimization of production processes, increased resilience, and cost reduction.

Honeywell's Asset Performance Management is a digital platform provided by Honeywell, aimed at optimizing production and enhancing efficiency in the oil industry [4]. Honeywell's solutions for the oil and gas sector ensure worker safety in complex conditions and contribute to improving production processes.

Honeywell offers solutions for the oil industry that include automation systems, data monitoring, and analytics, aimed at optimizing production processes and increasing operational resilience. These solutions may encompass asset management systems, equipment condition monitoring, data analysis, and failure prediction, enabling oil industry enterprises to enhance the efficiency and reliability of their operations.

Pros:

- Improved equipment reliability through predictive analytics.
- Optimization of production processes and reduction of equipment downtime.
- The system allows for more accurate planning of maintenance.

Cons:

- Potential integration complexities with existing systems.
- Implementation may require time and resources.

Therefore, Honeywell's Asset Performance Management serves as an important tool for the digital transformation of the oil industry, ensuring the optimization of production processes, increased resilience, and cost reduction.

ABB Ability is a digital platform provided by ABB, integrating various digital solutions to improve performance and efficiency in different sectors, including the oil industry [5]. The platform offers a wide range of digital tools, including automation systems, data monitoring, and analytics, contributing to optimizing production processes and enhancing operational resilience (Figure 2).

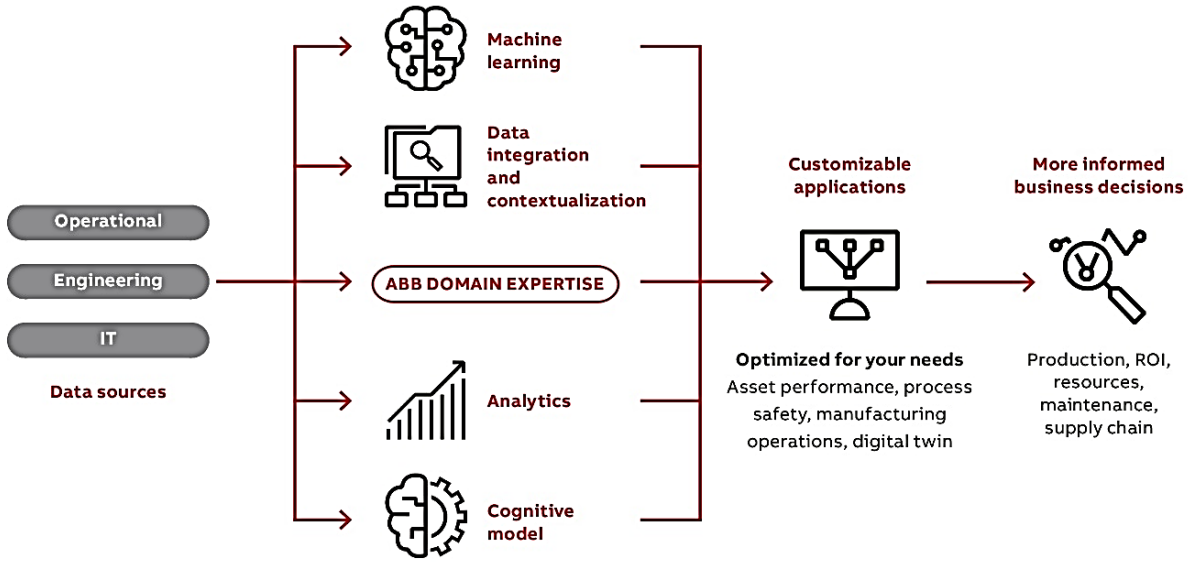


Figure 2. Schematic diagram of ABB Ability System

ABB Ability has been successfully deployed in various projects in the oil and gas industry, such as implementing the ABB Ability System 800xA at an offshore site in Brazil, optimizing the operations of Yinson. Additionally, the system has been installed for Statoil's new Johan Castberg oil field in the Barents Sea, demonstrating its significance and effectiveness in the oil industry. ABB Ability's digital solutions find application in other industrial areas like cement production, where they contribute to increased production volumes and enhanced efficiency [6].

Pros:

- Diverse digital products and solutions for various industries.
- Powerful tools for data monitoring and analysis.
- Enhanced efficiency and safety across different production spheres.

Cons:

- Possible compatibility and integration complexities with other systems.

- Some features might require additional setup and training.

Thus, ABB Ability stands as a robust digital platform playing a crucial role in the digital transformation of the oil industry, ensuring production process optimization, increased resilience, and cost reduction.

Siemens MindSphere is an open, cloud-based operating system for the Internet of Things (IoT) by Siemens, connecting physical assets to the digital world [7]. MindSphere enables rapid and secure connectivity of products, factories, systems, and machines to the digital realm, facilitating the understanding and utilization of data for enhancing business processes. The MindSphere platform utilizes advanced analytics and artificial intelligence to create IoT solutions from the edge to the cloud based on data obtained from connected products, factories, and systems. It enables users to monitor assets, perform advanced analytics, and develop/integrate personalized IoT applications to optimize operations, create better products, and swiftly deploy new business models. The platform is employed to create new digital services such as predictive maintenance or remote condition monitoring. MindSphere represents an open ecosystem optimizing manufacturing processes through the collection and analysis of vast industrial data.

Pros:

- Cloud platform for industrial equipment data collection and analysis.
- Tools for building data-driven IoT applications.
- Assistance in making informed decisions to enhance production.

Cons:

- Possible limitations in use with specific types of equipment.
- Some functionalities might be complex for novice users.

Each of these systems has its strengths and limitations, and the choice between them should be based on specific business needs, functional requirements, and integration capabilities with existing systems.

The oil industry faces continuously evolving challenges and conditions, including growing demand for petroleum products, changing regulatory norms, and increasing competitive pressure. Ensuring reliable and efficient pump station operations becomes a key aspect of sustaining stability and successful operations for oil companies [8]. Maintaining safe and reliable pump station operations not only ensures the safety of personnel and the environment but also holds immense economic significance. Reducing downtime and preventing accidents helps decrease revenue losses, increase resource utilization efficiency, and reduce equipment maintenance costs.

Each of these systems focuses on digitalization and optimization in various industrial spheres, offering tools for data collection, analysis, and utilization to enhance efficiency, reliability, and management of industrial processes. The choice between them might hinge on specific enterprise or industry needs and features. Schneider Electric EcoStruxure and Honeywell’s Asset Performance Management are part of their respective companies’ digitalization and automation solutions, emphasizing modernizing control systems and energy management. ABB Ability and Siemens MindSphere are also significant players in the industrial automation sector, focusing on providing comprehensive automation solutions. Each of these systems has its own

advantages and areas of expertise, and the choice between them depends on specific requirements and use cases in industrial and energy sectors.

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УДК 81

FEATURES OF MODERN IDIOMATIC EXPRESSIONS AND HOW NON-SPEAKERS NAVIGATE IDIOMS IN SOCIAL AND CULTURAL CONTEXTS

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Abstract. This study aims to investigate the features of modern idiomatic expressions in English, using a corpus-based approach. The analysis focused on the frequency, distribution, variation, and pragmatics of idioms. The results showed that idioms are more prevalent in spoken and fiction genres than in academic genres. The study concludes that idioms are an integral part of modern English usage and that they reflect the dynamic and creative nature of language.

Keywords: idioms, culture, diversity, etymology, native-speakers, learning challenges and strategies.

ХАРАКТЕРИСТИКИ СОВРЕМЕННЫХ ИДИОМАТИЧЕСКИХ ВЫРАЖЕНИЙ И ПРИМЕНЕНИЕ ИХ В СОЦИАЛЬНО-КУЛЬТУРНЫХ СИТУАЦИЯХ НОСИТЕЛЯМИ ДРУГИХ ЯЗЫКОВ

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Аннотация. Целью данной работы является изучение особенностей современных идиоматических выражений в английском языке с использованием корпусного подхода. Анализ был сосредоточен на частоте, распространении, вариациях и прагматике идиом. Результаты показали, что идиомы более распространены в разговорных и художественных жанрах, чем в академических жанрах. Авторы приходят к выводу, что идиомы являются неотъемлемой частью современного использования английского языка и отражают динамичную и творческую природу языка.

Ключевые слова: идиомы, культура, разнообразие, этимология, носители языка, проблемы обучения и стратегии.

Language helps fulfill the human need to be understood, but what happens when you can't find the precise word to express yourself, when one word doesn't do justice to the situation or emotion you are trying to convey. In these circumstances, we often turn to figurative language, like metaphors, hyperbole, symbolism or idioms. English is a language particularly rich in idioms or idiomatic expressions. Without idioms it

would lose much of its variety and humor both in speech and writing. The background, etymology and history of idioms are even more compelling. Some idioms of the "worldwide English" have first been seen in the works of writers like William Shakespeare, Sir Walter Scott, Lewis Carroll or even in the paperbacks of contemporary novelists. An example of Shakespearian quotation can be found in the following sentence: "I can't believe the waitress dropped all the plates. She was the laughing stock of the restaurant." [1]. To be a laughing stock means you did something funny or embarrassing that could make you an object of ridicule. Moreover, biblical references are also the source of many idioms. Since idiomatic expressions are so frequently encountered in both spoken and written discourse, this issue requires special attention.

Idiomatic expressions are words or phrases that are employed figuratively, that is, in a manner that deviates from their literal meaning. At its simplest, an idiom is an expression whose meanings cannot be inferred from the meanings of the words that comprise it. Some phrases which become figurative idioms, however, do retain the phrase's literal meaning. Idioms are used in order to add variety and color to speech or writing. They can also be used to emphasize a point, or to make a statement more memorable. In fact, some of the best-known idiomatic expressions, more than 80 %, have been derived from popular culture, such as movies, books, or songs, they enhance speech with expressiveness, beauty, wit, or emotionality and are conventionally understood by native speakers. The use of idioms has a great influence in the teaching and learning process of a foreign language, because it could be one of the ways to give non-native speakers better conditions to improve communicative skills in the daily context. For non-native speakers most of the figurative expressions are difficult to understand because they do not know what the image is based on.

Learning modern idiomatic expressions in English as a second language can be challenging, but also rewarding. Some of the challenges that learners face are [2, p. 4]:

1. Recognizing when a phrase is idiomatic or not. Sometimes, the context can help to indicate that a phrase is not meant to be taken literally, but other times, it may not be clear. For example, if someone says "I'm feeling blue today", it could mean that they are sad or depressed, or that they are wearing a blue shirt.

2. Understanding the source and origin of idiomatic expression. It can help us appreciate the richness and diversity of language, as well as the cultural and historical contexts that shaped the meanings of these phrases. Idioms are not just random combinations of words, but expressions that often have fascinating stories behind them. By learning about the origins of idioms, we can gain insights into the values, beliefs, and experiences of different people and societies.

Idioms are often ambiguous and dynamic, meaning that they can have more than one possible interpretation or explanation and that they can change over time in their form, meaning, or usage. Sometimes, the origin of an idiom becomes obsolete or irrelevant, and the idiom acquires a new meaning or function that is more suitable for the current situation or context. For example, the idiom "the time is ripe" may have originated from the agricultural practice of harvesting fruits when they are at their peak of ripeness, but it has come to mean that the time is right or opportune for something to happen or be done.

3. Understanding the source and origin of idiomatic expressions is crucial, but ultimately, the most significant aspect of idioms is their meaning. Even if learners know that a phrase is idiomatic, they may not know what it means or how to use it appropriately. For example, if someone says “You hit the nail on the head”, it could mean that they agree with what you said, or that you did something exactly right. However, you cannot use this idiom to say “I hit the nail on the head” when you actually hammered a nail.

The long-standing usage of an idiomatic expression results in its fixed arrangement or choice of words, making it impossible to explain why it has an uncommon or unusual arrangement. For example, the English idiomatic expression “to buy a pig in a poke” means to buy something without inspecting it previously and which is worth less than what it has been paid for. Although the word “poke” is no longer used today, it appears in present-day language only in this specific idiom. This shows that the idiom has survived, while the single word has disappeared over time.

4. Idioms can have a variety of structures and forms. Sometimes, native speakers may not even realize that certain idioms are grammatically incorrect because they focus on their meaning and understand them perfectly. Non-speakers, on the other hand, may find it challenging to convey the meaning and content of an idiomatic expression from one language to another, especially when there is no equivalent cultural context or words in the target language. Idioms can be very short, such as “cold war”, or quite long, like “to take the bull by the horns”. Some idioms have a regular structure but their meaning is not clear, while others have an irregular or even grammatically incorrect structure but their meaning is obvious. Additionally, there are idioms where both the structure and meaning are not clear. The idiom “I am good friends with him” is both irregular and illogical in its grammatical structure, as the pronoun “I” is singular and the correct form should be “I am a good friend with him” or “of his”. However, the non-speaker would not have any difficulty translating this idiomatic expression into another language, as the meaning of this expression is clear even though its structure is irregular. On the other hand, the idiom “to have a bee in one’s bonnet” has a regular form but its meaning is not immediately apparent. It means that someone is obsessed with an idea, but the non-speaker would not know this unless they learned it as an idiom. Lastly, there are idiomatic expressions such as “to be at large”, which have an unusual grammatical form (verb, preposition, adjective, and no noun) and an unclear meaning.

5. Learning and remembering idioms. There are thousands of idioms in English, and they vary in frequency, formality, and regional variation. Learners may find it hard to learn and remember all the idioms that they encounter, especially if they do not use them often or encounter them in different contexts. It could be hard to learn the idioms due to the grammatical patterns which are used inside the phrase, they can seem illogical and irrational. It is widely known that those modes of expression peculiar to a language (or dialect) frequently defy logical and grammatical rules.

To overcome these challenges, learners can use various strategies to help them learn and use idioms effectively. Some of the strategies that have been suggested by researchers and teachers are [3, p. 29]:

– guessing the meaning of idioms from context. This is a common and useful strategy that involves using the clues from the surrounding text or situation to infer the meaning of an idiom;

– predicting the meaning of idioms. This is a similar strategy that involves using your prior knowledge and expectations to anticipate the meaning of an idiom before you encounter it;

– figuring out an idiom from an equivalent one in your mother language. This is a strategy that involves using your native language as a resource to help you understand an idiom in English. For example, if you know that "It's raining cats and dogs" is an idiom that means it's raining heavily, you can figure out its meaning by comparing it to an equivalent idiom in your mother language, such as "Льёт как из ведра" in Russian or "下倾盆大雨" in Chinese;

– consulting dictionaries or other reference materials. This is a strategy that involves using external sources of information to help you learn and confirm the meaning and usage of idioms. For example, you can use a dictionary that specializes in idioms, such as The Free Dictionary Idioms or Cambridge Dictionary Idioms, or other online resources, such as Idioms Online or English Idioms;

– practicing and reviewing idioms. This is a strategy that involves using various activities and exercises to help you reinforce and consolidate your knowledge and skills of idioms. For example, you can practice using idioms in sentences, dialogues, stories, or games; you can review idioms by making flashcards, lists, or quizzes; or you can expose yourself to idioms by reading books, watching movies, listening to songs, or talking to native speakers.

Under any historical circumstances of our existence, idioms and any other figurative expressions will always retain their relevance, invariably occupying their respective positions. Moreover, it not only helps the advancement of globalization, fosters cultural exchange among different countries, what is reflected in all domains. Idioms also mirror the natural environment, customs, history, and culture of its people.

Idiomatic expressions are influenced by the changes in society, technology, media, and communication. For example, some idioms that have emerged in 2010 are "ghost someone" (to stop communicating with someone without explanation), "to go viral" (to become very popular or widely known in a short time, especially on the internet). According to the etymonline website [4], the adjective "viral" was first used in 1944 to describe something related to or caused by a virus. The phrase "to go viral" was first attested in 1999, originally in reference to marketing strategies that aimed to create a buzz and generate word-of-mouth publicity by using the internet. Another example is "cancel culture" – the practice of withdrawing support from public figures or companies after they have done or said something considered objectionable or offensive.

They are creative and innovative, often using metaphors, similes, allusions, or puns to express ideas or emotions. For example: "when life gives you lemons, make lemonade" (to make the best out of a bad situation), "break a leg" (popular idiom used to wish someone good luck before a performance, especially in the theater). The origin of this phrase is not entirely clear, but there are several theories. One theory suggests

that the phrase comes from the belief that wishing someone good luck before a performance is bad luck [4]. Another theory suggests that the phrase comes from the German saying "Hals- und Beinbruch," which means "break your neck and leg" and was used as a way to wish someone good luck. Yet another theory suggests that the phrase comes from the practice of bowing or curtsying at the end of a performance, which requires bending one's leg [5]. "Have a cow" means to get very angry or upset. It is believed to have originated in the early- to mid-20th-century United States. In the early 1900s, "cow" was slang for a fit of anger or rage.

They are diverse and varied, reflecting the different backgrounds, experiences, and perspectives of the speakers. For example, some idioms that are specific to certain regions or cultures are "kick the bucket" (to die) in American English, "pop one's clogs" is a euphemism for dying and is often used in a humorous or lighthearted way. The actual origin of this idiom is still a matter of dispute, but it is believed to have been in use since at least 1970 [5] in British English, and "go to the West" (to die, be killed, or disappear) is related to the direction of the setting sun, which symbolizes the end of the day and life in Chinese.

Idioms can also reveal the values, beliefs, or norms of a certain culture or society. For example, the idiom "to have a chip on one's shoulder" means to have a grudge or a sense of inferiority. This idiom originated from the practice of placing a wooden chip on one's shoulder and challenging others to knock it off as a sign of provocation or defiance [6, p. 79]. This idiom reflects the culture of aggression and confrontation in some societies.

Idioms can also change or adapt over time to suit different contexts or situations. For example, "to spill the beans" means to reveal a secret or some important information. This idiom comes from an ancient Greek voting system where people used beans to cast their votes in secret jars. If someone accidentally spilled the beans, the votes would be exposed [7]. This idiom has changed its meaning and usage over time to suit modern scenarios.

Idioms can also be used to create a sense of identity or belonging among a group of people who share the same language or culture. For example, "to be on cloud nine" means to be very happy or ecstatic. This idiom is derived from a classification of clouds by the US Weather Bureau in the 1950s, where cloud nine was the highest and most pleasant type of cloud. This idiom is widely used and understood by English speakers around the world.

However, the frequency of idiomatic expressions use may vary depending on the style, register, and context of the communication.

According to one study [8, p. 34] idiom use frequency varies significantly from fiction to conversation, with more idioms occurring in fiction than in actual conversation. Another study [8, p. 45] found that the frequency of idioms also depends on their familiarity and literalness. Familiar and literal idioms are easier to process and understand than unfamiliar and figurative ones.

Therefore, it is hard to say how often idioms are used in modern world, as it may depend on many factors. Nevertheless, some sources [9, p. 197] provide lists of the most frequently used English idioms, which can be helpful for learners or speakers of English who want to improve their idiomatic competence.

Modern idiomatic expressions that have emerged or become popular in recent time, have peculiarities:

– they are often based on conceptual metaphors or metonymies, which are mappings between two domains of meaning that create new associations or implications. For example, the idiom “break the internet” means to cause a lot of online attention or excitement, based on the metaphor of the internet as a fragile system that can be overloaded or damaged;

– they often reflect current trends, events, or issues that are relevant to the speakers or their context. For example, the idiom “Groundhog Day” means a situation that repeats itself in the same way, based on the movie of the same name where the protagonist relives the same day over and over;

– they often use colloquial or slang language that is familiar or informal to the speakers. For example, “go the extra mile” means to do more than what is expected or required, based on the slang term “mile” for a unit of distance or effort;

– they often have a humorous, ironic, or sarcastic tone that expresses the speaker’s attitude or emotion. For example, the idiom “first-world problem” means a trivial or minor problem that only affects people in wealthy or developed countries, used to mock or criticize someone who complains about such things.

It is estimated that the English language contains at least 25,000 idiomatic expressions [9, p. 100]. English idiomatic expressions are used in both written (formal) and oral (informal) communications. Oral idioms are often based on colloquialisms, slang, metaphors, or cultural references that make the speech more lively and expressive, but they may not be appropriate or clear for academic or professional writing. Written idioms are often based on literary devices, historical allusions, or technical terms that make the writing more precise and sophisticated, but they may not be suitable or natural for casual or everyday conversation.

Some examples of oral idioms are:

– Hit the hay: This means to go to bed or sleep. It comes from the old practice of using hay as bedding. For example, “I’m really tired, I think I’ll hit the hay early tonight.”

– Cut to the chase: This means to get to the point or the main issue. It comes from the film industry, where a chase scene was often used to end a movie. For example, “Stop beating around the bush and cut to the chase, what do you want from me?”

Some examples of written idioms are:

– The elephant in the room: This means a big or obvious problem that is ignored or avoided. It comes from the idea of an elephant being too large to overlook. For example, “We need to address the elephant in the room, our company is losing money fast.”

– Achilles’ heel: This means a weakness or vulnerability that can cause failure or defeat. It comes from the Greek mythology, where Achilles was a hero who was invulnerable except for his heel. For example, “His arrogance was his Achilles’ heel, he underestimated his opponents and lost the game.”

– The tip of the iceberg: This means a small or visible part of a larger or hidden problem. It comes from the fact that most of an iceberg is submerged under water. For

example, “These errors are just the tip of the iceberg, there are many more issues in this project.”

From all of the above it can be concluded that figurative figures of speech are present in any style of discourse and pervade the entire language, irrespective of the epoch in which we live. In the English language, idiomatic expressions are spontaneously used by native speakers daily.

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УДК 50

THE RELEVANCE OF THE PROBLEM OF OZONE HOLES IN THE ATMOSPHERE

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Abstract. This article discusses the problem of ozone holes in the atmosphere. The layers of the atmosphere and the chemical composition of the atmosphere are described. The causes and consequences of the appearance of ozone holes are considered.

Keywords: atmosphere, layers of the atmosphere, chemical composition of the atmosphere, ozone, ozone holes, temperature, radiation.

АКТУАЛЬНОСТЬ ПРОБЛЕМЫ ОЗОНОВЫХ ДЫР В АТМОСФЕРЕ

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Аннотация. В данной статье обсуждается проблема озоновых дыр в атмосфере. Описываются слои атмосферы, химический состав атмосферы. Рассматриваются причины и следствия появления озоновых дыр.

Ключевые слова: атмосфера, слои атмосферы, химический состав атмосферы, озон, озоновые дыры, температура, излучение.

At the moment, environmental protection is one of the most pressing problems of our time. Scientific and technological progress, as well as the tightening of anthropogenic impact on the natural environment, inevitably lead to a deterioration of the ecological situation. Already in the middle of the 20th century, the problems associated with environmental pollution sharply worsened. Pollution of the biosphere is associated with causing enormous damage to natural waters, soil cover, forests and animals, as well as the atmosphere. Pollutants enter the atmosphere with emissions from industrial enterprises, exhaust gases from motor vehicles, with municipal household waste from the production sector, which adversely affects the layers of the atmosphere.

The atmosphere is of great importance for the nature of the Earth. Breathing of living organisms is impossible without oxygen. Its ozone layer protects all living things from harmful ultraviolet rays. The atmosphere smooths out temperature fluctuations: the Earth's surface is not supercooled at night and does not overheat during the day.

Human economic activity has a significant adverse effect on the atmosphere. Atmospheric air pollution occurs, which leads to an increase in the concentration of carbon dioxide (CO2). And this contributes to global warming and enhances the "greenhouse effect", which contributes to the thinning of the ozone layer [1].

The composition of the Earth's atmosphere consists mainly of gases, as well as various impurities, for example, water particles, dust, ice, gorenje products, etc. 78 % of the shell consists of nitrogen, 21 % of oxygen. Among other components there are argon, carbon dioxide, helium, hydrogen and others (Figure).

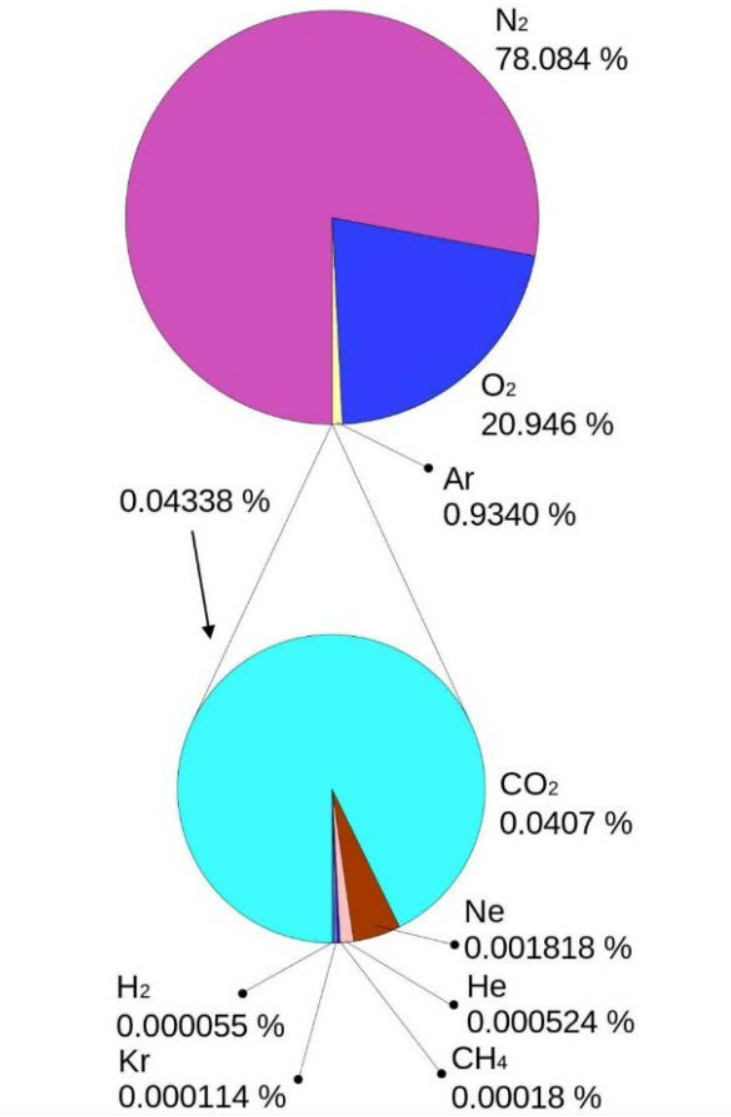


Figure. Chemical composition of the atmosphere

The atmosphere consists of several layers that differ in composition, density and temperature.

The structure of the Earth's atmosphere begins with the troposphere, which is the lower part of the atmosphere with a height of about 10-15 km. The main part of atmospheric air is concentrated here. A characteristic feature of the troposphere is a drop in temperature by 0.6 C as it rises up for every 100 meters. The troposphere has concentrated almost all atmospheric water vapor, and clouds are also forming here.

Above the troposphere layer is the stratosphere, which is 50-55 km in height. The peculiarity of this layer is the increase in temperature with height. There is a transitional layer between the troposphere and the stratosphere, called the tropopause. It is in this layer that most of the ozone is located.

Approximately from a height of 25 kilometers, the temperature of the stratospheric layer begins to increase and, upon reaching a maximum height of 50 km, acquires values from +10 to +30º C.

Next is the mesosphere. The height of the mesosphere layer is approximately 80 km. Here, with an upward rise, the temperature decreases and at the uppermost boundary reaches values of several tens of degrees below zero. Clouds can also be observed in the mesosphere, which are presumably formed from ice crystals. These clouds are called "silvery". The mesosphere is characterized by the coldest temperature in the atmosphere: from -2 to -138º C.

The mesosphere is followed by the thermosphere. The thermosphere consists of:

- Ionospheres.
- Exospheres.

The ionosphere is characterized by rarefied air, each centimeter of which at an altitude of 300 km consists of 1 billion atoms and molecules, and at an altitude of 600 km – more than 100 million.

The ionosphere is also characterized by high ionization of air. These ions consist of charged oxygen atoms, charged molecules of nitrogen atoms and free electrons.

From an altitude of 800-1000 km, the exospheric layer begins. Gas particles, especially light ones, move here with great speed, overcoming gravity. Such particles, due to their rapid movement, fly out of the atmosphere into outer space and disperse. Therefore, the exosphere has the name of the scattering sphere. Mainly hydrogen atoms, which make up the highest layers of the exosphere, fly into space. Thanks to particles in the upper atmosphere and solar wind particles, we can observe the Northern lights.

Each layer has no sharp boundaries between them, and their height is affected by latitude and seasons. Such a layered structure was formed as a result of temperature changes at different heights [2].

Most of the ozone in the earth's atmosphere (about 90 %) is located in the stratosphere and is a colorless gas distributed in all layers of the atmosphere. This is an allotropic modification of oxygen, in which three atoms of this chemical element are combined. It is much more reactive than diatomic oxygen, and enters into chemical interaction with almost all metals and nonmetals, many inorganic and organic substances.

The importance of the ozone layer for humanity is very great. Ozone in the stratosphere protects life on Earth from harsh ultraviolet radiation. This layer is especially important because it does not allow ultraviolet radiation from the Sun to reach the troposphere in full. Long-term exposure to solar ultraviolet radiation on a person can provoke the development of acute and chronic diseases and the immune system. UV radiation can cause degenerative changes in skin cells, fibrous tissue and blood vessels. Skin cancer and cataracts are the most serious and frequent consequences of ultraviolet radiation. Ultraviolet radiation has a high power and is more often divided into three categories:

– UV-A (from 320 to 400 nanometers): the length not absorbed by ozone, as it is at a safe distance.

– UV-B (280 to 320 nanometers): most of it is absorbed by ozone, but this length of radiation can be harmful to sensitive skin.

– UV-C (less than 280 nanometers): completely absorbed by ozone. This is the most dangerous length, because it is the shortest and can destroy a significant part of our ecosystem [3].

But the ozone layer located in the stratosphere cannot always completely protect us from ultraviolet radiation. The ozone layer is being depleted in some parts. Areas of reduced ozone concentration in the stratosphere are called ozone holes. In these areas, ultraviolet rays can easily penetrate the surface of the Earth and have a destructive effect on the inhabitants of the planet [4].

For many decades, humanity did not know about the existence of the ozone layer, but its activity had a detrimental effect on the state of the atmosphere all this time.

With the development of modern technology, the problem of ozone holes is more relevant than ever.

Depletion of the ozone layer occurs for many reasons:

- launching rockets and satellites into space;
- operation of air transport at an altitude of 12-16 kilometers;
- emissions of freons into the air.

The biggest enemies of the oxygen modification layer are hydrogen compounds and chlorine. This is due to the decomposition of freons, which are used as atomizers. At a certain temperature, they are able to boil and increase in volume, which is important for the manufacture of various aerosols. Very often freons are used for freezing equipment, refrigerators and cooling units. When freons rise into the air, chlorine cleaves off in atmospheric conditions, which in turn converts ozone into oxygen [5].

There are several groups of freons, depending on their destructive potential. The most dangerous substances for ozone are chlorofluorocarbons (CFCs) with the chemical formula CFCl3. The danger of CFCs is that they are exceptionally powerful greenhouse gases, whose warming potential is thousands of times greater than that of CO2.

The next group is hydrochlorofluorocarbons (HCFCs). Their destructive potential is significantly lower than that of CFCs, because they are mostly destroyed already in the troposphere. Just like CFCs, HCFCs are powerful greenhouse gases.

Finally, the third group is hydrofluorocarbons (HFCs). They do not destroy the ozone layer because they do not contain chlorine, and they were mainly used to replace CFCs and HCFCs.

Calculations show that a reduction in the production and release of freons into the atmosphere should have a positive effect on the ozone layer in a few decades – due to the long lifetime of these substances in the stratosphere [6].

Work began at a rapid pace to prepare an international direct-action agreement that would deal exclusively with the topic of CFCs and contain specific obligations and deadlines for replacing old freons with new ones.

The Montreal Protocol (MP) became such a document. It was signed by thirty countries in 1987 and entered into force on January 1, 1989. The MP provided for freezing the production of old-generation freons (they are designated by numbers 11, 12, 113, 114, 115) at the 1986 level, starting in 1992, and in the period 1993-1998, according to the schedule, reducing the production level to 50 % of the original. Since then, the protocol has been revised (in the direction of tightening) seven times: in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal) and 1999 (Beijing). Some other compounds that can destroy the ozone layer have been added to the freons. For example, halons, hydrochlorofluorocarbons (HCFCs), carbon tetrachloride (HCCs) [7].

A scientific assessment of ozone depletion conducted by the World Meteorological Organization (WMO) in 2018 showed that the ozone layer has a chance to return to pre-1980 levels by 2060 thanks to the Montreal Protocol prohibiting emissions of ozone-depleting chemicals. Even outside the polar regions, the ozone content in the upper stratosphere has increased by 1-3 % every decade since 2000. Given the success of the Montreal Protocol, its relevance is still far from over. In 2020 The WMO has recorded one of the largest and deepest holes in the ozone layer in the last 40 years. The hole has been growing since mid-August, peaking in September at nearly 25 million square kilometers (about 10 million square miles), spreading across most of the Antarctic continent. When the hole finally closed on December 28, the WMO reported that the ozone hole was still subject to annual fluctuations, although the ozone layer was slowly recovering due to the rules of the Montreal Protocol [8].

Thus, we are faced with the task of technological progress: the development of technologies and unique substances that help minimize environmental damage.

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УДК 628.32

MARKET ANALYSIS OF DIGESTER PRODUCTION IN RUSSIA

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Abstract. The method of wastewater treatment using activated sludge is used in various devices, including digesters. This direction is developing due to a number of advantages of this method. The level of production of apparatus for wastewater treatment in Russia directly depends on the development of treatment plants. The purpose of this work is to study the process of digester operation, its varieties, as well as to analyze the leading companies-manufacturers of digesters in Russia.

Keywords: methane digester, methane digestion, digestion, activated sludge, overlap, advantages, disadvantages.

АНАЛИЗ РЫНКА ПО ПРОИЗВОДСТВУ МЕТАНТЕНКОВ В РОССИИ

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Аннотация. Метод очистки сточных вод при помощи активного ила используется в различных аппаратах, включая метантенки. Данное направление получает развитие за счет ряда преимуществ этого способа. Уровень производства аппаратуры для очистки сточной воды в России напрямую зависит от развития очистных установок. Целью исследования является изучение процесса работы метантенка, его разновидности, а также проведение анализа лидирующих фирм-производителей метантенков в России.

Ключевые слова: метантенк, метановое сбраживание, сбраживание, активный ил, перекрытие, преимущества, недостатки.

In today’s world, the issue of water treatment and waste treatment is acute. Organic waste and biological sludge are particularly difficult to treat. At the moment there are various devices that can cope with this task, but not many of them are able to release a useful fraction in the purification process. One of such devices is a digester,

which yields a useful product – biogas, which in turn is a raw material for industrial processes.

A methane digester is a facility that is a tank for digestion of organic waste and biological sewage sludge. They are used in municipal, industrial and local wastewater treatment plants

Methane digestion is the process of breaking down organic compounds to simple substances, resulting in the release of gas. Fats and proteins are mainly broken down with a high release of methane, and carbohydrates with a high release of carbon dioxide. The mixture of these gases is called biogas. The decomposition process occurs as a result of anaerobic microorganisms [1].

Digesters digest:

- primary settling tank sludge;
- activated sludge;
- a mixture of activated sludge and sludge.

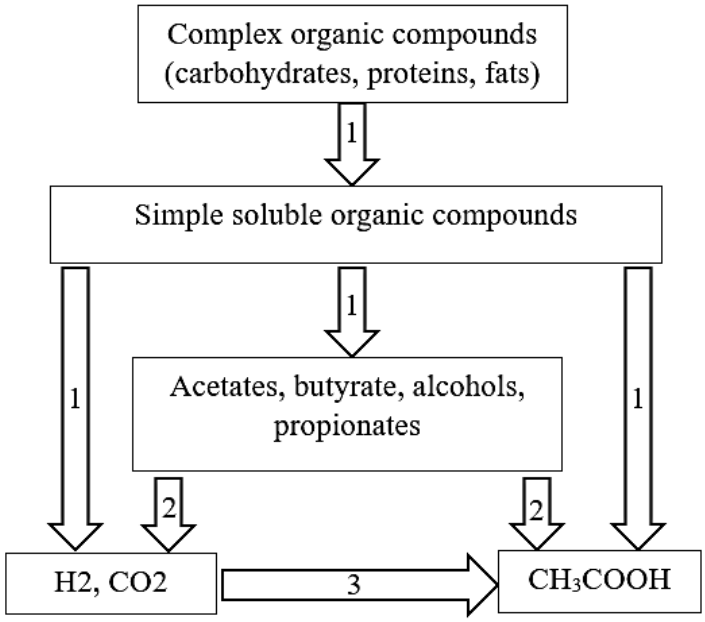


Figure 1. Fermentation process

Digestion is divided into several stages (Figure 1):

1. Enzymatic hydrolysis of undissolved complex organic matter, to form simpler dissolved substances [2, p. 34].

2. Acid formation – with the release of short-chain volatile fatty acids, amino acids, alcohols, and hydrogen and carbon dioxide.

3. Acetogenic stage in which volatile fatty acids, amino acids and alcohols are converted into acetic acid, dissociating into an acetate anion and a hydrogen cation [3].

There are two modes of digester operation:

- mesophilic – at temperature t = 33°C;
- thermophilic – at temperature t = 53°C.

There are two types of digester according to constructional features:

- with a fixed flooded slab;
- with a movable slab.

The most widespread in domestic practice are digesters with fixed slabs (Figure 2).

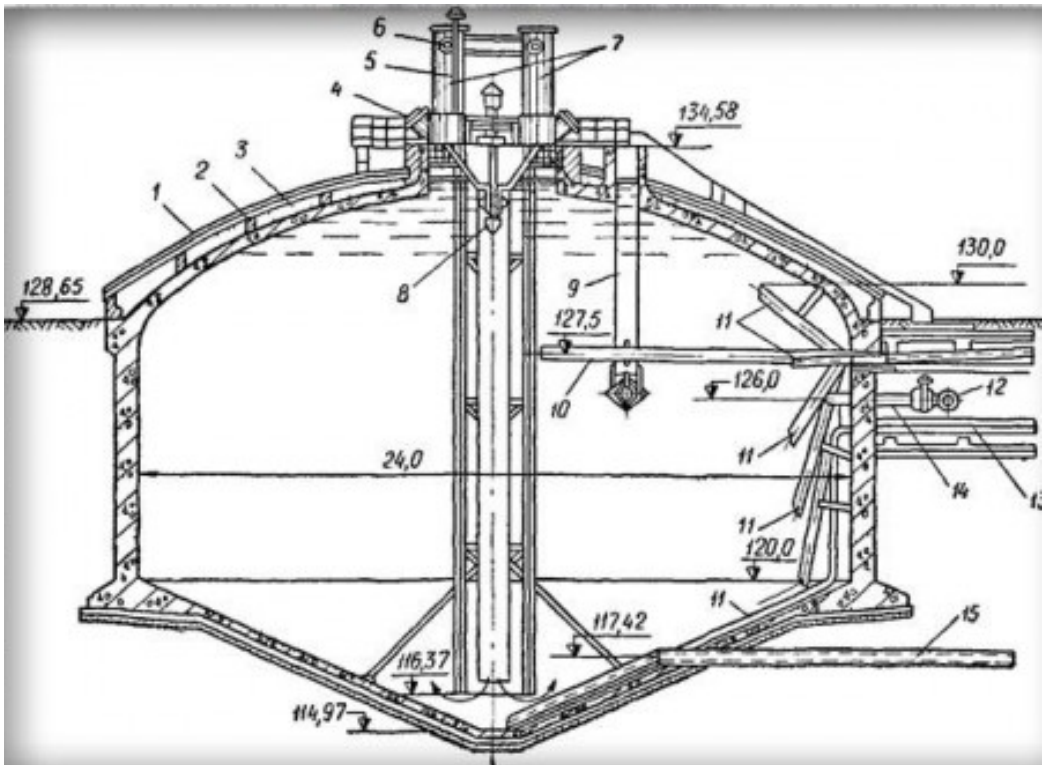


Figure 2. Diagram of a digester with fixed flooded slab

Sludge and activated sludge are piped into the digester from above. To speed up the fermentation process, the digester is heated and the contents are stirred. Heating is carried out by a water or steam radiator. In the absence of oxygen, fatty acids are formed from organic substances (fats, proteins, etc.), from which methane and carbon dioxide are formed during further fermentation [4, p. 59].

The digested sludge with high moisture content is removed from the lower part of the digester and sent for drying (e.g. sludge pads). The resulting gas is vented through pipes in the roof of the digester. One cubic meter of sludge in the digester produces 12-16 cubic meters of gas, of which about 70 % is methane.

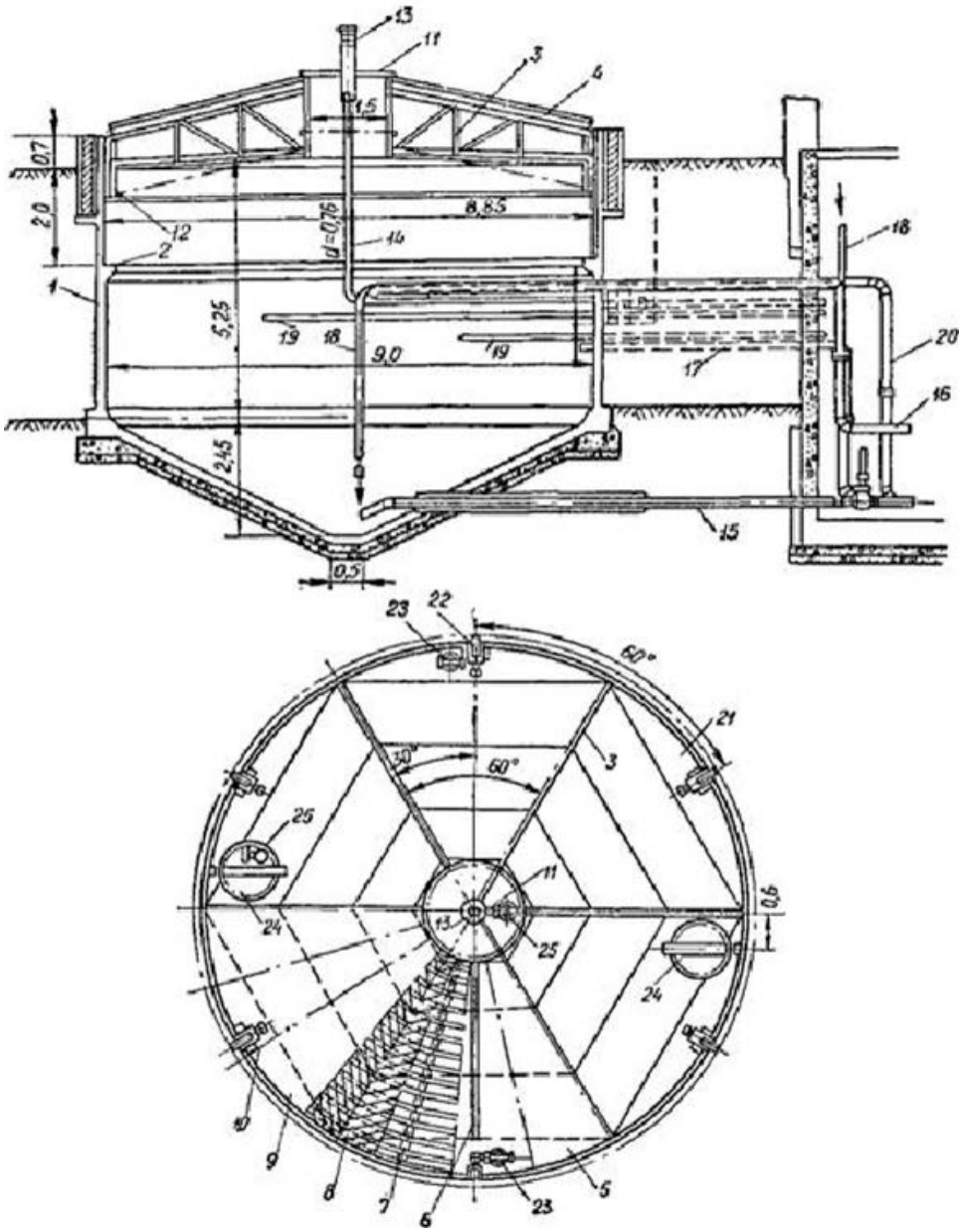


Figure 3. Floating slab digester

Among the advantages of floating slab digesters (Figure 3) are their explosion safety and the possibility to control sludge loading and unloading according to the height position of the floating slab. However, their use is limited, as the large mirror of the fermenting mass creates favorable conditions for the formation of crusts. In addition, at low air temperatures, the movement of the floating slab along the guide rollers becomes difficult due to freezing.

The analysis of the apparatuses in the form of identification of advantages and disadvantages depending on the type of digestion and type of construction is given in Tables 1.1 and 1.2 respectively.

Table 1.1 – Advantages and disadvantages by digestion mode

Type of digestion	Advantages	Disadvantages
Mesophilic	The sludge is well fermented and can be dehydrated better; less heat consumption compared to thermophilic digestion	Larger facilities required; sludge is not fully decontaminated
Thermophilic	Greater intensity of organic matter decomposition; the process lasts half as long as mesophilic process, thus reducing the size of the plant; better sludge disinfection is achieved	Low water holding capacity of the digested sludge, which requires flushing of the facility for subsequent dewatering; large amounts of heat are required

Table 1.2 – Advantages and disadvantages by types of construction

Type of construction	Advantages	Disadvantages
With fixed flooded slab	Simple design and maintenance	Light impurities accumulate on the surface and form a “crust” that interferes with normal operation; pressure fluctuations inside the digester, which can lead to cracks in the housing
With movable slab	No crusting of light impurities; the sludge dose can be accurately fixed due to the slab’s mobility; explosion safety	Complex design, expensive to maintain

Table 2 – Characteristics of leading companies producing digesters in Russia

Parameter	JSC Center “EcoRos”	PF “Fluid”
Reactor volume	2,2 m^3	5 m^3
Daily volume of waste treated	0,05 – 0,2 t/day	0,3 t/day
Daily volume of biogas	3 – 12 m3/day	15 m3/day
Methane content	55 – 60 %	70 %
Mode of operation	Thermophilic	Mesophilic
Equivalent to 1 m^3 of biogas	0,4 l gasoline 1,2 kg firewood	0,6 – 0,8 l gasoline 1,3 – 1,7 kg firewood
Cost	650880 rub.	1422750 rub.

The tables were compiled by the author on the basis of [5, 6].

Comparing the characteristics of the two companies in Table 2, producing digesters, we can conclude that the equipment produced by PF “Fluid” is the best on the market at present, because the methane content in the biogas produced is higher and the productivity is proportional, provided that the digester of PF “Fluid” operates in mesophilic mode.

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УДК 004.9

APPLICATION OF THE PLOTLY LIBRARY OF THE PYTHON PROGRAMMING LANGUAGE IN DATA ANALYSIS

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Abstract. Nowadays data analysis plays a key role in the development of science, business, medicine. This article deals with the application of modern and powerful data analysis tool, Plotly library of Python programming language. The main attention is paid to the capabilities of this library and its ease of use.

Keywords: analysis, graph, library, data, technology, visualization, funnel.

ПРИМЕНЕНИЕ БИБЛИОТЕКИ PLOTLY ЯЗЫКА ПРОГРАММИРОВАНИЯ PYTHON В АНАЛИЗЕ ДАННЫХ

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Аннотация. В наше время анализ данных играет ключевую роль в развитии науки, бизнеса, медицины. В статье рассматривается прикладное применение современного и мощного инструмента анализа данных – библиотеки Plotly языка программирования Python. Основное внимание уделяется возможностям данной библиотеки и простоте ее применения.

Ключевые слова: анализ, график, библиотека, данные, технологии, визуализация, воронка.

Today’s world is overflowing with vast amounts of data, and data analysis has become an integral part of many fields, including business, science, medicine, and many others. Successful data analysis requires tools that not only provide powerful computational capabilities, but also facilitate clear and interactive visualization of the results. One such tool is the Plotly library, which is part of the Python programming language ecosystem.

The history of the Plotly library is remarkably intertwined with the evolution of data visualization and the development of programming tools. Plotly was developed

by Plotly Technologies Inc. to provide analysts and data scientists with a powerful and flexible tool for creating interactive graphs and data visualization.

Plotly's first steps were taken in the early 2010s, when the company started working on the library in response to the growing demand for real-time data analysis and visualization tools. Plotly was one of the first libraries to provide the ability to create interactive graphs using the Python programming language, an important step in the evolution of data analysis. Over time, Plotly has evolved extensively, adding new features and support for various programming languages such as R and JavaScript [1].

Today, the Plotly library provides many features for creating interactive graphs and data visualization in a variety of programming languages, including Python, R, and JavaScript.

The main features and capabilities of the Plotly library:

- Ability to create a variety of chart types. Plotly supports the creation of many different chart types, including line graphs, pie charts, bar charts, bar graphs, histograms, heat maps, scatter plots, and more. This allows analysts to choose the best way to visualize data for their specific needs.
- Interactivity. One of the main features of Plotly is the ability to create interactive graphs. Users can interact with the graphs, zoom in and out, hover the mouse to view detailed information, and customize the display of data.
- Multiple programming languages support. Plotly provides APIs for Python, R and JavaScript. This means you can use Plotly in your projects regardless of the language you prefer.
- Integration with popular frameworks and tools. Plotly integrates with popular frameworks and tools such as Jupyter Notebooks, Dash (for building interactive web applications), and various data storage and analytics systems, making it usable in different scenarios.
- Cloud support and web services. The library provides the ability to create and store graphs in cloud services, which facilitates collaborative work on data visualization and their publication on the web.
- Open source and active community. The Plotly library is open source, and an active community of developers is constantly working to improve it. This means that the library is constantly being developed and updated.
- Multi-platform support. Users can use Plotly on different platforms, including Windows, macOS and Linux. [2]

Despite such extensive features, the library also has a number of drawbacks:

The first disadvantage is a limited set of charts. The high-level API does not allow to create charts of any type, so some users may need to use additional tools such as Cufflinks or Express.

There is also a compatibility issue. Some users have reported problems loading the library in certain environments, such as VS Code. This programming environment is one of the most popular among programmers, so many users can use an analog of this library compatible with Visual Studio Code.

Let’s consider some examples of Plotly library application. Often in data analysis it is necessary to consider large correlation tables, but because of their size it becomes quite difficult to identify the necessary relationships, so in such cases it is necessary to use visualizations. An example using Plotly is shown in Figure 1.

Program code:

```
import plotly.express as px
z = [[.1, .3, .5, .7, .9],
    [1, .8, .6, .4, .2],
    [.2, 0, .5, .7, .9],
    [.9, .8, .4, .2, 0],
    [.3, .4, .5, .7, 1]]
fig = px.imshow(z, text_auto=True)
fig.show()
```

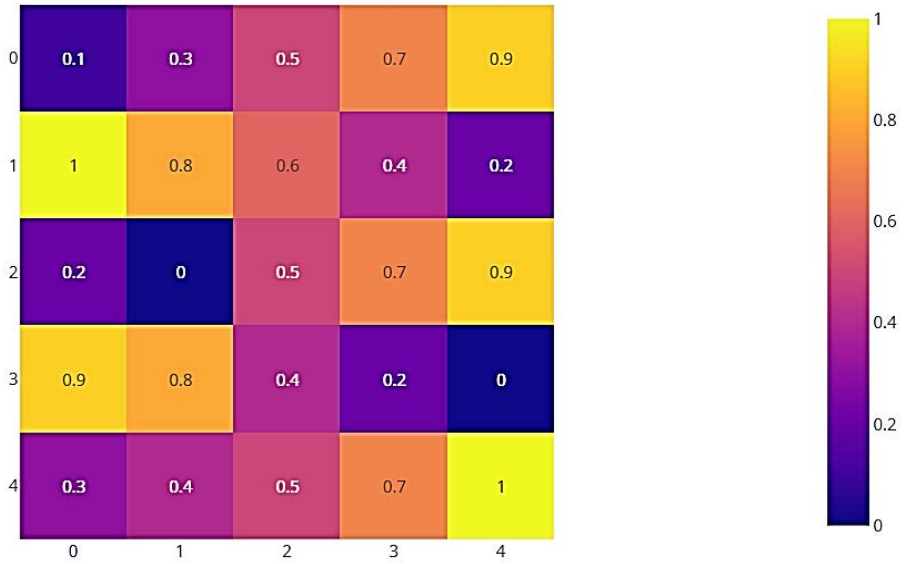


Figure 1. Heat map in Plotly

Another popular task in data analysis is to look at product funnels. Such funnels are built when you need to consider how many users reach the next step, for example, when buying a product through an online store. Plotly has handy tools to visualize this type of task clearly [3].

Program code:

```
from plotly import graph_objects as go
fig = go.Figure(go.Funnel(
    y = ["Website visit", "Downloads", "Potential customers", "Requested price",
"invoice sent"],
```

```
    x = [39, 27.4, 20.6, 11, 2]))
fig.show()
```

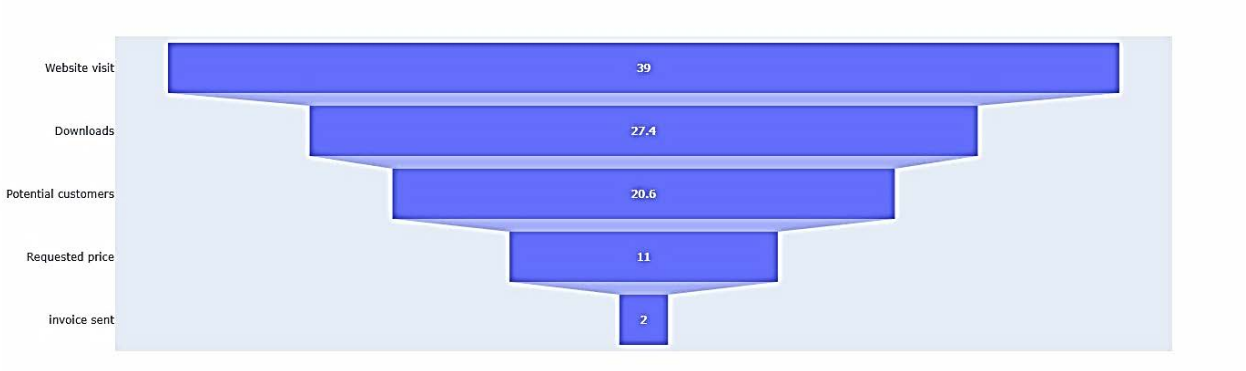


Figure 2. Product funnel in Plotly

Figure 2 shows an example of building a product funnel using Plotly. You can also notice that when you move the cursor over the funnel, a block with information showing the percentage of users in this funnel from the total number of users, as well as from the previous funnel appears. The visualization turned out to be quite clear, with its help you can easily identify a problematic step, where too many users were lost [4].

The library can also be useful for drawing scatter plots. Scatter plots, also known as dot plots, are mathematical diagrams that display the values of two variables as points on a Cartesian plane. They are used to demonstrate the presence or absence of correlation between two variables. If one parameter is assumed to be dependent on another, the values of the independent parameter are plotted on the horizontal axis and the values of the dependent parameter are plotted on the vertical axis. Scatter plots are useful for identifying potential relationships between quantitative variables and allow visual assessment of the distribution of data [5].

Program Code:

```
import plotly.express as px
import numpy as np
mean = [0, 0]
cov = [[1, 0.7], [0.7, 1]]
x_values, y_values = np.random.multivariate_normal(mean, cov, 200).T
fig = px.scatter(x=x_values, y=y_values)fig.show()
```

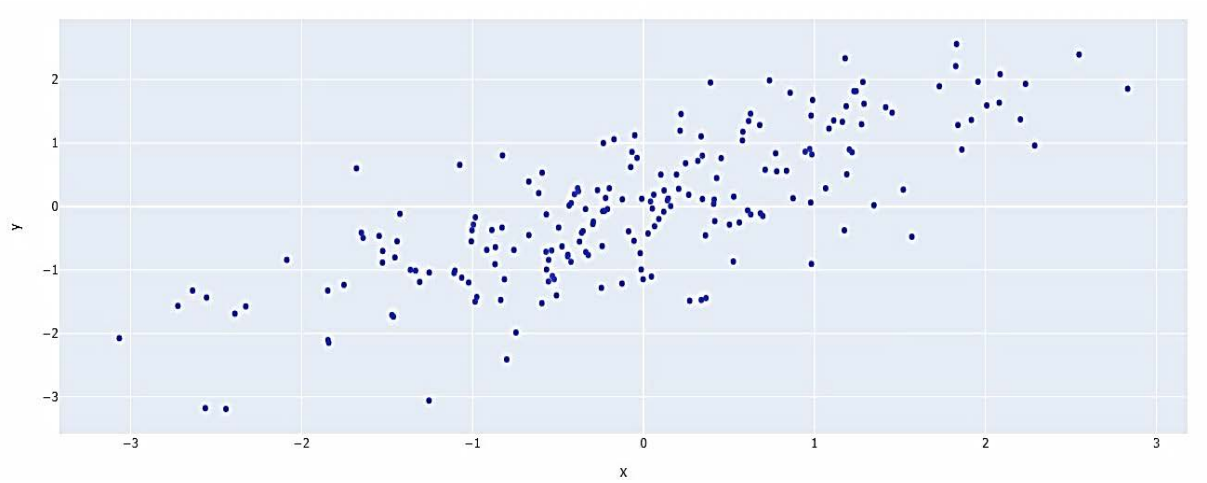


Figure 3. Scatter diagram in Plotly

Of course, this library is able to build both specific graphs and ordinary graphs, for example, time graphs (Figure 4). Using this library allows you to make the graph interactive. When pointing, information on the given time interval will appear.

Program Code:

```
df = pd.read_csv('https://raw.githubusercontent.com/plotly/datasets/master/finance-charts-apple.csv')


fig = go.Figure([go.Scatter(x=df['Date'], y=df['AAPL.High'])])

fig.show()
```



Figure 4. Time Series graph

In summary, the Plotly tool library is a powerful tool for creating interactive and informative data visualizations. The library demonstrates its ability to present complex data in a convenient and accessible form, as well as to provide interaction with the

results of analysis. This makes it a valuable tool for researchers and data analysis professionals alike, making it easier to understand data, identify trends and important patterns. It not only lowers the threshold of entry into the world of data analysis, but also opens the door to creating compelling visual stories about data.

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2024 ● Часть I

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Дата подписания к использованию 08.02.2024. Изд. № 5213/23

Высшая школа технологии и энергетики СПбГУПТД
198095, СПб., ул. Ивана Черных, 4.