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VALUE-ORIENTED MANAGEMENT OF DIGITALIZATION IN HIGH-TECH PROJECTS

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Abstract. As organizations increasingly embrace digitalization to enhance their operations and competitiveness, high-tech projects play a pivotal role in driving innovation and technological advancements. This paper explores the significance of value-oriented management in the context of digitalization within high-tech projects. The research focuses on understanding how organizations can effectively leverage digital technologies to create value, mitigate risks, and optimize project outcomes. The study employs a multidisciplinary approach, drawing on principles from project management, technology management, and strategic management. It investigates the integration of digital technologies, such as artificial intelligence, Internet of Things, and data analytics, into high-tech projects and assesses their impact on project value creation. Through a comprehensive review of literature, case studies, and interviews with industry experts, the paper identifies key success factors and challenges associated

with managing digitalization in high-tech projects. The concept of value-oriented management is examined in depth, emphasizing the need for a holistic framework that aligns project goals with organizational objectives. The paper introduces a model for value assessment, encompassing both tangible and intangible aspects, to guide decision-makers in evaluating the effectiveness of digitalization efforts in high-tech projects. Furthermore, the research explores the role of leadership, organizational culture, and stakeholder engagement in fostering a value-oriented approach to digitalization. It highlights the importance of creating a conducive environment that encourages collaboration, innovation, and adaptability to navigate the dynamic landscape of high-tech projects. The findings of this study contribute to the theoretical understanding of value-oriented management in the context of digitalization within high-tech projects. Practical implications and recommendations are provided for project managers, executives, and policymakers seeking to enhance the success of digital initiatives in the high-tech sector. Ultimately, the paper aims to provide insights that can guide organizations in maximizing the value derived from their digitalization efforts in the rapidly evolving landscape of high-tech projects.

Keywords: Digitalization, High-tech projects, Value-oriented management, Project management, Value creation

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Аннотация. Ұйымдар өздерінің операциялық қызметі мен бәсекеге қабілеттілігін арттыру үшін цифрлық технологияларға көбірек ауысып жатқандықтан, жоғары технологиялық жобалар инновациялар мен технологиялық прогресті

ынталандыруда шешуші рөл атқарады. Бұл мақалада жоғары технологиялық жобалар шеңберіндегі цифрландыру контекстіндегі құндылыққа бағытталған менеджменттің маңызы зерттеледі. Зерттеу ұйымдардың құндылық жасау, тәуекелдерді азайту және жоба нәтижелерін оңтайландыру үшін цифрлық технологияларды қалай тиімді пайдалана алатынын түсінуге бағытталған. Зерттеу жобаларды басқару, технологияларды басқару және стратегиялық менеджмент принциптеріне негізделген пәнаралық тәсілді қолданады. Ол жасанды интеллект, Заттар интернеті және деректерді талдау сияқты цифрлық технологиялардың жоғары технологиялық жобаларға интеграциясын зерттейді және олардың жоба құндылығын құруға әсерін бағалайды. Әдебиеттерді жан-жақты шолу, жағдайлық зерттеулер және салалық сарапшылармен сұхбат негізінде құжатта табыстың негізгі факторлары және жоғары технологиялық жобалардағы цифрландыруды басқарумен байланысты проблемалар анықталды. Құндылыққа бағытталған басқару тұжырымдамасы жобаның мақсаттарын ұйымның міндеттерімен үйлестіретін біртұтас құрылымның қажеттілігін көрсете отырып, егжей-тегжейлі қарастырылады. Құжатта жоғары технологиялық жобаларда цифрландыру бойынша күш-жігердің тиімділігін бағалау кезінде шешім қабылдаушыларға басшылық ету үшін материалдық және материалдық емес аспектілерді қамтитын құндылықты бағалау моделі келтірілген. Сонымен қатар, зерттеу көшбасшылықтың, ұйымдастырушылық мәдениеттің және мүдделі тараптардың цифрландыруға құндылыққа бағытталған көзқарасты дамытуға қатысуының рөлін зерттейді. Бұл жоғары технологиялық жобалардың динамикалық ландшафтын шарлау үшін ынтымақтастықты, инновацияны және бейімделуді ынталандыратын қолайлы ортаны құрудың маңыздылығын көрсетеді. Бұл зерттеудің нәтижелері жоғары технологиялық жобалар шеңберіндегі цифрландыру контекстіндегі құндылыққа бағытталған басқаруды теориялық түсінуге ықпал етеді. Жоғары технологиялар секторындағы цифрлық бастамалардың жетістігін арттыруға ұмтылатын жоба менеджерлеріне, топ-менеджерлерге және саясаткерлерге практикалық қорытындылар мен ұсыныстар беріледі. Сайып келгенде, бұл құжаттың мақсаты — ұйымдарға жоғары технологиялық жобалардың тез өзгеретін ландшафтында цифрландыру бойынша күш-жігерін барынша арттыруға көмектесетін ақпарат беру.

Түйін сөздер: цифрландыру, жоғары технологиялық жобалар, құндылыққа бағдарланған менеджмент, жобаларды басқару, құндылық құру

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ЦЕННОСТНО-ОРИЕНТИРОВАННОЕ УПРАВЛЕНИЕ ЦИФРОВИЗАЦИЕЙ В ВЫСОКОТЕХНОЛОГИЧНЫХ ПРОЕКТАХ

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Аннотация. Поскольку организации все чаще используют цифровизацию для повышения своей операционной деятельности и конкурентоспособности, высокотехнологичные проекты играют ключевую роль в стимулировании инноваций и технологических достижений. В этой статье исследуется значение управления, ориентированного на ценности, в контексте цифровизации в рамках высокотехнологичных проектов. Исследование сосредоточено на понимании того, как организации могут эффективно использовать цифровые технологии для создания ценности, снижения рисков и оптимизации результатов проектов. В исследовании используется междисциплинарный подход, основанный на принципах управления проектами, управления технологиями и стратегического менеджмента. В нем исследуется интеграция цифровых технологий, таких как искусственный интеллект, Интернет вещей и аналитика данных, в высокотехнологичные проекты и оценивается их влияние на создание ценности проекта. На основе всестороннего обзора литературы, тематических исследований и интервью с отраслевыми экспертами в документе определены ключевые факторы успеха и проблемы, связанные с управлением цифровизацией в высокотехнологичных проектах. Концепция управления, ориентированного на ценности, подробно рассматривается, подчеркивая необходимость целостной структуры, которая согласовывает цели проекта с задачами организации. В документе представлена модель оценки ценности, охватывающая как материальные, так и нематериальные аспекты, для руководства лицами, принимающими решения, при оценке эффективности усилий по цифровизации в высокотехнологичных проектах. Кроме того, в исследовании исследуется роль лидерства, организационной культуры и вовлечения заинтересованных сторон в развитие ценностно-ориентированного подхода к цифровизации. В

нем подчеркивается важность создания благоприятной среды, поощряющей сотрудничество, инновации и адаптивность для навигации в динамичном ландшафте высокотехнологичных проектов. Результаты этого исследования способствуют теоретическому пониманию ценностно-ориентированного управления в контексте цифровизации в рамках высокотехнологичных проектов. Приводятся практические выводы и рекомендации для руководителей проектов, топ-менеджеров и политиков, стремящихся повысить успех цифровых инициатив в секторе высоких технологий. В конечном счете, цель статьи — предоставить информацию, которая может помочь организациям максимизировать ценность, получаемую от их усилий по цифровизации, в быстро меняющемся ландшафте высокотехнологичных проектов.

Ключевые слова: Цифровизация, высокотехнологичные проекты, ценностно-ориентированный менеджмент, Управление проектами, создание ценности

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Introduction

In the contemporary landscape of rapid technological advancement and digital transformation, high-tech projects stand as the vanguards of innovation, driving organizations towards increased efficiency, competitiveness, and growth. As industries across the globe embrace digitalization, the management of high-tech projects becomes a critical focal point for ensuring successful integration and realization of value. This introduction sets the stage for an exploration into the intricacies of value-oriented management within the context of digitalization in high-tech projects.

The convergence of advanced technologies, such as artificial intelligence, the Internet of Things (IoT), and data analytics, has propelled high-tech projects into uncharted territories. The dynamic nature of these projects necessitates a comprehensive and adaptive management approach that goes beyond traditional project management methodologies. In this context, value-oriented management emerges as a guiding principle that seeks to align digitalization efforts with the overarching goals of the organization, emphasizing the creation of tangible and intangible value.

The digitalization of high-tech projects not only presents unprecedented opportunities but also introduces a myriad of challenges. Organizations grapple with issues ranging from risk mitigation in the face of evolving technologies to the seamless integration of digital tools into existing workflows. Recognizing these complexities, this research endeavors to delve into the multifaceted dimensions of value-oriented management, offering insights into how organizations can navigate the digital landscape to maximize the benefits of their high-tech endeavors.

This study adopts a multidisciplinary lens, amalgamating perspectives from project management, technology management, and strategic management to construct a holistic

framework for value assessment. By synthesizing theoretical insights, real-world case studies, and expert interviews, the research aims to distill key success factors and illuminate potential pitfalls in the pursuit of value through digitalization in high-tech projects.

The subsequent sections will unfold the layers of value-oriented management in digitalization, exploring the integration of cutting-edge technologies, evaluating project outcomes, and delineating the role of leadership and organizational culture in fostering a conducive environment for value creation. Through this exploration, the paper aspires to offer practical guidance for project managers, executives, and decision-makers engaged in high-tech projects, contributing to the broader discourse on effective digitalization strategies in the ever-evolving landscape of technology-driven initiatives.

Material and methods

Digitalization supports production value creation logic in construction, but creates challenges for project value creation logic by hindering mutual adjustment in practices, and commodifies information, shifting coordination contexts and affecting management and policy (Blštáková et al., 2020). The paper (Bushuyev et al., 2023) presents a Value Management Framework for Green Digital Marketing projects, integrating value processes and techniques, and addressing risk inherence, aiding decision-making and addressing uncertainty related to digitalization and sustainability. Digital technologies can enhance strategic execution and value-driven process management by enhancing business processes and enhancing strategic alignment (Çıdık et al., 2022). Digitalization-driven service marketing can increase relative profitability by promoting value co-creation and resource integration, leading to cost-efficient co-creation services (Kindermann et al., 2020). Digitalization transforms corporate people management, with meaningfulness, communication, and cooperation being key to business sustainability, regardless of the company's size, focus, or performance (Kirchmer, 2017). Digital service innovation projects face four main challenges: shared objectives, joint design, project management across organizational boundaries, and combining agile organizing approaches (Kuula et al., 2018). Digital orientation is a new strategic orientation construct that captures an organization's approach to digital innovation and transformation initiatives, and is linked to firm performance in large US firms (Peñarroya-Farell et al., 2021). The article (Simonsson et al., 2018) is dedicated to the study of impact of a BANI-world conditions to implementation of the high technology industrial projects and in particular of the nuclear industry projects. The purpose of the article is to analyze tendencies of changes of different factors related to the high technology nuclear project implementation against the changing conditions of the environment. The object is the project management methodologies in the BANI environment. This study clarifies the terms Business Model Innovation, Adaptation, and Evolution to better align their evolution with strategic value appropriation in a VUCA environment (Zaidouni et al., 2019).

Conceptual model of research

In the digital era, the value of created high-tech products must be harmonized, taking into account all its key aspects. Responsibility becomes the highest priority for businesses, so the commercial value of products based on new technologies is no longer

the primary decision-making criterion. If certain aspects of the value of such products raise doubts and cannot be acceptable in light of modern requirements, there is a need to modify the products to ensure value harmonization.

Thus, the task of evaluating value, considering its multi-aspect nature in the digital era, emerges as the first step in deciding on the acceptability of new products based on emerging technologies. The diagram in Fig. 1 illustrates the concept of evaluating the value of AI products in the processes of its harmonization.

Within the realm of high-tech projects, the effective leverage of digital technologies is a pivotal factor in determining the success and impact of these initiatives. Digital technologies, ranging from artificial intelligence to the Internet of Things and data analytics, offer organizations unprecedented opportunities to create value across various dimensions.

This section provides a deeper exploration into how organizations can strategically harness these technologies to enhance their value propositions. Structure of conceptual model values creation presented on Fig. 1.

The acceptance of evaluation aspects is not equivalent, leading to the need for establishing a priority system. Any evaluation is meaningless without the establishment of permissible levels, so permissible levels should be set for each direction (evaluation point) of value. If the components of value fall below permissible levels, the high-tech product requires specific modifications in this context to ensure value harmonization. If all components of the value of a high-tech product meet the minimum permissible thresholds, then this product can be introduced to the market.

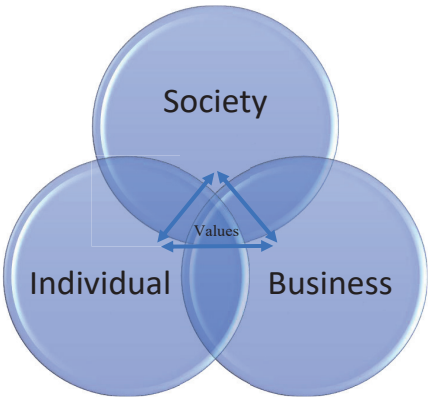

Figure 1- “Structure of conceptual model values creation and migration”

The triangle connecting the elements of the model with arrows determines the complementary values of the system.

To assess value in the digital age, it is proposed to use the following formula:

$$V = \sum_{i=1}^{3} \beta_i \left[\sum_{k=1}^{K_i} \alpha_i^k \cdot S_i^k \right] \qquad (1)$$

where $0 \le V \le 1$ - total value,

$0 < \beta_i < 1, i = \overline{1,3}$ - priority of each element of structure (individual, business, social),

$0 < \alpha_i^k < 1, k = \overline{1, K_i}$ - priority of aspects per each element (Table 1);

$K_i, i = \overline{1,3}$ number of value aspects for each direction;

According to the generally accepted approach for priorities (weights), the following conditions must be met:

$$\sum_{i=1}^{3} \beta_i = 1, \quad (2)$$

$$\sum_{k=1}^{K_i} \alpha_i^k = 1, i = \overline{1,3}. \quad (3)$$

$0 \le S_i^k \le 1$ assessment of the value of a product from the point of view of each aspect of value is established by expert means (which gives a rather subjective view, taking into account the characteristics of experts), or, which is the most rational, is assessed by artificial intelligence, which must have some basis for comparison and comparison in the form of a set of judgments reflecting the attitude of modern humanity to certain aspects of digital technologies and high-tech products.

Taking into account the three directions of value assessment — individual, society and business, it is not even the final assessment of value that is of greater interest, but its three components:

$$V_i = \sum_{k=1}^{K_i} \alpha_i^k \cdot S_i^k, i = \overline{1,3} \quad (4)$$

The assessment of priorities was formed in Table 1 based on the assessment of the average value of 14 experts in the field of high-tech projects.

Table 1- "Key aspects, organizations can navigate the complexities of digitalization in high-tech projects and proactively work"

№	Name of aspect	Explanation	Priority (1-10)
1	*Strategic Integration of Digital Technologies.*	Organizations must strategically identify and integrate digital technologies that align with their overall business strategy and objectives. A thoughtful evaluation of how specific technologies can enhance operational efficiency, product/service innovation, and customer experience is crucial.	8
2	*Value Proposition Alignment*	Digitalization efforts should be directly tied to creating value for both the organization and its stakeholders. Understanding the specific needs and expectations of customers, employees, and other relevant stakeholders is essential for tailoring digital solutions that truly add value.	9
3	*Agile Implementation Strategies.*	High-tech projects often operate in fast-paced, dynamic environments. Agile methodologies can be instrumental in adapting to changing requirements and technologies. Incremental implementation allows organizations to continuously assess and adjust their strategies based on real-time feedback.	8

4	*Data-Driven Decision Making.*	The abundance of data generated through digital technologies provides organizations with valuable insights. Establishing robust data analytics capabilities enables informed decision-making, helping organizations identify trends, optimize processes, and uncover new opportunities for value creation.	7
5	*User-Centric Design.*	Prioritizing user experience is paramount. Whether developing new products, services, or internal systems, a user-centric design approach ensures that digital solutions resonate with end-users, enhancing overall satisfaction and adoption rates.	7
6	*Risk Mitigation Strategies*	The integration of digital technologies introduces inherent risks such as cybersecurity threats and technological obsolescence. Organizations must proactively implement robust risk mitigation strategies to safeguard against potential disruptions.	6
7	*Collaborative Ecosystems.*	Leveraging digital technologies often involves collaboration with external partners, suppliers, and even competitors. Building collaborative ecosystems can amplify the value derived from shared resources, knowledge, and innovation.	7
8	*Measurable Key Performance Indicators (KPIs).*	Establishing clear and measurable KPIs is essential for assessing the success of digitalization efforts. KPIs should align with overarching business objectives and provide a quantifiable means of evaluating the value generated through digital initiatives.	8

Sourse: authors

By addressing these aspects, organizations can navigate the complexities of digitalization in high-tech projects and proactively work towards creating tangible and sustainable value. The subsequent sections of this research will delve into specific case studies, theoretical frameworks, and practical insights to further elucidate the strategies and considerations associated with value-oriented management in the digital age.

Conclusion

In conclusion, the dynamic landscape of high-tech projects necessitates a strategic and value-oriented approach to digitalization for organizations to thrive in the face of technological disruption and rapid innovation. This research has delved into the multifaceted dimensions of managing digitalization in high-tech projects, emphasizing the imperative of creating tangible and intangible value. The strategic integration of digital technologies emerged as a cornerstone for success, with organizations being urged to align their digitalization efforts with overarching business strategies. The effective leverage of technologies such as artificial intelligence, the Internet of Things, and data analytics was identified as a key driver for enhancing operational efficiency, fostering innovation, and ultimately creating value across various facets of high-tech projects.

A user-centric design approach and the adoption of agile methodologies were underscored as critical elements in ensuring that digital solutions not only meet the evolving needs of end-users but also adapt to the rapidly changing technological landscape. Moreover, the establishment of robust data analytics capabilities emerged as a linchpin for informed decision-making, providing organizations with the insights needed to optimize processes and uncover new avenues for value creation. The research

also highlighted the importance of risk mitigation strategies, as the integration of digital technologies introduces inherent risks such as cybersecurity threats and technological obsolescence. Organizations were encouraged to adopt a proactive stance in addressing these challenges to safeguard against potential disruptions to high-tech projects.

Collaborative ecosystems were identified as an avenue for amplifying the value derived from digital initiatives, emphasizing the need for organizations to engage with external partners, suppliers, and competitors in a mutually beneficial manner. As organizations embark on their digitalization journeys within the high-tech landscape, the establishment of measurable key performance indicators (KPIs) was advocated to gauge the success of digital initiatives and ensure alignment with overarching business objectives. In practical terms, this research contributes valuable insights and recommendations for project managers, executives, and decision-makers engaged in high-tech projects. By adopting a value-oriented management approach, organizations can navigate the complexities of digitalization, capitalize on emerging opportunities, and position themselves as leaders in the rapidly evolving high-tech sector.

In essence, the value-oriented management of digitalization in high-tech projects is not merely a strategy; it is a dynamic mindset that empowers organizations to embrace change, foster innovation, and create sustainable value in an era defined by technological advancements. As the high-tech landscape continues to evolve, organizations that prioritize value-oriented management will be better positioned to navigate uncertainties, capitalize on opportunities, and emerge as trailblazers in the digital age.

The further research

The conclusion of this research suggests several avenues for further exploration and investigation in the realm of value-oriented management of digitalization in high-tech projects. Here are potential areas for future research:

Long-Term Impact Assessment.

Conduct longitudinal studies to assess the long-term impact of digitalization efforts on high-tech projects. Understanding how value creation evolves over time can provide insights into the sustainability of digital strategies.

Cross-Industry Comparative Analysis.

Explore how value-oriented management principles vary across different high-tech industries. Comparative analyses can uncover industry-specific challenges, success factors, and best practices in managing digitalization.

Ethical Considerations in Digitalization.

Investigate the ethical implications of digitalization in high-tech projects. This could include issues related to privacy, security, bias in AI algorithms, and the ethical use of data. Understanding and addressing these concerns are crucial for responsible digitalization.

Cultural Impact on Digitalization.

Examine the influence of organizational culture on the success of digitalization initiatives in high-tech projects. Cultural factors, such as openness to innovation, risk tolerance, and collaboration, can significantly impact the effectiveness of digital strategies.

Human-Centric Approaches.

Explore methodologies and frameworks that prioritize the human element in digitalization. This could include studies on the impact of digitalization on the workforce, the role of employee training and development, and strategies for managing the human side of technological change.

Global Perspectives on Digitalization.

Investigate how digitalization strategies and value-oriented management practices vary in a global context. Factors such as regulatory environments, cultural differences, and market conditions can influence the implementation and outcomes of high-tech projects.

Dynamic Risk Management Strategies.

Research innovative and dynamic risk management strategies tailored to the ever-evolving landscape of high-tech projects. This could include adaptive risk assessment frameworks and real-time risk mitigation approaches.

Collaborative Innovation Networks.

Explore the formation and dynamics of collaborative innovation networks in the high-tech sector. Understanding how organizations collaborate and share resources to drive innovation can provide insights into ecosystem-based value creation.

Integration of Emerging Technologies.

Investigate how the integration of emerging technologies, beyond the current state, impacts value creation in high-tech projects. This could include the exploration of blockchain, quantum computing, and other cutting-edge technologies.

Post-Implementation Challenges.

Examine challenges that organizations face after the implementation of digitalization in high-tech projects. This could include issues related to system maintenance, upgrades, and ensuring the ongoing relevance of digital strategies.

By delving into these areas, researchers can contribute to a deeper understanding of the complexities and nuances surrounding the value-oriented management of digitalization in high-tech projects. This continued exploration is essential for guiding organizations in optimizing their digitalization efforts and staying at the forefront of technological innovation.

REFERENCE

Blštáková J., Joniaková Z., Jankelová N., Stachová K. & Stacho Z. (2020). Reflection of Digitalization on Business Values: The Results of Examining Values of People Management in a Digital Age. Sustainability. — *https://doi.org/10.3390/su12125202*.

Bushuyev S., Piliuhina K., Elams Chetin (2023). "Transformation of values of the high technology projects from a VUCA to a BANI environment model", Innovative Technologies and Scientific Solutions for Industries. — No. 2 (24). — Pp. 25–44. — *https://doi.org/10.30837/ITSSI.2023.24.025*

Çıdık M. & Boyd D. (2022). Value implication of digital transformation: the impact of the commodification of information. Construction Management and Economics, — 40. — Pp. 903–917. — *https://doi.org/10.1080/01446193.2022.2033287*.

Kindermann B., Beutel S., Lomana G., Strese S., Bendig D. & Brettel M. (2020). Digital orientation: Conceptualization and operationalization of a new strategic orientation. European Management Journal. — *https://doi.org/10.1016/j.emj.2020.10.009*.

Kirchmer M. (2017). Digital Technologies for Process Execution. — Pp. 47–65. — https://doi.org/10.1007/978-3-319-51259-4_3.

Kuula S., Haapasalo H. & Tolonen A. (2018). Cost-efficient co-creation of knowledge intensive business services. Service Business. — 12. — Pp. 779–808. — *https://doi.org/10.1007/S11628-018-0380-Y*.

Peñarroya-Farell M. & Miralles F. (2021). Business Model Dynamics from Interaction with Open Innovation. Journal of Open Innovation: Technology, Market, and Complexity. — https://doi.org/10.3390/JOITMC7010081.

Simonsson J. & Magnusson M. (2018). Collaboration Challenges in Digital Service Innovation Projects. Int. J. Autom. Technol. — 12. — Pp. 499–506. — *https://doi.org/10.20965/ijat.2018.p0499*.

Zaidouni A. & Idrissi M. (2019). A VALUE MANAGEMENT FRAMEWORK FOR GREEN DIGITAL MARKETING PROJECT. — 04. — Pp. 56–62. — https://doi.org/10.33564/ijeast.2019.v04i08.009.

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DIGITAL SOLUTION FOR CONNECTING VOLUNTEERS WITH ORPHANAGES AND NURSING HOMES

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Abstract. This article presents an overview and analysis of the digital solution "HelpingHands", developed for effective communication and cooperation of volunteers with orphanages and nursing homes. The Helping Hands solution is an innovative platform that provides an opportunity for volunteers and organizations to establish effective interaction to support those who need help. The article describes the functionality of HelpingHands, the platform provides convenience of interaction between volunteers and organizations, which contributes to more effective coordination of volunteer work. The goal of HelpingHands is to facilitate the volunteering process and improve the lives of children in orphanages and elderly people in nursing homes. The article emphasizes the importance of this digital solution in providing communication between volunteers and institutions, contributing to the creation of a strong and supported volunteer network for charity and social support.

Keywords: volunteering, digital platform, orphanages, nursing homes, social support, interaction of volunteers, organizations, network of volunteers, cooperation, charity, innovative solutions

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ЕРІКТІЛЕРДІ БАЛАЛАР МЕН ҚАРТТАРҒА КҮТІМ ЖАСАУ ОРТАЛЫҚТАРЫМЕН БАЙЛАНЫСТЫРУДЫҢ ЦИФРЛЫҚ ШЕШІМІ

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Аннотация. Бұл мақала еріктілердің балалар үйлерімен және қарттар үйлерімен тиімді байланысы мен ынтымақтастығы үшін әзірленген "HelpingHands" цифрлық шешіміне шолу мен талдауды ұсынады. Helping Hands шешімі еріктілер мен ұйымдарға көмекке мұқтаж адамдарды қолдау үшін тиімді өзара әрекеттесу мүмкіндігін қамтамасыз ететін инновациялық платформа болып табылады. Мақалада HelpingHands функционалдығы сипатталған, платформа еріктілер мен ұйымдар арасындағы өзара әрекеттесудің ыңғайлылығын қамтамасыз етеді, бұл еріктілер жұмысын тиімдірек үйлестіруге ықпал етеді. HelpingHands-тің мақсаты-еріктілік процесін жеңілдету және балалар үйлеріндегі балалар мен қарттар үйіндегі қарттардың өмірін жақсарту. Мақала қайырымдылық пен әлеуметтік қолдау үшін күшті және қолдау көрсетілетін еріктілер желісін құруға ықпал ете отырып, осы цифрлық шешімнің еріктілер мен мекемелер арасындағы байланысты қамтамасыз етудегі маңыздылығын көрсетеді.

Түйін сөздер: еріктілік, цифрлық платформа, балалар үйі, қарттар үйі, әлеуметтік қолдау, еріктілердің өзара әрекеті, ұйымдар, еріктілер желісі, ынтымақтастық, қайырымдылық, инновациялық шешімдер

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ЦИФРОВОЕ РЕШЕНИЕ ДЛЯ ВЗАИМОДЕЙСТВИЯ ВОЛОНТЕРОВ С ЦЕНТРАМИ ЗАБОТЫ О ДЕТЯХ И ПОЖИЛЫХ ЛЮДЯХ

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Аннотация. Данная статья представляет обзор и анализ цифрового решения "HelpingHands", разработанного для эффективной связи и сотрудничества волонтеров с детскими домами и домами престарелых. Решение Helping Hands представляет собой инновационную платформу, обеспечивающую возможность волонтерам и организациям установить эффективное взаимодействие для поддержки тех, кто нуждается в помощи. Статья описывает функционал HelpingHands: платформа обеспечивает удобство взаимодействия между волонтерами и организациями, что способствует более эффективной координации волонтерской работы. Статья подчеркивает значимость данного цифрового решения в обеспечении связи между волонтерами и учреждениями, способствуя созданию сильной волонтерской сети для благотворительности и социальной поддержки.

Ключевые слова: волонтерство, цифровая платформа, детские дома, дома престарелых, социальная поддержка, взаимодействие волонтеров, организации, сеть волонтеров, сотрудничество, благотворительность, инновационные решения

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Introduction

"HelpingHands" is a digital platform that has laid the foundations for more effective interaction between volunteers and institutions working with orphanages and nursing

homes. The platform aims to overcome the existing problems facing volunteering and simplify the process of finding and participating in important social projects. Orphanages and nursing homes play a crucial role in our society, serving as a refuge for those who need care, support and, above all, sincere compassion. These institutions provide shelter to vulnerable groups of the population who are looking for love and health, education and emotional well-being.

The relevance of our platform is to create an IT solution to meet the urgent need to connect volunteers to nursing homes and orphanages, optimize the recruitment process of volunteers and improve the quality of care and support provided.

The goal of this project is to offer an innovative solution that will bridge this communication gap and increase the effectiveness of volunteer activities. Our work is focused on developing the HelpHands platform, a digital ecosystem that connects volunteers with orphanages and nursing homes. This innovative platform is designed to optimize the process of recruiting and managing volunteers, which ultimately improves the quality of care and support provided to residents and beneficiaries. The main mission of the HelpHands platform is to solve this problem with the help of technology to create a more interconnected, compassionate and effective society that meets the needs of those who most deserve care and support.

The object of the study is a system for finding volunteers for nursing homes and orphanages using information technology.

The subject of this research is the development, implementation and evaluation of the platform as an innovative tool that uses information technology to improve the experience of volunteering and the quality of care and support provided to children and the elderly.

The novelty of this research lies in the creation of a specialized platform that not only acts as a digital bridge connecting volunteers with agencies, but also offers a user-friendly interface and functions adapted to the needs of users.

Material and methods

1. Literature review

Analysis of the article "User-Centered Development of a Web Platform Supporting Community-Based Health Care Organizations for Older Persons in Need of Support " (2021)

Ensuring dignified aging and providing care for older persons in need of support has become increasingly relevant. Community-based health care (CBHC) organizations play a crucial role in developing sustainable strategies for organizing and delivering care to older individuals. Digitalization is key to enhancing the efficiency and effectiveness of these organizations. This literature review examines the article "User-Centered Development of a Web Platform Supporting Community-Based Health Care Organizations for Older Persons in Need of Support: Qualitative Focus Group Study," which is part of the European Active and Assisted Living (AAL) project known as "ICareCoops." The article explores the concepts, approaches, and workflows of CBHC organizations to gain a comprehensive understanding of their services and the requirements for supporting them through information and computer technology (ICT) solutions.

One of the central aspects of the study is its commitment to a user-centered approach. By involving various stakeholders, including care receivers, their significant others, and care providers, the research recognizes the importance of considering the needs and preferences of the end users in the development of ICT solutions for CBHC organizations. This aligns with best practices in information systems development, emphasizing user engagement and co-design as critical factors for successful implementation.

The study reveals that the needs and requirements of the three stakeholder groups vary significantly. Care receivers prioritize accessibility and ease of use, emphasizing the importance of user-friendly interfaces. Significant others are concerned with the platform's ability to facilitate communication and coordination, supporting their involvement in the care process. In contrast, care providers and managers focus on the platform's ability to streamline operations, optimize resource allocation, and enhance service quality. These diverse perspectives underscore the complexity of designing a web platform that can satisfy the demands of all stakeholders.

The article "User-Centered Development of a Web Platform Supporting Community-Based Health Care Organizations for Older Persons in Need of Support" presents a comprehensive exploration of the requirements and needs of stakeholders involved in CBHC organizations. By adopting a user-centered approach and using focus groups to capture insights, the study provides valuable input for the development of web platforms that can enhance the provision of care for older individuals. The research highlights the complexity of meeting the diverse needs of care receivers, significant others, and care providers, emphasizing the importance of customization and adaptability in information system design for this domain. Furthermore, the use of user stories is a practical and effective means of translating user requirements into technical specifications, ensuring that the resulting web platform meets the expectations of all stakeholders. This study contributes to the broader field of information systems by emphasizing the importance of user engagement and user-centric design in the development of healthcare-related ICT solutions, ultimately striving for more dignified and efficient care for aging populations.

Analysis of the article "Effective Volunteerism: Helping Child Caregivers in Developing Countries - An Information System Perspective" (2016)

This literature review explores the article titled "Effective Volunteerism: Helping Child Caregivers in Developing Countries," which focuses on the application of mental health consultation to child caregivers in developing countries. The article outlines a method of volunteering that is characterized by episodic visits and the establishment of long-term relationships.

The article emphasizes the significance of the consultant's role in providing mental health consultation to child caregivers in developing countries. The consultant serves as a knowledgeable guide who imparts essential information and skills to the caregivers. This role aligns with the principles of information systems, where information is seen as a valuable resource for decision-making and problem-solving. The consultant acts as a source of information, offering guidance on effective caregiving practices, strategies to address mental health issues, and resources that can be utilized by caregivers. Their role can be likened to that of an information system that facilitates the flow of valuable information to end-users.

The article underscores the importance of establishing long-term relationships with caregivers as a key element of effective volunteerism. In the context of information systems, the development of enduring relationships is essential for the exchange of information. A long-term connection allows for the accumulation of knowledge, trust, and the transfer of information over time. This aligns with the notion of information systems that aim to create databases and repositories of knowledge for ongoing use. Moreover, maintaining long-term relationships enhances the sustainability and impact of the volunteer work, which is crucial for the effectiveness of the proposed method.

The article "Effective Volunteerism: Helping Child Caregivers in Developing Countries" offers a valuable method for mental health consultation in developing countries, focusing on episodic visits and long-term relationships with caregivers. From an information system perspective, the article's emphasis on the consultant's role, the establishment of long-term relationships, the method's adaptability in different settings, and the recognition of challenges all align with the core principles of information systems.

The proposed method exemplifies how information can be effectively harnessed to improve the well-being of neglected and traumatized children in developing countries. It highlights the importance of a well-structured and sustained approach that can be further enriched by the principles of information systems, enabling the efficient exchange of knowledge and resources to benefit child caregivers and, ultimately, the children they care for.

2. Comparative analysis

There are several platforms similar to ours that connect volunteers and organizations.

1. VolunteerMatch is an organization that connects volunteers with non-profit organizations. Volunteers can use the app to find offers tailored to their location, industry, and skills, as well as additional volunteer training resources.

2. Idealist.org is an online community that connects volunteers with community organizations. Here you can not only become a volunteer but also find job or internship offers from non-profit organizations.

3. BeMyNeighbor.org is a website that matches volunteers with elderly neighbors who need help with transportation, yard work, and socializing.

4. DoSomething.org is an organization that provides opportunities for young people who want to volunteer, address social issues, and offer prizes and scholarships for their work.

5. Catchafire.org is a website that connects volunteers with specific skills and experience to non-profit organizations.

Table 1 – "Comparative analysis"

Feature/ Aspect	Helping Hands	VolunteerMatch	Idealist.org	BeMy-Neighbor.org	DoSomething. org	Catchafire. org
User Regis-tration	Stream-lined regis-tration process	Well-established and trusted plat-form Lengthy registration process	Simple and intuitive regis-tration Limited advanced fea-tures	User-friendly registration Limited cus-tomization	Easy sign-up process Limited profile customization	User-friend-ly registra-tion Limited user custom-ization

Volunteer Search	Comprehensive search options	Extensive database of volunteer opportunities Overwhelming choice	Vast database with diverse opportunities Limited advanced search options	Easy-to-navigate search functionality Less diverse opportunities	Search based on interests Limited advanced search options	Search based on skills and interests Less diverse opportunities
Institution Profiles	Specia-lized for orpha-nages and nursing homes	Offers a wide range of organizations May lack a specialized focus	Hosts a variety of nonprofit organizations May lack a specialized focus	Broad spectrum of institutions Limited focus	Focus on social impact May lack a specialized focus	Focus on skills-based volunteering Limited focus
Secure Messaging	In-platform communication for user	In-platform messaging for ease of communication Basic messaging features	Integrated messaging for user interaction Limited advanced features	In-app chat for easy communication Limited features	Messaging for coordination Limited customization	In-platform messaging for collaboration Limited customization
Admin Panel	Efficient management and moderation	Robust admin tools for organization management Complex admin interface	Admin features for organization management Limited customization	User-friendly admin panel Limited customization	Admin tools for platform management Limited customization	Admin dashboard for managing projects Limited customization
Scalability	Built with scalability in mind for future expansion	Proven scalability and reach May experience slower growth	Expansive network and scalability Potential for information overload	Potential for growth and scaling Limited regional reach	National reach and growth potential Limited focus on specific sectors	Scalability and expansion possibilities Limited focus on skills-based volunteering
Social Impact	Focused on elderly care and children in need	Broader focus with extensive reach Less specialization	Supports various social causes May lack specific sector focus	Focus on local community engagement Less global impact	Empowers young activists Limited focus on specialized skills	Focus on skills-based volunteering May lack a broad focus

Differences for each platform:

1. VolunteerMatch has a much larger volunteer base than HelpingHands, but it is not designed specifically for orphanages and nursing homes.

2. Idealist.org offers a wider range of volunteer opportunities than HelpingHands, but it may lack the specialization and personalized support that HelpingHands offers to orphanages and nursing homes.

3. BeMyNeighbor.org is focused on connecting volunteers with elderly neighbors, and HelpingHands is focused on connecting volunteers with orphanages and nursing homes.

4. DoSomething.org is focused on empowering young people to make a difference through volunteering, while HelpingHands is focused on connecting volunteers with orphanages and nursing homes.

5. Catchafire.org connects nonprofits with qualified volunteers who can provide free services, while HelpingHands focuses on connecting volunteers with orphanages and nursing homes.

Advantages of HelpingHands over other applications:

HelpingHands is specially designed for orphanages and nursing homes. This means it can offer a more personalized and supportive experience for both volunteers and agencies. HelpingHands uses technology to make it easier for volunteers to find and contact orphanages and nursing homes. This helps increase the number of volunteers who can meet the needs of these institutions. Our platform provides a variety of tools and resources to support volunteer management. This helps children's homes and care homes make the most of their volunteer workforce. The platform also collects and analyzes data. This data can be used to improve the platform and better understand the needs of volunteers and institutions. Overall, HelpingHands is a unique and innovative platform that offers several advantages over other similar applications.

3. Survey-based preference research

A survey was conducted to collect information from volunteers and orphanages/ nursing homes about their needs and experiences with volunteering platforms. Information obtained from the survey will be used to develop the functionality and overall design of the platform.

The survey asked questions for volunteers and organizations. The questions were based on their experiences as well as what problems they encountered with their needs and what would be the most effective application for them. For volunteers, motivation has been shaped by a variety of interests in health, education, and mental health, often discovered through social media and community events. They strive for simplified discovery and secure communication, valuing HelpingHands potential features such as user-friendliness and real-time notifications.

Agencies need volunteers for health care, education, and support, and face challenges in recruiting and retaining employees. Desired platform features include robust databases, efficient matching, and administrative panels. They include increased care and a wider network of volunteers through HelpingHands. Agencies value technology platforms for increased visibility and smoother volunteer interactions.

Survey results:

According to the survey results, a significant number of volunteers are motivated by the opportunity to gain specialized experience that has a positive impact on society. Challenges often include finding suitable volunteer opportunities. Volunteers noted that it is important for a platform like HelpingHands to have features such as a user-friendly interface, advanced search capabilities, and secure communication tools. And nursing homes and orphanages are having great difficulty finding volunteers. Agencies have expressed strong support for a platform like HelpingHands, noting the potential benefits of streamlined volunteer recruitment and management. Key features that agencies find valuable include a user-friendly dashboard, volunteer candidate management tools, and secure communication channels.

Problem statements

Research tasks for the Helping Hands application represent a variety of research areas necessary for more effective development and improvement of the platform.

The first task is related to understanding the specific needs of orphanages and nursing homes. This includes research to determine what types of help and support these institutions need. Such an analysis will help to identify where volunteer assistance can have the greatest effect and which areas require special attention.

Another area of research is the study of motivation and preferences of volunteers. We plan to understand what motivates people to join the volunteering program and what types of help or time they are willing to provide. This will allow us to more accurately adapt the offers for volunteers and make the participation process more attractive.

Our task is also to analyze technological needs. We want to study the existing technological solutions in the field of volunteering and their effectiveness. This will allow us to determine how to improve the accessibility and usability of our platform for volunteers and organizations.

These are just some of the aspects that we plan to explore within the framework of the Helping Hands project. These tasks will help us create more effective strategies for involving volunteers and improving the functioning of the platform aimed at supporting vulnerable groups of society.

As part of the research for the Helping Hands project, a number of hypotheses and proposed solutions are proposed aimed at improving the operation of the application and involving more volunteers and institutions.

The first hypothesis is the need for a deeper understanding of the needs of orphanages and nursing homes. To do this, it is planned to conduct a series of interviews with the heads of these institutions in order to identify specific areas where volunteer assistance will be most useful and meaningful. This will allow us to focus our efforts on providing the most valuable services.

The second hypothesis suggests that the motivation of volunteers plays a key role in their participation. It is planned to organize focus groups and conduct surveys for volunteers in order to identify their main incentives and preferences in choosing types of assistance. This will help to adapt the volunteering program, making it more attractive to potential participants.

The third hypothesis is related to the study of existing technologies and platforms in the field of volunteering. The analysis will determine which solutions already exist and identify their advantages and disadvantages. This will help to create a more convenient and effective "Helping Hands" platform.

The fourth hypothesis assumes that the collection and analysis of data on user experience and the effectiveness of the platform will identify areas for improvement. It is planned to analyze the data to assess the impact of the application on user satisfaction and the quality of services provided.

Solutions to confirm these hypotheses include conducting interviews and surveys with the management of institutions, focus groups for volunteers, as well as analyzing technological solutions on the market. In addition, it is supposed to collect data on user

experience to analyze their impact on the effectiveness of the platform. These steps will be useful to identify the most effective strategies for improving the app and attracting more volunteers and institutions.

Application architecture logic

Deployment diagram:

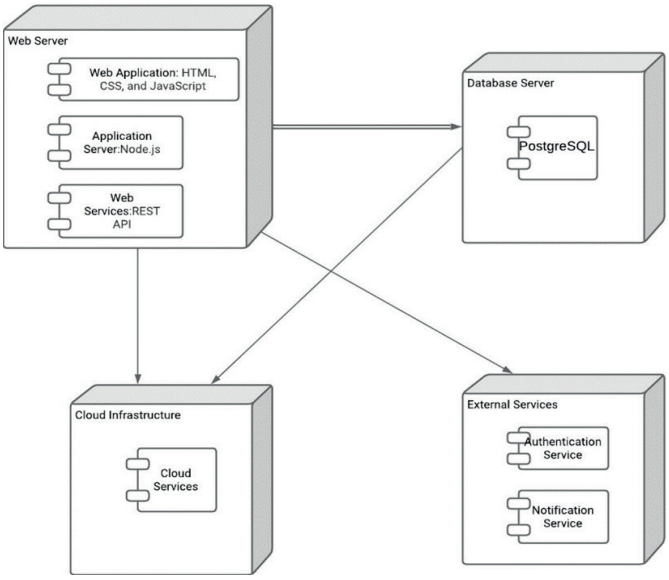

Figure 2 - "Deployment diagram"

Component diagram:

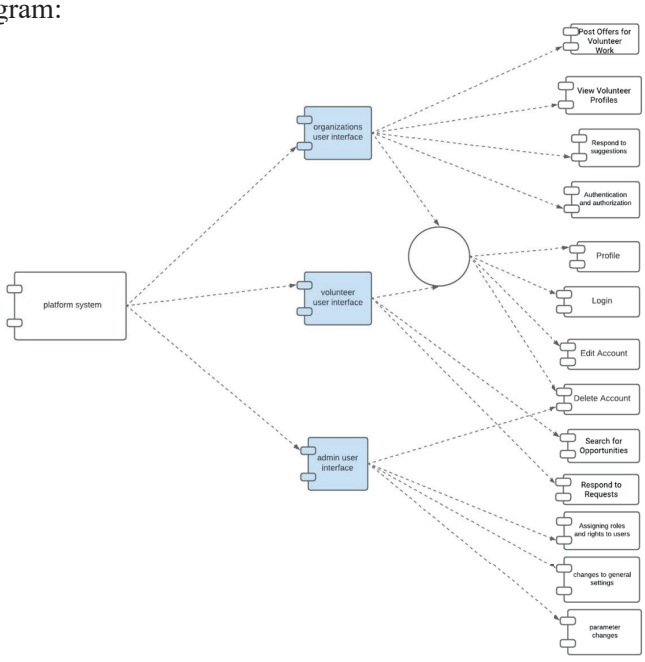

Figure 3 - "Component diagram"

Main features of the application

The main features of the HelpHands app include the following:

User Profiles: Users can create and manage profiles using personal information, skills, and qualifications.

Volunteer Search: The platform offers robust search functions that allow volunteers to find suitable positions based on location, experience, and availability.

Facility Profiles: Children's homes and nursing homes can create profiles to publish their needs, preferences, and requirements.

Admin Panel: The application includes an admin panel for efficient management, moderation, and control.

Scalability: The HelpingHands app is designed with scalability in mind, allowing it to potentially expand to other regions and service categories in the future.

Confirmation of research results

Based on surveys and interviews with potential volunteers, orphanages and nursing homes, as well as organizations, we have confirmed that there is a significant demand for such an application. There is a need to develop and launch the "Helping Hands" application to connect volunteers with organizations and places that require volunteer help.

Basic needs of volunteers: The study revealed that volunteers are looking for volunteering opportunities that match their skills, interests and specialization. The application should provide tools for personalized search and selection of volunteer activities.

Needs of orphanages and nursing homes: Orphanages and nursing homes have expressed a need for volunteers with specific skills and experience, such as medical services, psychological support and educational activities. The application should provide an opportunity for organizations to place requests for volunteer assistance with specific requirements.

The analysis of competitors showed that there are other platforms and applications for volunteering, but they may not fully meet the needs of the target audience. There is a potential to improve and add functionality to make the "Helping Hands" application more attractive and user-friendly.

During the study, it became clear that both volunteers and organizations value security and trust when working with the application. When developing an application, special attention should be paid to the aspects of security and user identification. Organizations and volunteers expressed expectations from the application related to convenience, efficiency and ease of use. The application should be intuitive and provide useful tools for organizing and searching for volunteer activities.

In general, the "Helping Hands" application has the potential to become a valuable resource for volunteers and organizations, the application provides an effective solution to the needs and problems of your audience and provides convenience and security for all users.

Conclusion

The HelpingHands platform is an innovative solution aimed at improving communication and collaboration between volunteers and institutions, in particular

orphanages and nursing homes. This platform aims to enable seamless interaction between volunteers and organizations, thereby facilitating more effective coordination of volunteer work and ultimately improving the quality of care and support offered to those in need.

Key results:

Building bridges: Research highlights the urgent need to improve interactions between volunteers and agencies, which is vital for a strong volunteer network that supports social causes.

Development goals: The project was aimed at creating HelpingHands, a specialized digital system connecting volunteers with orphanages and nursing homes, optimizing staffing, and improving the quality of care.

Research results: literature review, comparative analysis, and surveys provided key information on the needs of volunteers and institutions. The results highlighted the need for a dedicated, user-friendly platform.

Problem Statements and Hypotheses: Research objectives focus on understanding institutional needs, volunteer motivation, technology requirements, and user experience. Hypotheses focused on institutional understanding, volunteer motivation, technology analysis, and data-driven improvements.

Application Architecture: HelpingHands includes user profiles, robust volunteer matching, facility profiles, admin panels, and scalability for future expansion.

Research Validation: Surveys and interviews confirmed the demand for HelpingHands. The findings emphasized personalized searches, secure communications, and user-friendly tools for volunteers and agencies.

Future directions:

The development and launch of the HelpingHands app will address the specific needs of volunteers and agencies, offering tools for personalized volunteer searches and requests.

Continuous improvement and additional functionality must be considered to enhance the appeal and usability of the application.

Focusing on safety, trust, convenience, and efficiency is critical for both volunteers and organizations when using the app.

At its core, the HelpingHands app is a potentially valuable resource that effectively addresses the needs and concerns of its audience while providing convenience and safety for all users.

REFERENCES

Alexandra Murray Harrison. Effective Volunteerism: Helping Child Caregivers in Developing Countries - An Information System Perspective. — 2016 Nov. — 37(6)

Anna Narvaes (2020). The Surprising Ways Volunteering Benefits Children. — 2020 Feb 4. — *https://mountainkidslouisville.com/blog/surprising-ways-volunteering-benefits-children/*

Ellie Sims, Jess Pidcock, Chioma Eucharia Nnajidema, Chioma Vivian Ezunu, Richard Denton, Carly Davis, Devansh Chiralayath Njalil Baburaj, Lucy Allen (2017). Developing the role of volunteers in care homes. — 2017 January 23.

https://www.researchgate.net/publication/325585674_Technology_in_Nonprofit_Organizations_and_Voluntary_Action

https://www.researchgate.net/publication/241909632_Information_Technology_and_the_Voluntary_Sector_Workplace

John McNutt, Chao Guo, Lauri Goldkind, Seongho An. Technology in Nonprofit Organizations and Voluntary Action. — 2018 June.

Judith R (2003). Saidel, Stephanie Cour. Information Technology and the Voluntary Sector Workplace. — 2003 March.

Karen Marie (2021). Volunteers do the fun stuff – Experiences from volunteer–professional caregiver cooperation in nursing homes. — 2021 July. — *https://pubmed.ncbi.nlm.nih.gov/34328234/*

Verena Biehl M.A., Heidrun Becker, Prof Dr., Alenka Ogrin, M.A., Alenka Reissner, PhD, Johannes Burger, M.A., and Andrea Glaessel, Prof Dr, MPH, MSc. User-Centered Development of a Web Platform Supporting Community-Based Health Care Organizations for Older Persons in Need of Support: Qualitative Focus Group Study. — 2021 Mar. — 23(3). — *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7991984/*

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BLOCKCHAIN-BASED VOTING SYSTEM: A SYSTEMATIC LITERATURE REVIEW

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Abstract. Democratic elections are a cornerstone of modern society, enabling citizens to exercise their right to vote and express their preferences for political leaders and policies. However, traditional voting systems have faced numerous challenges in recent years, including allegations of fraud, hacking, and misinformation. To address these challenges, many countries have started exploring new technologies that can help secure and modernize the voting process. One such technology is blockchain, a decentralized and tamper-proof database that allows multiple parties to maintain a shared ledger without the need for a central authority. By providing a transparent and immutable record of all transactions, blockchain technology has the potential to revolutionize the way we conduct elections, making them more secure, transparent, and efficient. In this paper, we will explore the benefits and challenges of using blockchain technology in voting systems.

Keywords: blockchain, voting, e-voting, voting system, decentralized

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БЛОКЧЕЙН НЕГІЗІНДЕГІ ДАУЫС БЕРУ ЖҮЙЕСІ: ЖҮЙЕЛІ ӘДЕБИЕТТЕРГЕ ШОЛУ

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Аннотация. Демократиялық сайлау азаматтарға сайлау құқығын жүзеге асыруға және саяси көшбасшылар мен саясаттарға өз қалауларын білдіруге мүмкіндік беретін заманауи қоғамның ірге тасы болып табылады. Дегенмен, дәстүрлі дауыс беру жүйелері соңғы жылдары көптеген қиындықтарға тап болды, соның ішінде алаяқтық, бұзу және жалған ақпарат бар. Осы міндеттерді шешу үшін көптеген елдер дауыс беру процесін қауіпсіздендіруге және жаңғыртуға көмектесетін жаңа технологияларды зерттей бастады. Осындай технологиялардың бірі блокчейн болып табылады, орталықтандырылмаған және бұрмаланбайтын дерекқор, ол бірнеше тараптарға орталық органның қажеттілігінсіз ортақ кітапты жүргізуге мүмкіндік береді. Блокчейн технологиясы барлық транзакциялардың мөлдір және өзгермейтін жазбасын қамтамасыз ете отырып, сайлауды қауіпсіз, ашық және тиімді етіп өткізу тәсілін өзгертуге әлеуеті бар. Бұл мақалада біз блокчейн технологиясын дауыс беру жүйесінде қолданудың артықшылықтары мен қиындықтарын зерттейміз.

Түйін сөздер: блокчейн, дауыс беру, электронды дауыс беру, дауыс беру жүйесі, орталықтандырылмаған

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СИСТЕМА ГОЛОСОВАНИЯ НА ОСНОВЕ БЛОКЧЕЙНА: СИСТЕМАТИЧЕСКИЙ ОБЗОР ЛИТЕРАТУРЫ

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Аннотация. Демократические выборы являются краеугольным камнем современного общества, позволяя гражданам реализовать свое право голоса и выразить свои предпочтения в отношении политических лидеров и политики. Однако в последние годы традиционные системы голосования столкнулись с многочисленными проблемами, включая обвинения в мошенничестве, хакерстве и дезинформации. Чтобы решить эти проблемы, многие страны начали изучать новые технологии, которые могут помочь защитить и модернизировать процесс голосования. Одной из таких технологий является блокчейн - децентрализованная и защищенная от взлома база данных, которая позволяет нескольким сторонам вести общую бухгалтерскую книгу без участия центрального органа. Обеспечивая прозрачную и неизменяемую запись всех транзакций, технология блокчейн способна произвести революцию в проведении выборов, сделав их более безопасными, прозрачными и эффективными. В этой статье мы рассмотрим преимущества и проблемы использования технологии блокчейн в системах голосования.

Ключевые слова: блокчейн, голосование, электронное голосование, система голосования, децентрализованная

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Introduction

Blockchain technology has emerged as a promising solution for secure and transparent voting systems. By providing a decentralized and tamper-proof database, blockchain systems can help ensure the integrity of voting processes and increase public trust in democratic institutions. In this paper, we will explore the benefits and challenges of using blockchain technology in voting systems, drawing on case studies from around

the world. We will also discuss some of the criticisms and concerns that have been raised about blockchain-based voting systems, and provide recommendations for future research and implementation.

The topic of using blockchain technology in voting systems is important and worth studying for several reasons:

1. Ensuring the integrity of democratic processes: Voting is a fundamental component of democratic processes, and any attempt to manipulate or influence the outcome of an election can undermine the legitimacy of the democratic system. Using blockchain technology in voting systems can help ensure the integrity of the voting process by providing a transparent, tamper-proof, and auditable record of all transactions.

2. Increasing trust in the voting process: Trust is essential for the functioning of democratic systems, and any perceived lack of trust in the voting process can undermine public confidence in the democratic system. By using blockchain technology, voting systems can provide a high degree of transparency and security, increasing trust in the voting process.

3. Improving efficiency and reducing costs: Traditional voting systems can be time-consuming and expensive to administer, requiring significant resources and infrastructure. By using blockchain technology, voting systems can be designed to be more efficient and cost-effective, reducing the burden on election officials and taxpayers.

4. Facilitating more inclusive and accessible voting: Traditional voting systems can present barriers to participation for certain groups, such as people with disabilities or those living in remote areas. By using blockchain technology, voting systems can be designed to be more inclusive and accessible, allowing more people to participate in the democratic process.

5. Advancing the development and implementation of blockchain technology: Blockchain technology is a rapidly developing area with many potential applications, and the study of blockchain-based voting systems can contribute to the advancement of this technology by identifying challenges and opportunities for further development and implementation. Overall, the study of blockchain-based voting systems is important and worth pursuing because it has the potential to improve the integrity, efficiency, accessibility, and inclusivity of democratic processes, while also contributing to the development and implementation of blockchain technology.

Material and methods

Background

Blockchain is a type of distributed ledger technology (DLT) that allows multiple parties to maintain a shared database without the need for a central authority. In a blockchain system, each block in the chain contains a cryptographic hash of the previous block, making it difficult to tamper with past transactions. This makes blockchain technology well-suited for applications where transparency, security, and immutability are important.

One of the key features of blockchain technology is decentralization, which means that no single entity controls the database. Instead, all parties in the network have a copy of the database, and any changes to the database must be approved by consensus

among the parties. This makes blockchain systems resistant to tampering and hacking, as any attempt to change the data in one copy of the database will be rejected by the other copies.

Another important feature of blockchain technology is transparency. In a blockchain system, all transactions are recorded in a public ledger that can be accessed and verified by anyone in the network. This makes it possible to trace the history of any transaction and ensure that it has not been tampered with. Additionally, some blockchain systems can be designed to allow users to verify the integrity of their own transactions, further increasing transparency and accountability.

Blockchain technology has a wide range of applications, including cryptocurrency, supply chain management, digital identity, and voting systems, among others. By providing a secure and transparent way to record and verify transactions, blockchain technology has the potential to revolutionize many industries and enable new forms of collaboration and innovation.

Result and discussion

Case studies

A blockchain-based voting system has both advantages and disadvantages. Advantages:

1. Increased transparency: Decentralized voting systems can provide a transparent and auditable record of all transactions, making it easier to detect and prevent fraud and manipulation.

2. Improved security: Decentralized voting systems are resistant to hacking and tampering, as they rely on a consensus mechanism among multiple parties to validate and approve transactions.

3. Reduced costs: Decentralized voting systems can reduce the costs of conducting elections, as they eliminate the need for central authorities and intermediaries.

4. Increased accessibility: Decentralized voting systems can be designed to be more accessible and inclusive, allowing a broader range of participants to engage in the voting process.

5. Enhanced voter privacy: Decentralized voting systems can protect voter privacy by allowing voters to cast their vote without revealing their identity.

Disadvantages:

1. Technical challenges and complexity: Implementing decentralized voting systems can be technically challenging and requires expertise in blockchain technology and cryptography (Taş et al., 2020).

1. Limited scalability: Decentralized voting systems may have limitations in terms of scalability, as the number of transactions that can be processed at any given time may be limited by the capacity of the network (Lauer, 2004).

2. Potential for unequal participation: Decentralized voting systems may not be accessible to all voters, particularly those who lack access to technology or have limited technical skills. And there can be several DDos attacks while voting process (Bokslag, 2016).

3. Difficulty in ensuring the accuracy of vote counting: Decentralized voting systems may face challenges in ensuring the accuracy of vote counting, as errors or discrepancies may be difficult to detect and correct.

4. Lack of legal and regulatory frameworks: Decentralized voting systems may face legal and regulatory challenges, as they may not fit within existing legal frameworks and regulations for voting systems.

5. Security: There can be a bunch of an unpredictable attacks. Ddos, TLS, MM (man in the middle) attacks (Manpearl, 2018). The client devices can have the viruses or some other mallware software.

In recent years, two major e-voting applications have been developed, but they have also been found to have significant security risks. Following the 2015 election, the Virginia Information Technologies Agency (VITA) conducted security tests on several aspects of their e-voting system, including physical security, network security, operating system security, data security, and the vote tally process. VITA discovered that the system had used unsafe security protocols and weak passwords, and that an attacker could compromise the confidentiality and integrity of the voting data. Due to these issues, VITA recommended discontinuing the use of the Advanced Voting System (Zetter, 2019).

6. In addition, the Swiss government had been working on implementing an e-voting system for many years. Swiss Post was also involved in this effort and opened its applications for safety testing to the public in 2019 (Lewis et al., 2019), believing in the transparency of the applications. However, international IT experts discovered a critical error in the source code of the Swiss Post application, which could not detect voting manipulation in the shuffle method. This error allowed hackers to replace valid votes with fraudulent ones. The IT experts noted that the codes were not standardized (Clarke et al., 2017). As a result of these critical issues, the Swiss government canceled the use of the system until a new appointment (Bollinger, 2018).

Over last there are several points of view based on blockchain based voting systems. Most of them bring the idea that it is hard to develop safe e-voting system itself (Specter et al., 2020). The other part says that the blockchain based architecture gives a opportunity to design safe voting system.

Conclusion

In conclusion, the use of blockchain-based voting systems has the potential to provide numerous benefits, such as improved transparency, security, and efficiency. However, there are also significant challenges and limitations to consider, such as the need for widespread adoption, potential technical issues, and the risk of centralization. It is clear that further research and development are necessary to overcome these challenges and ensure the successful implementation of blockchain-based voting systems. As such, it is important for policymakers and researchers to carefully evaluate the pros and cons of these systems and work towards developing robust solutions that can effectively address the needs and concerns of all stakeholders. Ultimately, the adoption of blockchain-based voting systems could pave the way for more democratic and secure electoral processes in the future.

REFERENCES

Bokslag W., de Vries M. (2016). Evaluating e-voting: Theory and practice. — *arXiv* 2016, — arXiv:160202509.

Bollinger L.C., McRobbie M.A. (2018). Ensuring the Integrity of Elections. In *Securing the Vote: Protecting American Democracy*; National Academies of Sciences: Washington, DC, USA, — 2018. — Pp. 103–105. — ISBN 978-0-309-47647-8.

Cardillo A., Essex A. (2018). The Threat of SSL/TLS Stripping to Online Voting. In *E-Vote-ID 2018: Electronic Voting*; Krimmer R., Volkamer M., Braun Binder N., Kersting N., Pereira O., Schürmann C., Eds.; Lecture Notes in Computer Science; Springer: Cham, Switzerland. — 2018. — Volume 11143. — Pp. 35–50. — ISBN 978-3-030-00419-4.

Clarke D. & Ali S.T. (2017). End to end security is not enough. In *Security Protocols XXV: 25th International Workshop, Cambridge, UK. — March 20–22. — 2017. — Revised Selected Papers 25*. — Pp. 260–267. Springer International Publishing.

Taş R. & Tanrıöver Ö.Ö. (2020). A systematic review of challenges and opportunities of blockchain for E-voting. *Symmetry*, — *12*(8), — 1328.

Lauer T.W. (2004). The risk of e-voting. *Electron. J. E-Gov.* — 2004, — *2*, — 177–186.

Lewis S.J., Pereira O. & Teague V. (2019). The use of trapdoor commitments in bayer-groth proofs and the implications for the verifiabilty of the scytl-swisspost internet voting system.

Manpearl E. (2018). Securing US election systems: Designating US election systems as critical infrastructure and instituting election security reforms. *BUJ Sci. & Tech. L.*, — *24*, — 168.

Zetter K. (2019). Experts Find Serious Problems with Switzerland's Online Voting System Before Public Penetration Test Even Begins.

Specter M.A., Koppel J. & Weitzner D. (2020, August). The ballot is busted before the blockchain: A security analysis of voatz, the first internet voting application used in us federal elections. In *Proceedings of the 29th USENIX Conference on Security Symposium*. — Pp. 1535–1552.

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DESIGN AND DEVELOPMENT OF AN INTEGRATED MOBILE APPLICATION COMBINING THE FEATURES OF 2GIS, ZENLY, AND GOOGLE MAPS

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Abstract. This article focuses on creating a universal mobile application that combines the power of 2GIS, Zenly and Google Maps to optimize user navigation and improve the location experience. This innovative application integrates the strengths of these platforms, simplifying navigation, route planning, real-time tracking of public transport and promoting social connectivity. The study covers the design, implementation and evaluation of this innovative solution, highlighting its potential to revolutionize modern location services. The main goal of the project is to create and evaluate a

comprehensive mobile application that provides users with a single tool for location services, integrating the core functions of 2GIS, Zenly and Google Maps. The app's design pays attention to usability, using detailed Google Maps for accurate and up-to-date location information. In summary, this study represents a significant contribution to the field of mobile navigation applications, demonstrating the potential to transform modern location services.

Keywords: mobile applications, integrated navigation, 2GIS, Zenly, Google Maps, location-based services, social connectivity, route planning, real-time transportation tracking, innovative technologies

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2GIS, ZENLY ЖӘНЕ GOOGLE MAPS МҮМКІНДІКТЕРІН БІРІКТІРЕТІН ИНТЕГРАЦИЯЛАНҒАН МОБИЛЬДІ ҚОСЫМШАНЫ ЖОБАЛАУ ЖӘНЕ ҚҰРУ

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Аннотация. Бұл мақала пайдаланушы навигациясын оңтайландыру және орынды анықтау тәжірибесін жақсарту үшін 2GIS, Zenly және Google Maps мүмкіндіктерін біріктіретін әмбебап мобильді қосымшаны жасауға бағытталған. Бұл инновациялық қосымша осы платформалардың күшті жақтарын біріктіреді, навигацияны жеңілдетеді, маршрутты жоспарлауды, қоғамдық көлікті нақты уақытта қадағалауды және әлеуметтік байланысты алға жылжытады. Зерттеу осы инновациялық шешімді жобалау, енгізу және бағалауды қамтиды, оның заманауи орналасу қызметтерін төңкеріс жасау мүмкіндігін көрсетеді. Жобаның негізгі мақсаты – пайдаланушыларға 2GIS, Zenly және Google Maps негізгі функцияларын

біріктіретін орынды анықтау қызметтерінің бірыңғай құралын ұсынатын кешенді мобильді қосымшаны жасау және бағалау. Қолданбаның дизайны нақты және жаңартылған орын туралы ақпарат алу үшін егжей-тегжейлі Google Maps қолданбасын пайдаланып, ыңғайлылыққа назар аударады. Қорытындылай келе, бұл зерттеу заманауи орынды анықтау қызметтерін түрлендіру әлеуетін көрсете отырып, мобильді навигациялық қосымшалар саласына айтарлықтай үлес қосады.

Түйін сөздер: мобильді қосымшалар, интегрированная навигация, 2GIS, Zenly, Google Maps, орналасу мемлекеті, әлеуметтік байланыс, маршрутты жоспарлау, тік уақытта қол жетімділігін бақылау, инновациялық технологиялар

Дәйексөз үшін: В.Ж. Элле, Ж. Абсаттар, М. Баден, А. Берік. 2GIS, ZENLY ЖӘНЕ GOOGLE MAPS МҮМКІНДІКТЕРІН БІРІКТІРЕТІН ИНТЕГРАЦИЯЛАНҒАН МОБИЛЬДІ ҚОСЫМШАНЫ ЖОБАЛАУ ЖӘНЕ ҚҰРУ//Ақпараттық және коммуникациялық технологиялардың халықаралық журналы. 2023. V.4. № 4. Бет 40-55 (ағылшын тілінде). *https://doi.org/10.54309/IJICT.2023.16.4.004*

ПРОЕКТИРОВАНИЕ И РАЗРАБОТКА ИНТЕГРИРОВАННОГО МОБИЛЬНОГО ПРИЛОЖЕНИЯ, ОБЪЕДИНЯЮЩЕГО ВОЗМОЖНОСТИ 2ГИС, ZENLY И GOOGLE MAPS

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Аннотация. Данная статья фокусируется на создании универсального мобильного приложения, объединяющего возможности 2GIS, Zenly и Google Maps для оптимизации пользовательской навигации и улучшения опыта в области местоположения. Это инновационное приложение интегрирует сильные стороны указанных платформ, упрощая навигацию, планирование маршрутов, отслеживание общественного транспорта в режиме реального времени и способствуя социальной связности. Исследование охватывает процессы проектирования, внедрения и оценки данного инновационного решения, подчеркивая его потенциал для революции в области современных местопо-

ложенческих сервисов. Основной целью проекта является создание и оценка всестороннего мобильного приложения, предоставляющего пользователям единый инструмент, интегрируя основные функции 2GIS, Zenly и Google Maps. Дизайн приложения удобен в использовании, детализированные карты Google Maps применяются для точной и актуальной информации о местоположении. Таким образом, данное исследование представляет значительный вклад в область мобильных навигационных приложений, демонстрируя потенциал для трансформации современных местоположенческих сервисов.

Ключевые слова: мобильные приложения, интегрированная навигация, 2GIS, Zenly, Google Maps, местоположенческие сервисы, социальная связь, маршрутное планирование, отслеживание транспорта в реальном времени, инновационные технологии

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Introduction

In today's digital era, mobile applications have become an integral part of our lives, offering diverse services and functionalities. Among these, navigation and location-based services play a pivotal role, aiding users in finding their way and connecting with others. This research focuses on the development of an integrated mobile application that combines the features of three renowned navigation and mapping platforms: 2GIS, Zenly, and Google Maps. Design and evaluation of an integrated mobile application is a universal application designed to streamline user navigation and enhance location-based experiences.

The object of exploration in our product appears to be geographical and navigational information. Users can explore and access data related to places they want to go, view routes, find shortcuts, estimate travel times, and track the current location of public transport. Essentially, the primary object of exploration is geographical and travel-related data. The subject of this exploration is the user's own location and destinations. Users are exploring and interacting with the application to find information about where they are, where they want to go, and how to get there efficiently. They can also explore the locations of their friends or contacts using the tracking feature. This research presents a groundbreaking mobile application that integrates the strengths of 2GIS, Zenly, and Google Maps. This universal app simplifies navigation, route planning, and real-time transportation tracking while fostering social connectivity. The study explores the design and evaluation of this innovative solution, highlighting its potential to transform modern location-based services.

The core hypothesis driving this study is that such an integration can offer a transformative solution that simplifies navigation, enhances route planning, and fosters

social connectivity. Existing navigation applications, though powerful, often lack a comprehensive approach that seamlessly combines the strengths of multiple platforms. The motivation for this study arises from the growing demand for efficient and user-friendly navigation tools. Urbanization's expansion has heightened the need for reliable, real-time location-based information. Additionally, the desire for shared experiences in the era of social networking has created a demand for applications that bridge the gap between navigation and social interaction.

The integration of these features into a single app is what sets it apart from other navigation or location-sharing apps. Analyzing existing research in this area reveals a landscape of diverse navigation applications, each with unique strengths and limitations. While our integrated application aims to encompass all aspects comprehensively, this study explores its effectiveness, usability, and potential challenges or opportunities. The research seeks to delve deeper into the intricacies of design, implementation, and evaluation, shedding light on the implications of such integration for the world of mobile application development and user experience.

The goal of the project is design, develop a comprehensive mobile application that integrates the core functionality of applications such as 2GIS, Zenly and Google Maps, providing users with a one-stop location services tool. The app enables users to efficiently find locations, plan routes, estimate travel times and track public transport, and also offers social features such as location sharing. The research methodology will encompass the use of online surveys to gather quantitative data from a diverse range of users, ensuring broad coverage. Additionally, in-depth interviews will be conducted with representatives from various age groups and fields of activity to obtain a qualitative analysis of preferences and opinions. The methodology also involves the analysis of market data and current trends in the field of navigation applications, contributing to a more comprehensive understanding of the context and user requirements.

Material and methods

Hypothesis

Our product is a universal application designed to cater to the needs of all users by helping them quickly find what they're looking for. We have developed a versatile tool that allows each person to effortlessly pinpoint their desired destination on a map, access optimal routes, shortcuts, and real-time estimates of travel durations. Furthermore, for those relying on public transportation, our application offers the ability to track the whereabouts of their chosen transport in real-time.

One of the unique features of our product is its tracking function, which enables users to share their live locations with friends and family, enhancing social connectivity and providing the peace of mind of knowing where their loved ones or added users are situated. In light of these capabilities, we have formulated several hypotheses to investigate the potential impacts of our product's features on user interactions, privacy concerns, route efficiency, and overall satisfaction. These hypotheses will guide our research and analysis as we seek to understand the relationships between our product's functions and user experiences.

Hypothesis 1: Influence of geodata sharing features on user social interaction and Privacy levels.

If the application utilizes geodata sharing features (e.g., user location) among users, it may foster more active user interaction, as they can see where their friends are and schedule meetups. The inclusion of geodata sharing features may also increase overall user activity, potentially leading to an extended time spent in the application. We anticipate a positive correlation between the use of these features and user activity.

Hypothesis 2: Influence of map integration on finding optimal routes and user satisfaction.

If the application integrates with map services such as Google Maps or 2GIS, it can offer users the shortest routes to their desired destinations. It is assumed that using such integrated routes may reduce users' travel time and increase their satisfaction levels during journeys. Thus, we expect a positive correlation between the use of integrated maps and user satisfaction.

Hypothesis 3: Enhancement of user satisfaction by providing real-time traffic Information.

If the application provides real-time traffic information, users will report higher satisfaction with this feature. Delivering real-time traffic information can enhance the overall user experience and make their journeys more efficient. Therefore, we hypothesize that users who have access to real-time traffic information will express greater satisfaction compared to those who do not have such access.

Comparison with other analogues

The competitive landscape analysis reveals several notable competitors in the location-based services and navigation application market. Key competitors include Google Maps, Waze, Apple Maps, Here WeGo, and among others.

Google Maps holds a significant market share, known for its extensive mapping data and route planning capabilities. Waze excels in real-time traffic and community-based reporting. Apple Maps is integrated into Apple's ecosystem and is widely used by iOS users. Here WeGo offers offline navigation. Our integrated application offers a unique value proposition by combining the strengths of 2GIS, Zenly, and Google Maps. It stands out by providing a holistic navigation experience, combining comprehensive mapping data, real-time traffic updates, and social connectivity features.Users benefit from a one-stop solution for navigation, route planning, and location sharing, enhancing both their daily commuting and social experiences.

Our integrated application excels in user experience. Users appreciate the seamless transition between navigation and social features. Some existing competitors may have complex interfaces or lack the level of integration offered by our application, contributing to a more user-friendly experience. Our application addresses feature gaps observed in some competitors. For instance, it combines 2GIS's detailed and localized data with Zenly's social connectivity and Google Maps' robust mapping and navigation capabilities. Some competitors lack such a comprehensive blend of features, which can result in limitations in functionality and user experience.

Figure 1: "SWOT analysis of our application"

Portrait of the beneficiary

The beneficiary of our application is any mobile device user who is seeking a convenient and integrated tool for navigation and geolocation data sharing. This can include:

1. Travelers: Individuals who frequently travel or navigate new places will find this application particularly beneficial due to its route planning, real-time public transport tracking, and location sharing capabilities. Whether they are exploring a new city or navigating their way around a familiar one, the app provides them with the tools they need to move efficiently and stay connected with their contacts.

2. Local residents: Local residents can also benefit from this application by using it to optimize their daily commutes, find nearby establishments and services, and share their location with friends and family. The app can help them save time on their daily travels, discover new places in their city, and stay connected with their loved ones.

3. Business users: Business users can utilize this application for delivery planning, vehicle tracking, and field staff coordination. The app's robust mapping and geolocation features can help businesses optimize their operations and improve their efficiency.

4. Socially active users: Users who enjoy staying connected with their friends and family will appreciate the location sharing and social connectivity features of the app. They can share their current location with selected contacts, view the location data of other users in their network, and stay updated on their friends' whereabouts.

5. Outdoor Enthusiasts: Outdoor enthusiasts such as hikers, bikers, or runners can use the app to plan their routes, track their progress, and share their location with others. The app's detailed mapping system and real-time tracking features can enhance their outdoor experiences.

Survey-based preference research

Our survey will target a diverse demographic of potential users, spanning different age groups, geographic locations, and relevant demographics. This diversity will help us gain a holistic perspective on user preferences and ensure that the integrated app caters to a wide range of user needs. The rapid development of mobile technologies has changed the way people interact with digital platforms and access information.Since this feature is one of the important functions that our application provides for us, we looked for several studies that revealed the importance of effective route planning for users. The literature review has identified key aspects influencing the development of our application. The study by Smith et al. (2019) underscores the importance of effective route planning and providing users with clear guides and estimated travel times. Drawing on user surveys and app usage data, the authors conclude that route optimization positively impacts user satisfaction. Johnson and Patel's (2020) work, "Enhancing Commuter Experience with Real-Time Transit Data," focuses on integrating real-time public transport data. Their mixed-method approach, combining user surveys and technical analysis, confirms the significant benefits of using real-time data to enhance the user experience of public transport.

Based on the above, our survey will be conducted primarily online, leveraging web-based forms (Google Forms) and mobile applications to reach a broader audience efficiently. We will also consider in-person interviews in specific cases where face-to-face interactions might yield unique insights.

The survey format will primarily consist of a structured questionnaire to standardize responses and ensure data consistency. Additionally, we may conduct interviews for more in-depth feedback. Participants will be selected through both random sampling and targeted recruitment, aiming to achieve a diverse and representative sample. Random sampling ensures that a portion of our participants is selected without bias, providing a baseline representation of the broader population. Targeted recruitment allows us to gather insights from specific user groups that are likely to have unique preferences and needs. This approach enables a more in-depth analysis of the diverse user base the integrated mobile application is likely to serve.

Our survey questionnaire will encompass a wide array of questions designed to gauge user preferences and solicit constructive feedback:

- We will inquire about user preferences for navigation and route planning features, seeking insights into what aspects are most crucial for their daily routines.
- Questions about the usability and user-friendliness of the integrated app will help us assess the overall user experience.
- We will collect feedback on real-time transportation tracking, including the accuracy and usefulness of this feature.
- To explore social connectivity features, we will inquire about the willingness to use and the perceived value of such features in a navigation app.
- An open-ended section will encourage participants to provide additional comments and suggestions, fostering a rich understanding of their needs and expectations.

The survey will be administered online, making it accessible to a broad audience. We

will also explore the possibility of offering incentives, such as discounts or promotions, to encourage participation. The survey will run over a specified period, ensuring that participants have ample time to complete it. Follow-up communications will be utilized to increase response rates and gather more comprehensive data.

Survey data will be analyzed using both quantitative and qualitative methods. Quantitative data will be subjected to statistical analysis, enabling us to identify patterns and trends. Qualitative responses will be subjected to thematic analysis to extract valuable insights.

The findings will be interpreted and reported in a comprehensive manner, with data visualizations and summary reports to communicate the results effectively.

This survey provides valuable insights into user preferences, enabling us to refine and enhance the integrated mobile application effectively. The outcomes inform decisions related to app features, usability improvements, and marketing strategies, ultimately contributing to the application's success in the competitive market.

Sample questions

- *Navigation and Route Planning Preferences:*

1. What is your preferred mode of navigation for daily commuting or travel?
- Car
- Public transportation
- Walking
- Cycling

2. How important are real-time traffic updates in your navigation app?
- Very important
- Important
- Somewhat important
- Not important

3. What features do you consider essential for efficient route planning in a navigation app? (Select all that apply)
- Alternative routes
- Real-time traffic data
- Points of interest (POIs)
- Offline maps
- Voice-guided navigation

4. How often do you use a navigation app to plan your routes?
- Daily
- Weekly
- Monthly
- Rarely

- Usability and User-Friendliness:

5. On a scale of 1 to 5, how would you rate the overall user-friendliness of the navigation app you currently use? (1 being the least user-friendly, 5 being the most user-friendly)

6. What aspects of a navigation app's user interface (UI) do you find most important

for ease of use? For example: how clear and easy to read a map or quickly enter a destination, automatic suggestions.

- *Real-Time Transportation Tracking:*

7. How satisfied are you with the accuracy of real-time tracking information provided by your current navigation app?

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied

8. In what situations do you find real-time tracking most useful? (Несколько вариантов)

- Daily commuting
- Traveling to new places
- Public transportation
- Walking or cycling

- *Social Connectivity Features:*

9. Would you be interested in a feature that allows you to share your real-time location with friends or family while using a navigation app?

- Yes
- No
- Maybe

10. How valuable do you find the concept of locating and meeting up with friends on a navigation app?

- Extremely valuable
- Valuable
- Neutral
- Not valuable

11. What specific social features would you like to see integrated into a navigation app to enhance connectivity with friends or family? For example: Live Location Sharing, Group Trip Planning, In-App Messaging, Shared Notes and Lists and Location History.

- *Open-Ended Feedback:*

12. Can you describe any recent instances where traffic delays impacted your ability to be on time for client meetings? What problems have you encountered?

13.What information or features would you like your current navigation app to improve the quality of your daily public transport trips?

14.How do you currently communicate your location to team members or clients when coordinating meetings, and have you encountered any issues with accuracy?

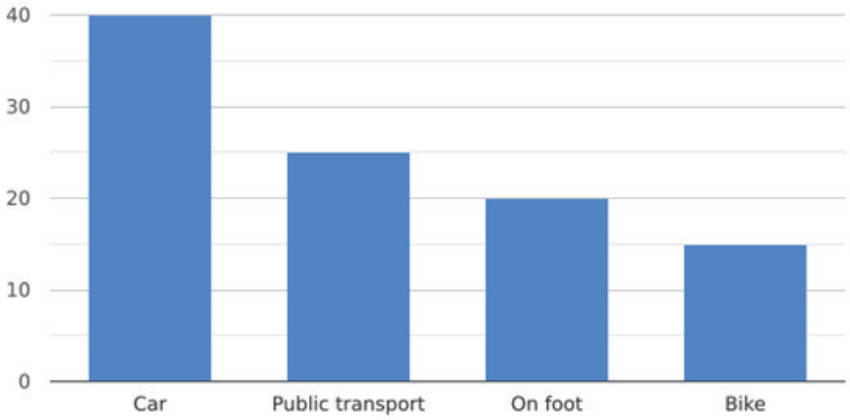

Figure 2: "Results of a survey on navigation preferences"

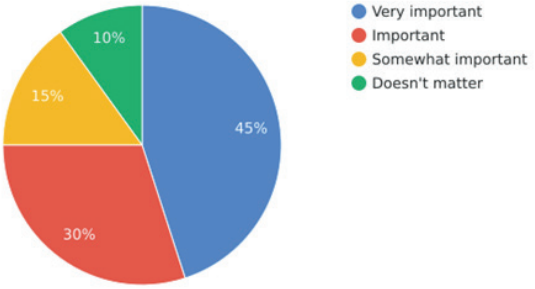

Figure 3: "The importance of real-time updates"

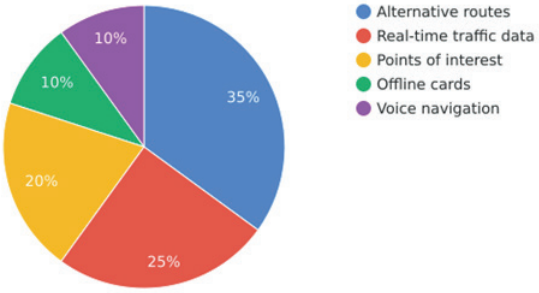

Figure 4: "Feature preferences for efficient route planning"

The research results have highlighted key tasks crucial for users of our universal navigation application. Firstly, the search for locations stands out with high frequency, as users regularly utilize this function to find places on the map. Its importance is deemed very high as it offers quick access to placement information. Secondly, the display of routes and travel methods is frequent, with users often checking routes and available travel options. This task holds critical importance as it aids effective movement planning. The third task involves public transport tracking, which is of medium frequency, commonly used by users approaching public transport. Despite its

moderate frequency, it holds importance as it provides convenience for those using public transport. Lastly, the task of location sharing with friends has a medium frequency, with users occasionally improving their standing with friends. Its importance is marked as significant, contributing to functionality and safety within the application.

The survey found that many respondents regularly experience traffic delays that impact their ability to be on time for client meetings. Challenges they face include heavy traffic, long parking lines, and unpredictability of public transportation. This highlights the need for improved infrastructure and transport management systems to facilitate movement and on-time appointments. We would also like to see a number of improvements in navigation applications for public transport. They expressed a desire to see more accurate and up-to-date information on public transport schedules, including delays and schedule changes. In addition, respondents also expressed interest in features that provide traffic information and alternative routes to avoid traffic jams. Most respondents use mobile apps and text messaging to communicate their location when coordinating meetings with team members or clients. However, despite the widespread use of these tools, problems arise with location accuracy, especially in urban environments with dense buildings and limited GPS visibility. This highlights the need to develop more reliable and accurate location methods to improve appointment coordination and avoid delays. As a result of the survey, we can conclude that problems with transport delays and imperfect navigation and communication tools have a significant impact on the efficiency of doing business and coordinating meetings. Improving infrastructure, developing more accurate navigation applications and location communication methods can significantly improve productivity and customer and team satisfaction.

Main characteristics of the developed application

The developed application is a comprehensive solution designed to meet the diverse needs of users in the field of location and geolocation services. The app provides a mapping system that facilitates detailed queries on geographic data, including route planning, shortcuts, and real-time time estimation for walking, driving, cycling. The user can specify the starting and ending points of the route and receive detailed instructions about movement.

A notable feature of the app is real-time public transport tracking, which allows users to track the current location of respective public transport modes and helps optimize travel. Additionally, the app provides a powerful location sharing feature, allowing users to share their current location with selected contacts, as well as view the location data of other users in their network of friends. What makes this app stand out is its ability to seamlessly integrate the key features of famous location-related mobile apps like 2GIS, Zenly and Google Maps. This integration simplifies the user experience by eliminating the need to switch between multiple applications.

Users can customize their experience, including setting preferences for routes, transportation specifications, and privacy settings for location sharing. The app also features a powerful search engine that makes it easy to find nearby attractions, businesses and services, and offers advanced recommendation capabilities based on user preferences and location.

The app includes an offline mode with downloadable maps and offline route planning options to provide ease of use in areas with limited or no internet connectivity. Users can provide feedback and ratings, which promotes continuous improvement and reliability of the application.Moreover, the app is designed with cross-platform compatibility in mind, ensuring accessibility for a wide range of mobile device users across platforms such as iOS and Android.Ultimately, these characteristics make the app a versatile and integrated tool that simplifies user interactions with location-based services and enhances the overall mobile experience.

Development tools overview

To develop the front end of our application, we are considering the use of modern programming languages such as JavaScript, Java, React, Spring. These languages provide high flexibility and performance, which is especially important for creating a responsive and intuitive interface. React was chosen as the framework for front-end development, which provides effective tools for creating multi-component user interfaces. Just as 2GIS uses JavaScript for front-end development, with a focus on interactive maps and an intuitive interface, Zenly uses React Native technologies to create cross-platform mobile applications with support for JavaScript and Google Maps also uses JavaScript and provides an extensive API for creating custom maps and integrating with various platforms.

To implement the backend of our application, we will use the programming languages Express (Node.js), Django (Python) and Spring (Java). Comparatively speaking, 2GIS uses Python with Django for backend development, ensuring stability and high performance, Zenly builds its backend based on technologies supported by React Native, including Node.js and Express. Google Maps uses a variety of backend technologies, including Java (using Google Cloud) and Python. Ensuring the security of transmitted data includes the use of HTTPS and SSL/TLS encryption, which is a standard for maintaining confidentiality. 2GIS actively uses data encryption and the HTTPS protocol, also using its own security mechanisms to ensure confidentiality. Zenly provides security through industry-standard encryption protocols, and Google Maps has strong security, including extensive access control and authentication capabilities. The use of modern authentication methods, such as OAuth 2.0 or JWT, ensures secure access to application functionality.

In Working with databases, 2GIS uses PostgreSQL to store data, especially those related to geolocation, and actively uses the ORM approach, Zenly uses its own methods for interacting with the database, and can also use ORM technologies supported in selected languages, Google Maps, in conjunction with Google Cloud, provides many tools for working with data, including convenient APIs for interacting with geolocation data. Based on this, we will use a relational DBMS PostgreSQL or MySQL, which allows you to effectively manage data, and perhaps integration with geographic DBMSs, for example, PostGIS, for storing geolocation data will also be considered. Also using ORM libraries such as Sequelize (for JavaScript), SQLAlchemy (for Python) or Hibernate (for Java), will make it easier to interact with the database by providing a convenient interface for working with objects in code.

Table-1: “Algorithm representation of stages”

Stage	Description
1. Requirements Analysis and Goal Definition	Conduct analysis of 2GIS, Zenly, and Google Maps features; define key goals for the application.
2. User Interface (UI) and User Experience (UX) Design	Develop an intuitive user interface, focusing on key functionalities.
3. Technology Stack Selection	Determine the technology stack: programming language, frameworks, databases.
4. Development of Core Features	Create fundamental features, such as location search, map display, and route optimization.
5. Integration of External Services	Integrate data and functionality from external providers, such as Google Maps and 2GIS.
6. Development of Social Features	Implement location-sharing and other social elements.
7. Real-Time Functionality Implementation	Ensure the real-time operation of features, including public transportation tracking.
8. Testing and Debugging	Conduct extensive testing to identify and rectify potential errors.
9. Launch and Marketing	Launch the application on iOS and Android platforms; develop a marketing strategy.
10. Gathering Feedback and Updates	Collect user feedback for improvement and update the application accordingly.
11. Support and Ongoing Development	Provide technical support for the application and explore opportunities for future feature expansion.

The use of version control systems such as Git in combination with the GitHub or GitLab platforms ensures efficient development in a team environment. 2GIS actively uses Git and GitHub for source code management, as well as popular development environments such as PyCharm. Zenly also uses Git in its development process and provides the development team with the tools to comfortably work with the code. Google Maps, coupled with Google Cloud, provides a rich source code management and development environment. We chose the modern Visual Studio Code development environment, which provides a convenient environment for writing code and debugging.

Conclusion

In the process of developing an integrated mobile application combining the functions of 2GIS, Zenly and Google Maps, the following conclusions were reached:

1. Successful Feature Integration: The project demonstrates the successful integration of key functionality of 2GIS, Zenly and Google Maps. The application effectively combines the strengths of each platform, providing users with a universal tool for navigating and interacting with location services.

2. Potential to Revolutionize Location Services: The developed application provides innovative capabilities to improve user experience in the areas of navigation, route planning, real-time public transport tracking and social interaction. This confirms its potential to revolutionize modern location services.

3. Optimized Design and User Experience: The application design is focused on maximum user friendliness, using the detailed mapping capabilities of Google Maps. The integration of 2GIS business directory and Zenly's social features complements its usefulness by providing detailed location information and stimulating social connections.

4. Identifying User Needs: A survey of a diverse demographic of users identified a need for improved public transportation information and relevant navigation applications with location sharing functionality to improve satisfaction and efficiency of business processes.

5. Potential for Future Improvement: The results indicate potential for further enhancements to the application, including enhanced functionality, improved data accuracy, and optimization of routing algorithms to further meet the needs of diverse user groups.

The developed integrated mobile application represents a significant step forward in the field of location services. Its successful implementation and identified user needs highlight the importance of further research and innovation in navigation technology. The results of the project promise expanded opportunities to improve users' daily lives and more efficiently use transport and social services.

REFERENCES

Cooper A., Reimann R. & Cronin D. (2014). "About Face: The Essentials of Interaction Design." Wiley, 2014. (Interface and User Experience Research). — *https://www.wiley.com/enus/About+Face%3A+The+Essentials+of+Interaction+Design%2C+4th+Edition-p-9781118766576*

Dey A.K. & Abowd G.D. (2000). "Towards a Better Understanding of Context and Context-Awareness." Proceedings of the CHI 2000 Conference on Human Factors in Computing Systems, — 2000. (Research in the field of mobile applications and location tracking).

Gartner, Inc. (2021). "Magic Quadrant for Location Services, Worldwid". Gartner, — 2021. (Sources for tracking and location sharing functionality). — *https://www.gartner.com/en/documents/3843369*

Goodchild M.F. & Janelle D.G. (2004). "Spatially Integrated Social Science." Oxford University Press, — 2004. (Articles about the development of navigation systems and maps). — *https://alternativepressreview.org/doc/spatially-integrated-social-science*

Garcia and Hernandez (2018). "Location-Based Social Networking Apps" (the impact of location-sharing features in social networking apps, emphasizing their role in enhancing social connections). — *https://wekho.wordpress.com/2013/09/18/location-based-social-networking-apps-a-geolocation-revolution/*

Johnson and Patel (2020). "Improving Commuter Experience with Real-Time Public Transport Data" (enhancing the commuter experience by integrating real-time public transport data into navigation apps). — *https://www.researchgate.net/publication/309471867_Improving_Attractiveness_of_Public_Transportation_with_Interactive_Experiences*

Isik S. (2015). "Location-Based Services and Geo-Information Engineering." Springer 2015. — *https://www.wiley.com/ennz/Location+Based+Services+and+Geo+Information+Engineering-p-9780470857380* (Sources for tracking and location sharing functionality)

https://www.researchgate.net/publication/205976764_Towards_a_Better_Understanding_of_Context_and_Context-Awareness

Raento M., Oulasvirta A. & Eagle N. (2009). "Smartphones: An Emerging Tool for Social Scientists." Sociological Methods & Research, — 2009. (Research in the field of mobile applications and location tracking). — *https://www.researchgate.net/publication/249693829_Smartphones_An_Emerging_Tool_for_Social_Scientists*

Rosenfeld L. & Morville P. (2006). "Information Architecture for the World Wide Web: Designing Large-Scale Web Sites." O'Reilly Media, — 2006. (Literature on Universal Application Development and User Participation). — *https://flylib.com/books/en/4.45.1/*

O'Brien J. (2010). "Universal Design: Solutions for Broadly Inclusive User Experiences." Wiley, 2010. (Literature on Universal Application Development and User Participation). — *https://www.wiley.com/en-us/Universal+Design:+Creating+Inclusive+Environments-p-9780470399132*

Smith D.H. (2015). "Mapping the User Experience: A Practical Guide to Creating Value through Journeys, Blueprints, and Diagrams." O'Reilly Media, 2015. (Articles about the development of navigation systems and maps). — *https://www.pdfdrive.com/mapping-experiences-a-complete-guide-to-creating-value-through-journeys-blueprints-and-diagrams-e188172335.html*

Smith et al. (2019). "Enhancing User Experience in Navigation Apps". — *https://www.researchgate.net/publication/365333054_Enhancing_User_Experience_in_Fashion_mRetail_Mapping_Shopping_User_Journey_Using_Google_Analytics_Eye_Tracking_Technology_and_Retrospective_Think_Aloud_Interview*. (Geolocation/map and route optimization)

Tondreau B. (2009). "Layout Essentials: 100 Design Principles for Using Grids". Rockport Publishers, — 2009. (Interface and User Experience Research). — *https://www.pdfdrive.com/layout-essentials-100-design-principles-for-using-grids-e162320404.html*

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ANALYSIS OF METHODS FOR FORECASTING FOOD CONSUMPTION

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Abstract. With the advancement of technology and changing consumer behavior, electronic commerce has become a key element of modern trade. Demand forecasting has become an integral part of strategic planning for businesses, providing suppliers with the ability to adapt to changes in consumer behavior, optimize inventory, and enhance customer service levels. In the context of Kazakhstan, a rapidly developing e-commerce market and swiftly changing consumer preferences make the effective demand management for food products more critical than ever. Predicting what consumers will demand in the future has become a key factor for success in this industry. Scientific research in the field of consumer demand forecasting plays a crucial role in optimizing resource management and providing quality services in the food market. This article analyzes various methods of forecasting the consumption of food products for Kazakhstan. The research is based on extensive data on purchasing behavior, pricing, seasonal fluctuations, and other factors influencing food product choices. Time series methods, regression analysis, neural networks, and decision trees are examined in detail, exploring their applicability and effectiveness for our country. Each method undergoes a comparative analysis in terms of forecast accuracy, adaptability to changing market conditions, and training time.

Keywords: market, forecasting model, demand, statistics, data analysis

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АЗЫҚ-ТҮЛІК ТҰТЫНУДЫ БОЛЖАУ ӘДІСТЕРІН ТАЛДАУ

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Аннотация. Технологияның дамуы және тұтынушылардың мінез-құлқының өзгеруі заманауи электронды сауданың негізгі элементіне айналды. Сұранысты болжау тұтынушылардың мінез-құлқындағы өзгерістеріне бейімделуге, тауарлы-материалдық құндылықтарды оңтайландыруға және тұтынушыларға қызмет көрсету деңгейін арттыруға мүмкіндік беретін жоспарлаудың ажырамас бөлігі болды. Қазақстан — қарқынды дамып келе жатқан электрондық коммерция нарығы. Тұтынушылар қалауының өзгерісі азық-түлік тауарларына сұранысты тиімді басқаруды бұрынғыдан да өзекті мәселеге әкеліп отыр. Болашақта тұтынушылар нақты не талап ететінін болжау осы саладағы табыстың негізгі факторы болды. Тұтынушылық сұранысты болжау саласындағы ғылыми зерттеулер ресурстарды басқаруды оңтайландыруда және азық-түлік нарығында сапалы қызмет көрсетуде шешуші рөл атқарады. Бұл мақалада Қазақстан үшін азық-түлік тұтынуды болжаудың әртүрлі әдістеріне талдау жасалады. Зерттеу сатып алу мінез-құлқы, баға белгілеу, маусымдық ауытқулар және азық-түлік таңдауына әсер ететін басқа факторлар туралы кең деректерге негізделген. Уақыт қатарларының әдістері, регрессиялық талдау, нейрондық желілер және шешім ағаштары қарастырылып, олардың біздің еліміз үшін қолданылуы мен тиімділігін анықтайды. Әрбір әдіс болжамның дәлдігі, өзгеретін нарық жағдайларына бейімделу қабілеті және оқу уақыты контекстінде салыстырмалы талдаудан өтеді.

Түйін сөздер: нарық, болжау моделі, сұраныс, статистика, деректерді талдау

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АНАЛИЗ МЕТОДОВ ПРОГНОЗИРОВАНИЯ ПОТРЕБЛЕНИЯ ПРОДУКТОВ ПИТАНИЯ

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Аннотация. С развитием технологий и изменением поведения потребителей электронная коммерция стала ключевым элементом современной торговли. Прогнозирование спроса стало неотъемлемой частью стратегического планирования для бизнеса, обеспечивая поставщикам возможность адаптироваться к изменениям в потребительском поведении, оптимизировать запасы и повысить уровень обслуживания клиентов. В контексте Казахстана, стремительно развивающегося рынка электронной коммерции и стремительно меняющихся потребительских предпочтений, вопрос эффективного управления спросом на продовольственные товары стоит более остро, чем когда-либо. Предсказание того,

что именно будет востребовано потребителями в будущем, стало ключевым фактором для успеха в данной индустрии. Научные исследования в области прогнозирования потребительского спроса играют ключевую роль в оптимизации управления ресурсами и предоставлении качественных услуг на рынке продуктов питания. В данной статье проводится анализ различных методов прогнозирования потребления продуктов питания для Казахстана. Исследование основано на обширных данных о покупательском поведении, ценообразовании, сезонных колебаниях и других факторах, влияющих на выбор продуктов питания. Подробно рассматриваются методы временных рядов, регрессионный анализ, нейронные сети и деревья решений, выявляя их применимость и эффективность для нашей страны. Каждый метод подвергается сравнительному анализу в контексте точности прогноза, способности адаптироваться к изменяющимся условиям рынка и времени обучения.

Ключевые слова: рынок, модель прогнозирования, спрос, статистика, анализ данных

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Введение

Современный мир характеризуется непрерывной цифровизацией и автоматизацией различных аспектов жизни. Одним из таких аспектов является торговля продовольственными товарами. Именно в этой сфере применение современных технологий может привести к значительному улучшению эффективности работы. Важным элементом в этом процессе является прогнозирование спроса на товары, что позволяет оптимизировать запасы и снизить издержки.

В Казахстане, как и во многих других странах, продовольственный сектор занимает важное место в экономике. Однако, несмотря на заметный прогресс в цифровизации, потенциал применения технологии прогнозирования спроса в продовольственной торговле пока не полностью реализован. Именно этот вопрос и становится предметом исследования.

Актуальность данного исследования обусловлена рядом факторов, которые влияют на продовольственную индустрию Казахстана. Во-первых, современные рыночные условия характеризуются высокой динамикой спроса и предложения, что создает вызовы для бизнеса в плане оптимизации производства, управления запасами и маркетинга. Спрос на продукты питания подвержен воздействию множества переменных, включая экономические факторы, изменения в потребительских предпочтениях, сезонные колебания и социокультурные тенденции. Поэтому точное прогнозирование потребительского спроса становится ключевым элементом в данной отрасли.

Во-вторых, Казахстан как страна переживает период интенсивных социально-экономических изменений, включая быстрый рост населения, увеличение уровня

доходов и изменения в потребительском поведении. Эти динамические изменения создают необходимость в более точных и адаптивных методах прогнозирования спроса, которые могут учитывать сложные факторы, связанные с демографией и экономикой.

В-третьих, внедрение современных технологий в продовольственной индустрии, таких как электронная коммерция и цифровые платформы, приводит к появлению большого объема данных о покупательском поведении. Эти данные предоставляют уникальные возможности для применения методов анализа больших данных и искусственного интеллекта для прогнозирования спроса, что, в свою очередь, требует глубокого исследования эффективности этих методов в конкретном регионе, таком как Казахстан.

Цель — выявить применимость каждого метода и их способность точно предсказывать спрос в условиях, уникальных для нашей страны. Исследование предоставит не только обзор современных методов прогнозирования, но также рассмотрит их применимость и ограничения в контексте специфических потребительских требований и рыночных факторов.

Материалы и методы

Различные исследования, в которых использовались модели прогнозирования по запросу, предсказывали продажи, рассчитанные с использованием регрессионных моделей машинного обучения и методов с анализом временных рядов для прогнозирования показателей продаж с использованием расширенных функций.

В статье «Decision Support System for Customer Demand Forecasting and Inventory Management of Perishable Goods» (Sridama, 2018) были исследованы продажи крупного магазина свиных котлет из провинции Бунг Кан, которая находится на северо-востоке Таиланда. Этот магазин продает более 300 000 бат в день и проводит распродажи в непраздничные дни. Для анализа данных используются три алгоритма:

1) алгоритм одиночного экспоненциального сглаживания (the single exponential smoothing algorithm);

2) алгоритм одиночного экспоненциального сглаживания с адаптивной скоростью отклика (the adaptive-response-rate single exponential smoothing algorithm);

3) двухпараметрический алгоритм линейного экспоненциального сглаживания Холта (the Holt's two-parameter linear exponential smoothing algorithm).

Выбранные три метода сравниваются и показывают, насколько точность прогноза заказа близка к фактическому значению. Методами оценки этих алгоритмов являются методы The Mean Squared Error (MSE) и The Mean Absolute Percentage Error (MAPE). Результаты прогнозирования данных показали, что однократное экспоненциальное сглаживание может дать наименьшее значение среднеквадратичной ошибки в каждом предложенном товаре.

В статье «Effective Demand Forecasting Model Using Business Intelligence Empowered With Machine Learning» (Adnan Khan, 2020) прогноз был основан на собранных данных из различных источников. Механизм машинного обучения обрабатывает данные и определяет еженедельные, ежемесячные и квартальные

потребности в товарах. Для проверки эффективности определяется процентная погрешность путем сравнения прогнозируемых данных с фактическими. Результаты моделирования показывают, что после применения разработанного решения к данным организации в режиме реального времени точность достигла 92,38 % для магазина с точки зрения интеллектуального прогнозирования спроса.

Алгоритм, используемый для прогнозирования, представляет собой обучение с учителем для одномерных (скалярных) временных рядов с использованием рекуррентных нейронных сетей (RNN). Для прогнозирования этого временного ряда был использован алгоритм Amazon sage maker Deep AR. Amazon sage maker называют полностью управляемым сервисом машинного обучения (Adnan Khan, 2020: 5).

Согласно прогнозным расчетам, производительность более глубоких моделей отличается высокой точностью. Это позволяет сделать вывод, что процентные значения погрешности относительно невелики, поэтому более глубокие модели дают высокий процент точности прогнозирования. По мере увеличения объема данных модель выдает более точные результаты.

В работе «Predictive big data analytics for supply chain demand forecasting: methods, applications, and research opportunities» (Seyedan, 2020) изучили приложения аналитики больших данных для прогнозирования спроса в цепочке поставок, чтобы предложить классификацию этих приложений, выявить пробелы и предоставить информацию для будущих исследований. Классифицируются эти алгоритмы и их приложения в управлении цепочками поставок (supply chain management) на прогнозирование временных рядов, кластеризация, K-ближайших соседей, нейронные сети, регрессионный анализ, машины опорных векторов и регрессию опорных векторов.

О применении аналитики больших данных для прогнозирования спроса в цепочках поставок сообщалось как в рамках контролируемого, так и неконтролируемого обучения. При контролируемом обучении данные будут связаны с метками, что означает, что входные и выходные данные известны. Алгоритмы контролируемого обучения идентифицируют лежащие в основе взаимосвязи между входными и выходными данными, чтобы сопоставить входные данные с соответствующими выходными данными, полученными из нового немаркированного набора данных.

Проанализировав последние 15 лет исследований по применению анализа больших данных/машинного обучения в прогнозировании спроса на SC, авторы нашли 64 исследовательских работ (исключая книги, главы из книг и обзорные статьи) и классифицировали их в соответствии с методологиями, принятыми для прогнозирования спроса. В таблице 1 перечислены пять наиболее часто используемых методов (Seyedan, 2020: 7–8).

Таблица 1 – «Статистика часто используемых методов прогнозирования спроса»

Рейтинг	Метод	Количество исследований
1	Нейронной сети	30
2	Регрессия	27

3	Прогнозирования временных рядов (ARIMA)	13
4	Метод опорных векторов	8
5	Дерево решений	8

Нейронные сети и регрессионный анализ рассматриваются как два наиболее часто используемых метода из семи основных техник. Исследование также указало на тот факт, что оптимизационные модели или имитационное моделирование могут быть использованы для повышения точности прогнозирования путем формулирования и оптимизации функции затрат для подгонки прогнозов к данным.

Результаты и обсуждение

Анализ научных публикаций не выявил работы, посвященных методам прогнозирования спроса на продукты в контексте Казахстана. Этот недостаток научных исследований представляет серьезное ограничение для бизнес-сектора и государственных органов, стремящихся оптимизировать свои стратегии предложения и ассортимента товаров в соответствии с растущими потребительскими требованиями. Подчеркивается необходимость проведения систематических исследований, направленных на разработку эффективных методов прогнозирования спроса в условиях Казахстана, что позволит улучшить стратегическое планирование и повысить конкурентоспособность как национальных, так и международных бизнес-инициатив в этом регионе.

Изменения в демографии населения имеют существенное влияние на спрос на социально значимые продукты питания. Демографические факторы, такие как возрастная структура, рождаемость, смертность, миграция и уровень образования, могут определять потребительские предпочтения, потребности в питательных веществах и общие покупательские тенденции в области продуктов питания. Изучение и анализ демографических факторов помогает государственным органам разрабатывать более эффективные программы поддержки, направленные на обеспечение доступности социально значимых продуктов питания для всех слоев населения.

Далее рассмотрим анализ зависимости между среднегодовой численностью населения страны и объемом употребленных социально значимых продуктов питания. На данном этапе был использован статистический метод – расчет коэффициентов корреляции Пирсона и Спирмена.

1. Коэффициент корреляции Пирсона измеряет силу и направление линейной связи между двумя переменными.

2. Коэффициент корреляции Спирмена измеряет силу и направление монотонной связи между двумя переменными.

Для анализа был использован набор данных, где объединены данные по потреблению продуктов питания населением (https://stat.gov.kz/ru/industries/labor-and-income/stat-life/publications/6432/) и среднегодовой численности населения Республики Казахстан за 2001–2022 годы (https://stat.gov.kz/ru/industries/social-statistics/demography/publications/6373/), которые предоставило Бюро национальной статистики. В таблице 2 приведен пример полученных данных по

объему употреблённого хлеба в среднем на душу населения на год и среднегодовой численности населения в стране.

Таблица 2 – статистика среднегодовой численности населения и объем употребленного хлеба на одного человека в год для каждого из рассматриваемых годов

Год	Среднегодовая численность населения	Объем употребленного хлеба, кг
2001	14 858 335	137.9
2002	14 858 948	120.4
2003	14 909 018	122.4
2004	15 012 985	116.0
2005	15 147 029	114.1
2006	15 308 084	123.6
2007	15 484 192	122.5
2008	15 674 000	121.9
2009	16 092 822	121.3
2010	16 321 872	122.765
2011	16 557 201	124.23
2012	16 792 089	123.623
2013	17 035 550	124.481
2014	17 288 285	126.19
2015	17 542 806	129.758
2016	17 794 055	130.717
2017	18 037 775	133.688
2018	18 276 452	138.488
2019	18 513 673	136.329
2020	18 755 665	140.311
2021	19 000 987	133.77
2022	19 634 983	127.969

Для оценки степени взаимосвязи между численностью населения и объемом потребления по всем группам продуктов питания были рассчитаны коэффициенты корреляции Пирсона, Спирмена (Downey, 2014: 96–102). Полученные результаты представлены в таблице 3.

Таблица 3 – Корреляции между употреблением продуктов и численностью населения: коэффициенты Пирсона и Спирмена

Продукт	Коэффициент корреляции Пирсона	Коэффициент корреляции Спирмена
Хлебопродукты	0.6662324806458779	0.7007340485601357
Мясо	0.9726066470869891	0.9620161718650192
Молоко	0.7944664031620555	0.8113026721069307
Масла и жиры	0.609949513622563	0.6686802811445746
Картофель	-0.21174477696216829	-0.340550370977031
Сахар	0.8272162619988708	0.8520109225611995
Овощи	0.5177865612648223	0.5735677231503435
Фрукты	0.9808018068887635	0.9706807344657554
Яйца	0.9717673630717111	0.9765703064790511
Рыба	0.9369722575760056	0.9398897812265632

Если коэффициент равен 1 или -1, это означает идеальную корреляцию переменных, что позволяет сделать точное предсказание значения одной переменной на основе знания другой. По результатам очень сильная положительная корреляция с численностью населения имеется у мяса, фруктов, яиц и рыб. При высокой численности населения уровень употребления картофеля склонен быть ниже, так как коэффициенты отрицательны, но близки нулю, что означает слабую корреляцию. Для оставшихся продуктов питания существует средняя положительная корреляция, которая указывает на то, что уровень употребления продуктов и численность населения имеют тенденцию расти вместе.

График, представленный на рисунке 1, иллюстрирует изменения в уровне потребления картошки, измеренные в килограммах, и численности населения, представленной в миллионах, в каждом году.

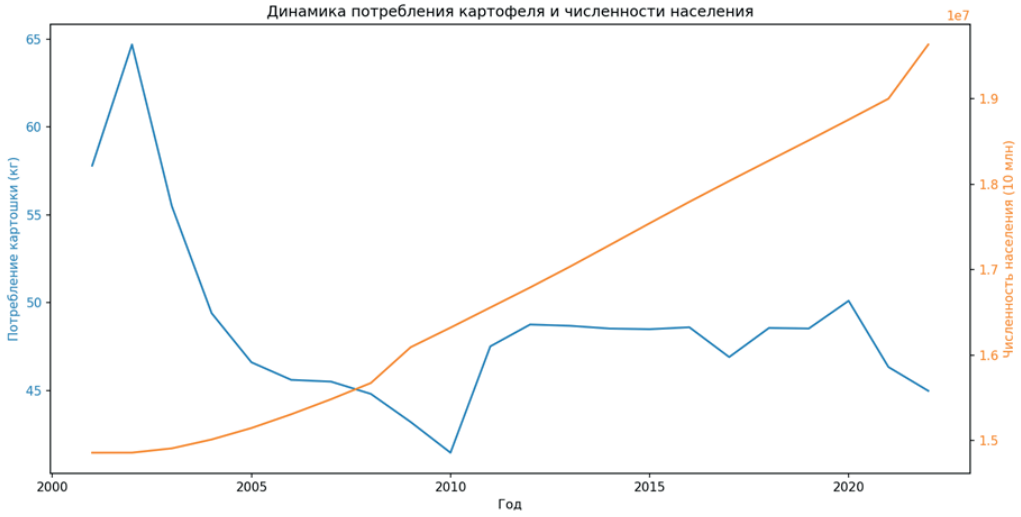

Рисунок 1 – «Динамика потребления картофеля и численности населения»

График позволяет наглядно оценить различия в масштабе изменений для двух переменных. Синяя линия представляет потребление картофеля, а оранжевая линия – численность населения. Таким образом, график не только соответствует значениям коэффициентов корреляции Пирсона и Спирмена, но и предоставляет визуальное подтверждение слабой отрицательной связи между потреблением картофеля и численностью населения в рассматриваемом временном периоде.

По графику на рисунке 2 видно, как изменения в потреблении фруктов (синяя линия) коррелируют с численностью населения (оранжевая линия). Высокие значения коэффициентов корреляции указывают на сильную положительную связь между потреблением фруктов и численностью населения. Графическое представление этой связи подчеркивает, что наблюдается тенденция увеличения потребления фруктов вместе с ростом населения.

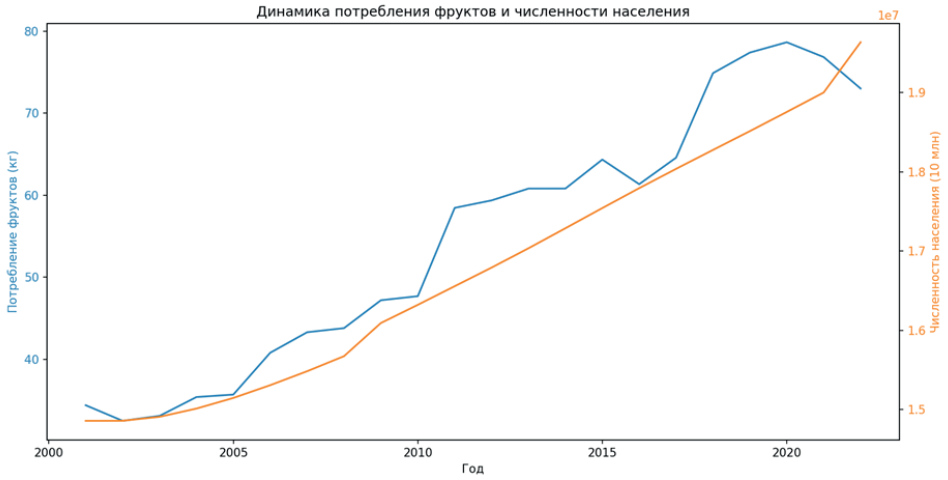

Рисунок 2 – «Динамика потребления фруктов и численности населения»

Интеграция различных видов данных, таких как демографические данные и прогнозы роста населения, в модель прогнозирования спроса может значительно улучшить ее точность и релевантность. К данным о потреблении продуктов если добавить данные о демографических показателях для конкретных регионов или групп населения, получится создать более точную и предсказуемую модель спроса на продукты.

Модель из нейронных сетей после обучения на обучающих данных и проверки ее производительности на тестовых данных, используя метрики, подходящие для задачи прогнозирования, такие как средняя абсолютная ошибка (MAE) и средняя квадратическая ошибка (MSE) оценят производительность модели.

Заключение

Результаты исследования не только подчеркивают важность точного прогнозирования потребительского спроса для устойчивого развития продовольственной индустрии в Казахстане, но также предоставляют ценные практические рекомендации для бизнеса и государственных органов. Полученные результаты могут быть использованы для оптимизации стратегий закупок, управления запасами, способствуя более эффективному удовлетворению потребностей населения и снижению рисков на рынке продуктов питания в Казахстане.

В результате исследования был проведен комплексный анализ динамики потребления основных продуктов питания и численности населения в период с 2001 по 2022 год. На основе статистических данных о потреблении хлеба, мяса, молока, масел и жиров, картофеля, сахара, овощей, фруктов, яиц и рыбы были рассчитаны коэффициенты корреляции Пирсона и Спирмена.

Из анализа данных выявлены интересные закономерности и тенденции. Например, сильная положительная связь между потреблением фруктов и численностью населения, что может указывать на важность здорового питания для общего благосостояния. С другой стороны, слабая отрицательная связь

между потреблением картофеля и численностью населения, подтвержденная коэффициентами корреляции, может требовать дополнительного исследования для выяснения возможных факторов влияния.

Демографические переменные оказывают влияние на спрос на социально значимые продукты питания, определяя тенденции потребления, предпочтения и паттерны покупок. Однако следует отметить, что проведенный анализ предоставляет описание корреляций, но не обеспечивает основы для выявления причинно-следственных связей между потреблением продуктов питания и динамикой численности населения.

Для полного понимания факторов, влияющих на эти взаимосвязи, требуется дополнительное исследование, учитывающее такие аспекты, как социально-экономические факторы, образ жизни, и здоровье населения.

Следовательно, исследование и учет демографических данных являются неотъемлемой частью эффективного управления спросом и предложением продуктов питания. Успешное сбалансированное внимание к демографическим аспектам позволяет обеспечить доступность и разнообразие социально значимых продуктов питания, способствуя здоровью и благосостоянию общества в целом.

ЛИТЕРАТУРЫ

M. Adnan Khan, S. Saqib, T. Alyas, A. Rehman, Y. Saeed, A. Zeb, M. Zareei & E.M. Mohamed. (2020). “Effective Demand Forecasting Model Using Business Intelligence Empowered With Machine Learning”.

Allen B. Downey. (2014). “Think Stats: Exploratory Data Analysis in Python”. (2014). — Стр. 96–102. — URL: *http://greenteapress.com/thinkstats2/thinkstats2.pdf*

Mahya Seyedan & Fereshteh Mafakheri. (2020). “Predictive big data analytics for supply chain demand forecasting: methods, applications, and research opportunities”.

Потребление продуктов питания в домашних хозяйствах Республики Казахстан. — URL: *https://stat.gov.kz/ru/industries/labor-and-income/stat-life/publications/6432/*

P. Sridama & C. Siribut. (2018). “Decision Support System for Customer Demand Forecasting and Inventory Management of Perishable Goods”.

Численность населения Республики Казахстан. — URL: *https://stat.gov.kz/ru/industries/social-statistics/demography/publications/6373/*

REFERENCES

P. Sridama & C. Siribut. (2018). “Decision Support System for Customer Demand Forecasting and Inventory Management of Perishable Goods”.

M. Adnan Khan, S. Saqib, T. Alyas, A. Rehman, Y. Saeed, A. Zeb, M. Zareei & E.M. Mohamed. (2020). “Effective Demand Forecasting Model Using Business Intelligence Empowered With Machine Learning”.

Mahya Seyedan & Fereshteh Mafakheri. (2020). “Predictive big data analytics for supply chain demand forecasting: methods, applications, and research opportunities”.

Food consumption in households of the Republic of Kazakhstan. — URL: *https://stat.gov.kz/ru/industries/labor-and-income/stat-life/publications/6432/*

Population of the Republic of Kazakhstan. — URL: *https://stat.gov.kz/ru/industries/social-statistics/demography/publications/6373/*

Allen B. Downey. (2014). “Think Stats: Exploratory Data Analysis in Python”. (2014). — Pp. 96–102. —URL: *http://greenteapress.com/thinkstats2/thinkstats2.pdf*

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GLOBALIZATION AND ADAPTATION OF DEVOPS CULTURE IN THE CORPORATE ENVIRONMENT: CHALLENGES AND PERSPECTIVES

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Abstract. Modern corporations strive to ensure high performance and flexibility of their information technologies, and in this context, the culture of DevOps becomes a key factor in the successful merging of development and operations. Our research paper is devoted to analyzing the challenges and prospects associated with adapting the culture of DevOps in the corporate environment in the context of globalization. We will begin with an overview of the main principles and values of DevOps, identifying how they can be implemented in the corporate structure. We explore the integration of DevOps into traditional project management processes and interactions between development and operations departments. Considering successful cases will highlight the most effective ways of implementing DevOps in large organizations. Within the article, we will also analyze the challenges companies face when implementing DevOps, especially in the context of changing corporate culture, training personnel, and managing changes. We will propose strategies to overcome these challenges and emphasize the importance of building flexible and responsive processes for successful adaptation in a global environment. In conclusion, the article will discuss the prospects for the development of DevOps culture in the corporate environment and its impact on

improving development timelines, product quality, and overall efficiency of IT processes, considering globalization. The research aims to provide practical recommendations and inspiration for organizations seeking to achieve maximum performance through the implementation of DevOps culture in their corporate environment.

Keywords: DevOps, Management, Integration, IT Project Performance, Globalization

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ЖАҺАНДАНУ ЖӘНЕ КОРПОРАТИВТІК ОРТАДАҒЫ DEVOPS МӘДЕНИЕТІН БЕЙІМДЕУ: ҚИЫНДЫҚТАР МЕН ПЕРСПЕКТИВАЛАР

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Аннотация. Қазіргі корпорациялар өздерінің ақпараттық технологияларының жоғары өнімділігі мен икемділігін қамтамасыз етуге тырысады және осы тұрғыда DevOps мәдениеті даму мен операцияларды сәтті біріктірудің негізгі факторына айналуда. Біздің ғылыми мақаламыз жаһандану жағдайында корпоративтік ортада DevOps мәдениетін бейімдеуге байланысты қиындықтар мен перспективаларды талдауға арналған. Біз DevOps-тің негізгі принциптері мен құндылықтарын шолудан бастаймыз, оларды корпоративті құрылымға қалай енгізуге болатындығын анықтаймыз. Біз DevOps-тің дәстүрлі жобаларды басқару процестеріне интеграциясын және даму және операциялар бөлімдері арасындағы өзара әрекеттесуді зерттейміз. Табысты жағдайларды қарастыру DevOps-ті ірі ұйымдарға енгізудің тиімді әдістерін бөліп көрсетуге мүмкіндік береді. Мақаланың бір бөлігі ретінде біз DevOps-ті енгізу кезінде компаниялардың алдында тұрған қиындықтарды, әсіресе корпоративтік мәдениетті өзгерту, қызметкерлерді оқыту және өзгерістерді басқару контекстінде талдаймыз. Біз осы қиындықтарды жеңу стратегияларын ұсынамыз және жаһандық ортада сәтті бейімделу үшін икемді және жауап беретін процестерді құрудың маңыздылығын атап өтеміз. Қорытындылай келе, мақала корпоративтік ортадағы DevOps мәдениетін дамыту перспективаларын және оның жаһанануды ескере отырып, әзірлеу мерзімдерін,

өнім сапасын және АТ процестерінің жалпы тиімділігін жақсартуға әсерін талқылайды. Зерттеу DevOps мәдениетін өзінің корпоративтік ортасына енгізу арқылы максималды өнімділікке қол жеткізгісі келетін ұйымдарға практикалық ұсыныстар мен шабыт беруге бағытталған.

Түйін сөздер: DevOps, басқару, интеграция, ат жобаларының өнімділігі, жаһандану

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ГЛОБАЛИЗАЦИЯ И АДАПТАЦИЯ КУЛЬТУРЫ DEVOPS В КОРПОРАТИВНОЙ СРЕДЕ: ВЫЗОВЫ И ПЕРСПЕКТИВЫ

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Аннотация. Современные корпорации стремятся обеспечить высокую производительность и гибкость своих информационных технологий, и в этом контексте культура DevOps становится ключевым фактором успешного слияния разработки и операций. Наша научная статья посвящена анализу вызовов и перспектив, связанных с адаптацией культуры DevOps в корпоративной среде в условиях глобализации. Мы начнем с обзора основных принципов и ценностей DevOps, выявляя, как они могут быть внедрены в корпоративную структуру. Мы исследуем интеграцию DevOps в традиционные процессы управления проектами и взаимодействие между отделами разработки и операций. Рассмотрение успешных кейсов позволит выделить наиболее эффективные способы внедрения DevOps в крупных организациях. В рамках статьи мы также проанализируем вызовы, с которыми сталкиваются компании при внедрении DevOps, особенно в контексте изменения корпоративной культуры, обучения персонала и управления изменениями. Мы предложим стратегии преодоления этих вызовов и подчеркнем важность построения гибких и отзывчивых процессов для успешной адаптации в глобальной среде. В заключение, статья обсудит перспективы развития культуры DevOps в корпоративной среде и ее влияние на улучшение сроков разработки, качества продукта и общей эффективности ИТ-процессов с учетом глобализации. Исследование направлено на предоставление практических рекомендаций и

вдохновения для организаций, стремящихся достичь максимальной производительности через внедрение культуры DevOps в своей корпоративной среде.

Ключевые слова: DevOps, управление, интеграция, производительность ИТ-проектов, глобализация

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Introduction

In the modern dynamic world of information technology (IT), where innovation and rapid response to changes are key elements of competitiveness, the adaptation of DevOps culture in the corporate environment becomes a matter of paramount importance. DevOps, as a term, unites practices and principles aimed at improving the interaction between development (Development) and operations (Operations) departments, with the goal of creating more effective and responsive IT processes. In 'The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win' DevOps is described as more than just a technical approach: 'We're hearing more lately: something called "DevOps." Maybe everyone attending this party is a form of DevOps, but I suspect it's something much more than that. It's Product Management, Development, IT Operations, and even Information Security all working together and supporting one another.' (Kevin Behr, Gene Kim, and George Spafford, 2013) Our scientific article is intended for a deep analysis of the challenges and prospects associated with the successful adaptation of DevOps culture within corporate structures.

DevOps is a set of software development and operation practices and a recent addition to a large family of different kinds of software process models. The model emerged out of the observation that information systems operations and developments should be closely integrated activities to ensure the success of any organization. Thus, DevOps methods are an additive tool for companies to improve overall performance in their software development processes and operations (Nasreen Azad, Sami Hyrynsalmi, 2023).

In the following sections of the article, we will examine the foundations of DevOps culture, successful cases of its integration, the challenges organizations face in seeking adaptation, change management strategies, and the prospects for developing DevOps culture in the corporate environment.

Introduction to DevOps culture provides a fundamental understanding of the key principles and values that underlie this methodology. DevOps, as a synthesis of "Development" and "Operations," aims to create a united and cohesive team of developers and operational staff to enhance the efficiency and flexibility of IT processes.

At the heart of DevOps culture lie key principles focused on close interaction between developers and operational staff. This approach embodies several main directions that define the uniqueness and effectiveness of DevOps.

First and foremost, DevOps strives to create a culture of collaboration and open communication. This means an active exchange of knowledge and experience among process participants, which in turn, contributes to increasing overall efficiency. It is important to note that DevOps pays special attention to creating conditions for successful interaction between developers and operational staff.

Another key aspect is the automation of processes. DevOps advocates for maximum automation of development, testing, and implementation of changes. This approach not only reduces the risk of human error but also significantly speeds up the development cycle, which is particularly important in rapidly changing markets.

DevOps also emphasizes iterativeness and frequent releases. Supporting the concept of continuous improvement, DevOps encourages teams to promptly implement new features and changes. This approach ensures more flexible and responsive development, meeting modern market demands. A key goal of continuous delivery is changing the economics of the software delivery process so the cost of pushing out individual changes is very low (Nicole Forsgren). This perspective highlights the economic efficiency achieved through the DevOps model, emphasizing the reduced costs and enhanced speed of delivering updates and new features.

A significant principle of DevOps culture is the responsibility for the production environment. The idea of "DevOps in production" involves not only the creation but also the support of applications in the production environment. This approach ensures that developed solutions will function successfully in real conditions, which is an integral part of the DevOps philosophy.

The second important aspect of DevOps culture is its distinction from traditional development methodologies, such as Waterfall. In this context, DevOps stands out for its flexibility and adaptability, providing a more flexible approach to development. Unlike Waterfall, where each development stage follows the previous one, DevOps allows for quick responses to changes in requirements, ensuring a more efficient development process.

Another key difference is the integration of development and operations. DevOps aims to reduce the gap between these departments, striving for their unity. Instead of considering development and operations as isolated processes, DevOps creates a common team, which promotes closer interaction and collaboration.

Another key distinction is the approach to release cycles. DevOps encourages short release cycles, meaning that new features and changes can be delivered to the business more promptly. This principle not only accelerates the introduction of new capabilities but also shortens the time from idea to actual implementation, which is important in a rapidly changing business landscape.

This section provides a fundamental view of the principles and values at the core of DevOps culture and clarifies how these foundations differ from traditional development methodologies. The following sections of the article will cover successful integration cases, adaptation challenges, and change management strategies in the context of DevOps.

Further Considerations of DevOps Culture Principles and Values

We will now examine the fundamental principles and values that underlie the culture of DevOps. The first is collaboration and cooperation: this principle emphasizes the importance of interaction between developers and operational staff. DevOps supports collaborative work to achieve a common goal - the creation and maintenance of stable and efficient information systems.

Another crucial principle is automation and tools: the value of DevOps in automating development processes and implementing changes enhances team efficiency and reduces the likelihood of human errors. The use of automation tools becomes a key component in achieving successful DevOps implementation.

Iterativeness and rapid release cycles also cannot be overlooked: the DevOps principle supports frequent iterations and quick release cycles, allowing for more prompt implementation of new features and fixes into the product. This reduces time delays and increases responsiveness to changes in requirements.

It is also necessary to consider several successful cases of integrating DevOps culture into large corporate structures. These examples provide valuable lessons and practical insights for organizations aspiring to successfully implement DevOps.

Example 1: Banking Sector

In one of the large banks, DevOps was successfully implemented to improve the processes of updating banking systems. Collaborative work between development and operational teams helped reduce the implementation time of updates from several weeks to a few days. Automated tests and implementation processes significantly reduced the number of errors and improved the stability of banking systems.

Example 2: Industrial Manufacturing

In the field of industrial manufacturing, DevOps culture was successfully implemented to optimize equipment monitoring and update processes. The use of automation tools significantly improved performance and timeliness of changes. The development and operational teams became more cohesive, leading to quicker responses to failures and problems in the production environment.

Example 3: Technology Startup

A technology startup successfully integrated DevOps culture from its inception. As a result, the startup was able to quickly deploy new features and services, contributing to rapid user base growth. The flexibility and responsiveness of DevOps gave the startup a competitive edge in the market.

These examples highlight that successful integration of DevOps culture is possible in various industries and types of organizations. A common factor in these cases is not only the use of technological tools but also the change in the culture of collaboration and interaction within teams.

Challenges in Adapting DevOps Culture

Implementing DevOps culture often requires significant changes in corporate culture. Developing new values of collaboration, openness to new ideas, and readiness for change can encounter resistance from old traditions. The need to change the mindset of employees and leadership is one of the main challenges that require careful guidance and educational programs.

Another significant challenge is training staff in new methods and tools implemented in the context of DevOps. Training not only in technical aspects but also in changing approaches to work, automation, and interaction between departments requires time and resources. Insufficient staff preparation can be a barrier to the successful adaptation of DevOps culture.

Effective change management is also a challenge in implementing DevOps. Moving away from old processes and introducing new ones implies not only technological changes but also changes in organizational structure, employee responsibilities, and ways of interaction between departments. Managing these changes in a way that minimizes resistance and maximizes the adoption of new methodologies is a complex task.

In this part of the study, we focus on strategies that organizations can use for effective change management in the process of adapting DevOps culture. Leadership plays a key role in the successful implementation of DevOps. Influential leaders must create an inspiring vision of change and demonstrate personal involvement in adapting DevOps. Transitioning to a new culture requires clear leadership and support from top management.

Using modern change management tools is an important component of successful adaptation to DevOps culture. Electronic systems for tracking changes, web platforms for information exchange, and training programs help structure and coordinate the change process, ensuring a smoother transition.

Analyzing successful practices of organizations that have already successfully implemented DevOps is a valuable resource for those just starting their journey in this area. We will consider specific cases where change management strategies played a key role in success and highlight proven methods that can be adapted for one's own needs.

In this part of the research, we focus on the prospects of developing DevOps culture in a corporate environment, considering the expected long-term benefits and potential challenges.

Adopting DevOps culture offers organizations a unique opportunity to achieve long-term benefits. Effective implementation of DevOps principles can lead to improved overall performance. Accelerating the development cycle, more frequent releases, and process automation contribute to overall efficiency enhancement.

One significant result of implementing DevOps is greater flexibility and responsiveness of the organization. The DevOps methodology provides a more flexible and responsive approach to changes in requirements, allowing companies to respond more quickly to market demands and customer requests.

Another advantage is the reduction of costs and risks. Automated processes and improved collaboration methods within DevOps reduce the risk of human error and, consequently, operational costs. This approach also helps in reducing overall risks associated with implementing changes, becoming an important factor in the pursuit of stability and reliability in operations.

Despite the potential advantages, the culture of DevOps faces challenges and trends in the future. Companies must be prepared primarily for cultural changes: ongoing cultural

changes may require constant attention and support from leadership for successful integration. DevSecOps security is also important: with the growing importance of IT security, the future of DevOps includes integrating security aspects into DevSecOps. Additionally, changes in tool and technology development: the future of DevOps culture is associated with the continuous development of tools and technologies that support effective automation and collaboration.

The international context and globalization of DevOps are also interesting to consider. Namely, how different countries and cultures adapt and implement DevOps practices.

The international context and globalization of DevOps are key factors in the modern world of information technology. In the era of globalization, where technology and innovation know no borders, DevOps practices are adapted and implemented in various countries and cultural contexts. This process not only contributes to the spread of DevOps as a global phenomenon but also enriches it with diverse approaches and unique implementations.

The adoption of DevOps in different countries depends on many factors, including economic conditions, the level of technological development, cultural features, and educational systems. In developed countries, such as the USA, Germany, and Japan, where there is a strong IT infrastructure and a high level of technological maturity, DevOps quickly became a popular practice. These countries often act as innovation leaders, and their approaches to DevOps are characterized by a high degree of automation, process improvement, and the introduction of advanced technologies.

In developing countries, such as India, Brazil, and South Africa, the implementation of DevOps is also gaining momentum but has its specifics. These countries often face limited resources, leading them to seek more economical and adaptable solutions. In these conditions, DevOps often acts as a means to increase efficiency and reduce costs. Companies in these regions tend to focus more on the cultural aspects of DevOps, such as collaboration and flexibility, and less on costly technological innovations.

The cultural context plays an important role in adapting DevOps. For example, in countries with high levels of hierarchy in organizations, such as Japan or South Korea, the implementation of DevOps may face certain obstacles, as this methodology requires flexibility and flat hierarchies. In such cases, companies must not only introduce new tools and processes but also work on changing corporate culture and management structure.

In the context of globalization, many companies become multicultural, including employees from different countries and cultural backgrounds. This creates unique challenges and opportunities for DevOps. Multicultural teams may face barriers in communication and understanding, but at the same time, they can bring diverse views and approaches that enrich the DevOps process. Effective management of multicultural teams and creating an environment where each team member feels involved and valued becomes a key aspect of DevOps success on a global scale.

With the diversity brought by globalization, it becomes increasingly crucial to ensure that every member of an organization, regardless of their geographical or cultural background, is aligned and informed about the ongoing processes. This alignment is

vital for maintaining a cohesive and efficient workflow across different teams. In order to be able to know if we are making progress toward our goal, it's essential that everyone in the organization knows the current state of work (Gene Kim, 2016).

Technological innovations also play a significant role in the globalization of DevOps. New tools and platforms that simplify collaboration and automation become available to companies worldwide. Cloud technologies, containerization, and microservices allow teams to develop and deploy applications faster and more efficiently, regardless of their geographical location.

However, the globalization of DevOps also comes with certain challenges. One of them is managing security and compliance with various international standards and regulations. Since DevOps often involves continuous delivery and deployment, companies must ensure that their processes comply with all necessary security and data confidentiality requirements.

Education and training are also key factors in the globalization of DevOps. The growing demand for DevOps specialists leads to the need to develop educational programs and courses focused on this methodology. Many universities and educational institutions around the world are introducing courses and programs dedicated to DevOps to prepare students for work in this rapidly developing field.

Conclusion

In the final part of our research, we summarize the analysis of the adaptation of DevOps culture in the corporate environment, with a particular focus on the influence of globalization. Our main conclusions emphasize that successful adaptation of DevOps culture requires not only technical changes but also cultural transformations within the organization, especially in a global context.

We discovered that collaboration and cultural changes are critically important for the effective adaptation of DevOps. Organizations need to not only implement new technologies and practices but also strive to create a culture of openness and flexibility that fosters innovation and effective interaction.

Training and supporting staff remain key factors for success. Developing competencies and skills of employees, as well as their adaptation to new methods of working in the DevOps environment, are critically important for achieving expected results.

Change management acts as a central element of successful DevOps implementation, especially in a multicultural and international environment. Effective change management helps minimize resistance and facilitates a smoother transformation.

In the context of globalization, DevOps significantly influences global IT strategies, contributing to more efficient, flexible, and innovative software development. The globalization process not only helps expand DevOps practices but also enriches its versatility and adaptability.

In conclusion, our study shows that the adaptation of DevOps culture in the corporate environment is a complex process that is enhanced and enriched in the conditions of globalization. Organizations aspiring to successfully implement DevOps should consider both technological and cultural aspects to fully realize the potential of this methodology in an international context.

As we conclude our discussion on the adaptation of DevOps culture in a corporate environment, it's important to reiterate the significance of process automation as a cornerstone of DevOps practices. The philosophy of incremental improvement and automation is aptly summarized by the following insight: 'So, when should you think about automating a process? The simplest answer is, “When you have to do it a second time.” The third time you do something, it should be done using an automated process. This fine-grained incremental approach rapidly creates a system for automating the repeated parts of your development, build, test, and deployment process.' (Jez Humble) This approach not only enhances efficiency but also aligns perfectly with the DevOps ethos of continuous improvement and adaptability.

REFERENCES

Forsgren, Nicole, et al. (2018). "Accelerate: The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizations." IT Revolution Press, — 2018, — *https://itrevolution.com/product/accelerate/#:~:text=%23%20%E3%80%900%E2%80%A0Accelerate%20,technology%20to%20drive%20business%20value*

Gene Kim, Jez Humble, Patrick Debois, John Willis (2016). "The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations." IT Revolution Press, — 2016, — *https://itrevolution.com/product/the-devops-handbook-second-edition/#:~:text=The%20DevOps%20Handbook%20The%20DevOps,Description*

Humble, Jez, and David Farley (2010). "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation." Addison-Wesley, — 2010, — *https://www.oreilly.com/library/view/continuous-delivery-reliable/9780321670250/#:~:text=Continuous%20Delivery%3A%20Reliable%20Software%20Releases,day%20free%20trial*

Kevin Behr, Gene Kim, George Spafford (2021). "The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win." IT Revolution Press, — 2013, — *https://www.haio.ir/app/uploads/2021/12/The-Phoenix-Project-A-Novel-about-IT-DevOps-and-Helping-Your-Business-Win-by-Gene-Kim-George-Spafford-Kevin-Behr-z-lib.org_.pdf*

Nasreen Azad, Sami Hyrynsalmi (2023). DevOps critical success factors — A Systematic Literature Review, — *https://www.sciencedirect.com/science/article/pii/S0950584923000046*

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ZIMBRA MAIL SERVER VULNERABILITIES IN RECENT YEARS

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Abstract. This article talks about the most dangerous Zimbra mail server vulnerabilities of 2021-2022. In addition, the terms of their use, vulnerable code parts and features are indicated. The risk of vulnerabilities is higher than 7.0 according to the Common Vulnerability Scoring System (CVSS) rating. This shows how easy it is to exploit the vulnerability and how much damage it can do to the system. Using them, attackers can perform various commands on the server itself, starting with accessing mail. If we take into account that Zimbra mail belongs to popular corporate solutions, we can see that its users are business representatives and the public sector. And the value of information in them is important not only for those individuals, but also for the state. After analyzing each vulnerability, their patches for each branch are shown.

Keywords: Zimbra mail server, vulnerability, malicious, Ajax, version, memcache, unrar, HTML, web server, RCE (Remote Code Execution), tag, CVE (Common Vulnerabilities and Effects)

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ZIMBRA ПОШТАЛЫҚ СЕРВЕРІНІҢ СОҢҒЫ ЖЫЛДАРДАҒЫ ОСАЛДЫҚТАРЫ

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Аннотация. Бұл мақалада Zimbra пошталық серверінің 2021–2022 жылдардағы ең қауіпті осалдықтары туралы айтылған. Сонымен қатар оларды қолдану шарттары, осал код бөліктері мен мүмкіндіктері көрсетілген. Осалдықтардың қауіпі Common Vulnerability Scoring System (CVSS) рейтингі бойынша 7,0-ден жоғары. Бұл осалдықты пайдалану қаншалықты оңай екенін және жүйеге үлкен зиянын тигізетінін білдіреді. Оларды қолдану арқылы зиянкестер поштаның хаттарына қол жеткізуден бастап сервердің өзінде турлі командалар орындай алады. Zimbra поштасы танымал корпоративтік шешімдерге жататынын ескерсек, онда оның қолданушылары бизнес өкілдері мен мемлекеттік секторы екенін байқаймыз. Ал олардағы мәліметтердің құндылығы тек сол тұлғаларға ғана емес сонымен қатар мемлекетке де маңызды. Әрбір осалдықты талдағаннан кейін олардың әрбір тармақ үшін патчтары көрсетілген.

Түйін сөздер: Zimbra почталық сервері, осалдық, зиянкес, Ajax, нұсқа, memcache, unrar, HTML, web-сервер, RCE (кодты қашықтықтан орындау), тег, CVE (жалпы осалдықтар мен әсерлер)

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УЯЗВИМОСТИ ПОЧТОВОГО СЕРВЕРА ZIMBRA ЗА ПОСЛЕДНИЕ ГОДЫ

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Аннотация. Статья содержит информацию о самых опасных уязвимостях почтового сервера Zimbra 2021–2022 годов. Авторы описывают условия их использования, уязвимые части кода и особенности. Риск уязвимостей, по оценке авторов, выше 7,0 по рейтингу Common Vulnerability Scoring System (CVSS), что показывает, насколько легко использовать уязвимость, какой ущерб она может нанести системе и каким образом злоумышленники могут выполнять различные действия на сервере. Если учесть, что почта Zimbra относится к популярным корпоративным решениям, то можно увидеть, что ее пользователями являются представители бизнеса и госсектора. И ценность информации в них важна не только для этих лиц, но и для государства. После анализа каждой уязвимости показаны их патчи для каждой ветви.

Ключевые слова: почтовый сервер Zimbra, уязвимость, злоумышленник, Ajax, версия, кэш памяти, распаковка, HTML, веб-сервер, RCE (удаленное выполнение кода), тег, CVE (общие уязвимости и эффекты)

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Кіріспе

Zimbra — жаһандық бизнес үшін танымал веб-пошта шешімі. Оны күн сайын миллиондаған пайдаланушылар арасында электрондық хат алмасу үшін 200000-нан астам компаниялар мен мыңнан астам мемлекеттік және қаржы институттары пайдаланады. Зиянкестер қызметкердің электрондық поштасына тіркелгісіне қол жеткізе алған жағдайда, көбінесе қауіпсіздікке елеулі әсер етеді. Құпия ақпарат пен құжаттардан басқа, электрондық пошта тіркелгісі құпия сөзді қалпына келтіруге мүмкіндік беретін басқа құпия тіркелгілермен жиі байланысады.

Осы мақалада бірнеше осалдықтар талқыланады. Айта кетсек CVE-2021–35208 (сайтаралық сценарий қатесі), CVE-2022–27924(аутенфикацияны өтпеген пайдаланушыға memcache командаларын орындау мүмкіндігі), CVE-2022–30333 (unrar-да файлды жазу кезіндегі осалдық) және CVE-2022–41352 (кодты қашықтықтан орындау немесе RCE) (Vulmon, 2022).

Материалдар мен әдістер

Осалдықтың әсерінен аутентификациядан өтпеген зиянкеске ұйымның Zimbra веб-пошта серверін бұзуға мүмкіндік береді. Нәтижесінде зиянкес сайттарға және барлық қызметкерлердің электрондық хаттарын қол жеткізе алады (OpenCVE, 2022).

CVE-2021–35208 — электрондық поштаның кірісін қарау кезінде пайда-

ланушының шолғышында іске қосылуы мүмкін сайтаралық сценарий қатесі. Зиянды электрондық поштада жасалған JavaScript жүктемесі болады, ол орындалған кезде зиянкеске пайдаланушының барлық электрондық хаттарына, сондай-ақ олардың веб-пошта сеансына қол жеткізуге мүмкіндік береді. Осының көмегімен басқа Zimbra мүмкіндіктеріне қол жеткізуге және одан әрі күрделі шабуылдарды бастауға болады.

Электрондық денеде DOM негізінде сақталған XSS

Zimbra архитектурасы кіріс пошта трафигін өңдейтін және веб-поштаны қамтамасыз ететін HTTP сервер бөлігіне бөлінген. Zimbra интерфейсі электрондық поштаны қарау үшін қолданылады және 3 түрлі клиент арқылы қол жетімді:

· Әдепкі клиент болып табылатын Ajax-қа сенетін клиент
· Статикалық HTML клиенті
· Мобильді құрылғылар үшін оңтайландырылған клиент

Үш түрлі клиенттің бірдей қауіпсіздік кепілдігін алуын қамтамасыз ету үшін сервер жағындағы кіріс электрондық пошталардың HTML мазмұнын тазарту туралы дизайнерлік шешім қабылданды. Бұл қадам OWASP Java-HTML-Sanitizer көмегімен мұқият және дұрыс орындалады (National Institute of Standards and Technology, CVE-2021).

Сервер жағында тазалауды пайдаланудың кемшілігі — барлық үш клиент кейіннен электрондық поштаның сенімді HTML кодын бірегей түрде көрсету үшін түрлендіре алады. Қазірдің өзінде өңделген HTML кірістерін түрлендіру HTML-дің бұзылуына, содан кейін XSS шабуылдарына әкелуі мүмкін.

Zimbra-да Ajax клиенті HTML тегтерінде ауыстыруларды орындау үшін тұрақты өрнекті пайдаланады. Бұл ауыстыру пішін тегінде әрекет атрибуты болмаған кезде орын алады, өйткені бұл атрибуттың әдепкі болмауы сол беттегі сұрауға алып келеді. Содан кейін тұрақты өрнек оның орнына әдепкі мәні бар қауіпсіз әрекет атрибутын енгізеді:

/js/zimbraMail/mail/view/ZmMailMsgView.js

```
if (html.search(/(<form)(?![^>]+action)(.*?>)/g))
{ html = html.replace(/(<form)(?![^>]+action)(.*?>)/ig, function(form)
{ if (form.match(/target/g)) { form = form.replace(/(<.*)(target=.*)(.*>)/g,
'$1action="SAMEHOSTFORMPOST-BLOCKED" target="_blank"$3'); }
else { form = form.replace(/(<form)(?![^>]+action)(.*?>)/g,
'$1 action="SAMEHOSTFORMPOST-BLOCKED" target="_blank"$2'); } return form; }); }
```

Сурет 1 - Zimbra поштасындағы осал кодтың бөлігі

Мұндай ауыстырулар қауіпті, өйткені зиянкес жарамды HTML бар пайдалы жүктемені жасай алады, мысалы:

```
<hr align="<form > x" noshade="<script>alert(document.cookie);//" />
```

Сурет 2 – Осалдықты қолдану үшін жасалатын пайдалы жүктеме

Hr тегінде басқа тегтер бар атрибуттар болса да, бұл қалыпты жағдай, өйткені form және script тегі қос тырнақшаға алынған және осы арқылы атрибут мәндері ретінде түсіндіріледі.

Алайда, жоғарыда сипатталған тұрақты өрнек align атрибутындағы пішін тегімен сәйкес келеді. Осылайша, келесі натижеге қол жеткізсек болады:

Сурет

```
<hr align="<form action="POST" target="blank" >
x" noshade="<script>alert(document.domain);alert(document.cookie);//"></div>
```

3 – Пайдалы жүктеменің күрделі түрі

HTML қазір бүлінген, өйткені бұрын зиянсыз hr тегіне бірнеше атрибуттар енгізілді. Google Chrome-да script тегі енді атрибут мәні ретінде емес, HTML тегінің өзі ретінде түсіндіріледі, бұл шабуылдаушыға электрондық поштаны қарайтын клиенттің шолғышында ерікті JavaScript кодын орындауға мүмкіндік береді.

Барлық мәселелерді Zimbra командасы 8.8.15 сериясы үшін 18 патчпен және 9.0 сериясы үшін 16 патчпен шешті. Екі тармақтың алдыңғы нұсқалары осал (OpenCVE, 2022).

CVE-2022–27924

CVE-2022–27924 8.8 нұсқаларында және 9-шы нұсқаның тармақтарында да бар. Кодтың кемшіліктері Zimbra-дағы кері прокси-серверіне әсер етеді және оны әдепкі параметрлермен аутентификацияланбаған зиянкес қолдана алады (National Institute of Standards and Technology, 2022).

Memcached — қарапайым мәтіндік протокол арқылы орнатуға және шығаруға болатын кілт/мән жұптарын сақтайтын сервер.

Zimbra-да іздеу қызметінен қажетті ішкі сервер алынғаннан кейін, ішкі сервердің мекен-жайы келесі хабарламаны жауапты Memcached қызметіне жіберу арқылы кэшке қосылады (Rapid Vulnerability, 2022):

```
# add route:proto=httpssl;user=admin@test.kz 0 3600 16(\r\n) 127.0.0.1:8443
```

Сурет 4 - Zimbra серверіне жаңа авторизациялану жолын қосады

Memcache хабарламаларының мысалдарындағы жаңа жолдарды көрсету үшін (\r\n) қолданылады, өйткені олар осалдықты түсіну үшін маңызды.

Содан кейін сервер Memcached клиентіне, бұл жағдайда кері Zimbra прокси-серверіне жадтың сәтті болғанын білдіретін қарапайым хабарламамен жауап береді:

```
STORED(\r\n)
```

Сурет 5–4-суретте орындалған командаға жүйенің жауабы

Бұл деректер кэшке қосылғаннан кейін, Zimbra-ның кері прокси-сервері пайдаланушының HTTP сұрауын орындаған сайын оларды алуға тырысады. Ол үшін Memcached серверіне келесі хабарлама жіберіледі:

```
get route:proto=httpssl;admin@test.kz
```

Сурет 6 - Пайдаланушының HTTP сұрауына жауап алу

Содан кейін Memcached сервері келесі жауапты қайтарады:

```
VALUE route:proto=httpssl;admin@test.kz 0 16(\r\n)
127.0.0.1:8443(\r\n)
END
```

Сурет 7 – «Сурет 6» жүйесінің жауабы

Кэштегі жазу кілті оңай. Ол келесі форматқа сәйкес келеді route: proto= PROTOCOL;user=EMAIL. Http ssl, imap немесе pop3 протоколдары болуы мүмкін.

Түзетілген нұсқалар 31.1 8.8.15 тармағына және 24.1 9.0.0 тармағына болып табылады.

CVE-2022–30333

CVE-2022–30333 — unrar-да файлды жазу кезіндегі осалдық. Пәрмен жолындағы unrar синтаксисі келесідей болуы мүмкін (Debian security tracker, CVE-2022):

```
unrar x archive.rar /tmp/extract
```

Сурет 8 - unrar арқылы архивті көрсетілген мұрағатқа шығару

Бұл пәрмен барлық файлдарды мұрағаттан /tmp/extract каталогына шығарады. Пәрменді шақыратын пайдаланушы файлдар тек /tmp/extract каталогына жазылады деп күтеді. Amavis сияқты бағдарламалық жасақтама барлық файлдарды өңдегеннен кейін қауіпсіз түрде жоюға болатындығына көз жеткізу үшін осы болжамға сүйенеді. Бұл қауіпсіздік жүйесі unrar көмегімен жүзеге асырылады және әдепкі бойынша қосылады (Nucleus Security Research Team Analysis CVE-2022).

Жоғарыда айтылғандай, RAR мұрағатына тіркемесі бар электрондық поштаны алған кезде, ол unrar арқылы Amavis талдауы үшін автоматты түрде алынады. Zimbra-да көптеген қызметтер, соның ішінде Amavis сервері zimbra пайдаланушысы ретінде жұмыс істейді.

Нәтижесінде файлға жазудың қарабайырлығы басқа қызметтердің жұмыс каталогтарында файлдарды құруға және қайта жазуға мүмкіндік береді. Зиянкес RCE-ге әртүрлі жолдармен қол жеткізе алады. Мысалы, ол JSP қабығын веб-каталогқа жаза алатынын айттық. Алайда, Zimbra даналарының көпшілігінде бірнеше серверлерге бөлінген өз қызметтері бар, сондықтан көптеген қондырғыларда бұл әдісті пайдалану мүмкін емес.

Зинкес Zimbra данасындағы unrar осалдығын сәтті пайдаланған кезде, ол Zimbra пайдаланушысы ретінде ерікті жүйелік командаларды орындай алады. Қазіргі таңда zimbra пайдаланушысынан root-қа дейін котеретін эксплойттар бар.

Патч 6.12 екілік нұсқасына енгізілген, оны RarLab веб-сайтынан жүктеуге

болады. Zimbra бұл мәселені Amavis-ті кіріс RAR тіркемелерін шығару үшін unrar орнына 7z орнату арқылы шешті.

CVE-2022–41352

CVE-2022–41352-ді пайдалану сценарийі келесідей (Twitter exploit for CVE-2022):

Сурет 9 - Зиянкестің CVE-2022–41352-ді пайдалану сценарийі

1) Шабуылдаушы Tar зиянды мұрағатын электрондық поштамен жібереді.

2) Электрондық поштаны алғаннан кейін Zimbra оны спам мен зиянды бағдарламаларға тексеру үшін Amavis-ке жібереді.

3) Amavis электрондық пошта тіркемелерін талдайды және тіркелген мұрағаттың мазмұнын тексереді.

4) Шығару кезінде JSP веб-қабығы webmail компоненті пайдаланатын жалпыға қол жетімді каталогтардың біріне орналастырылады. Зиянкес пайдаланушының компьютерінде ерікті командаларды орындауды бастау үшін веб-қабыққа өтуі мүмкін.

Келесі жолдар қазіргі уақытта CVE-2022–41352 пайдаланатын зиянкестердің веб-қабықшалар үшін орналастырған белгілі орындары болып табылады:

```
/opt/zimbra/jetty/webapps/zimbra/public/.error.jsp
/opt/zimbra/jetty/webapps/zimbra/public/ResourcesVerificaton.jsp
/opt/zimbra/jetty/webapps/zimbra/public/ResourceVerificaton.jsp
/opt/zimbra/jetty/webapps/zimbra/public/ZimletCore.jsp
/opt/zimbra/jetty/webapps/zimbra/public/searchx.jsp
/opt/zimbra/jetty/webapps/zimbra/public/seachx.jsp
```

Сурет 10 - зиянкестердің пайдалы жүктемелері орналасқан мұрағаттар

Егер Zimbra қондырғысында осы файлдардың бірі кездессе, демек зиянкестердің серверге кіруге мүмкіндігі бар. Тек қана файлды жою жеткіліксіз. Zimbra-да дезинфекциялау өте қиын, өйткені зиянкес әртүрлі қызмет тіркелгілері пайдаланатын құпия сөздерді қамтитын конфигурация файлдарына қол жеткізе алады. Бұл тіркелгі деректеріне интернеттен қол жетімді болса, онда серверге кіруді қалпына келтіруі мүмкін. Сонымен қатар, осы уақытқа дейін тапқан барлық веб-қабықтардың сипатын ескере отырып, зиянкес мұндай мүмкіндікке ие болғаннан кейін неғұрлым сенімді және күрделі артқы есіктерді орналастыратыны сөзсіз.

Қорытынды

Бұл мақалада Zimbra пошталық серверіндегі бірнеше осалдықтарды талдадық.

Ол осалдықтардың әрқайсысы өздігінен қауіпті болып табылады. Аталған осалдықтардан басқа да түрлі осалдықтар аз емес. Уақыт өткен сайын олардың қатары тек толығуда. Shodan утилитасына сүйенсек Қазақстанда 200 астам Zimbra пошта серверлері бар және олардың ішінде мемлекеттік мекемелер де аз емес.

ӘДЕБИЕТТЕР

Debian security tracker, [Электрондық ресурс] URL: — *https://security-tracker.debian.org/tracker/CVE-2022-30333*. (жүгінген күні 11.10.2022)

GitHub CVE-2022-30333, [Электрондық ресурс] URL: — *https://github.com/J0hnbX/CVE-2022-30333*. (жүгінген күні 15.10.2022)

National Institute of Standards and Technology (NIST), [Электрондық ресурс] URL: —*–https://nvd.nist.gov/vuln/detail/CVE-2021–35208*. (жүгінген күні 18.09.2022)

National Institute of Standards and Technology (NIST), [Электрондық ресурс] URL: — *https://nvd.nist.gov/vuln/detail/CVE-2022–27924*. (жүгінген күні 23.10.2022)

Nucleus Security Research Team Analysis CVE-2022-41352, [Электрондық ресурс] URL: — *https://nucleussec.com/cve/cve-2022–41352/*. (жүгінген күні 17.01.2023)

OpenCVE (the easiest way to track CVE updates), [Электрондық ресурс] URL: — *https://www.opencve.io/cve?vendor=zimbra*. (жүгінген күні 01.11.2022)

Rapid7 Vulnerability & Exploit Database, [Электрондық ресурс] URL: — *https://www.rapid7.com/db/vulnerabilities/zimbra-collaboration-cve-2022–27924/*. (жүгінген күні 23.10.2022)

Vulmon (vulnerability search engine), [Электрондық ресурс] URL: — *https://vulmon.com/searchpage?page=1&q=Zimbra+Collaboration&sortby=bydate&scoretype=cvssv3*. (жүгінген күні 10.09.2022)

Twitter exploit for CVE-2022–41352, [Электрондық ресурс] URL: — *https://twitter.com/sirifu4k1/status/1579102701123616768*. (жүгінген күні 20.01.2023)

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SPECIAL PURPOSE COMMUNICATION SYSTEMS

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Abstract. The article discusses the principles of human-machine control communication systems for special purposes, which belong to the class of controlled systems. In addition, the authors' attention is drawn to the methodological principles of the study of such systems; the functional architecture of a special purpose communication system (SPCS) in the form of a three-level conceptual model is considered. The most general methodological principles of communication system research, considered in the work is a systematic approach. Within the framework of this approach, an interconnected special-purpose communication system is considered as an integral part of the control system of higher-order systems. The authors believe that the methodology of the study of such systems is mainly based on a combination of methods of induction (from particular to complex) and deduction (decomposition), that is, consideration from general to particular, from simple to complex. The hierarchy of the SPCS description is used as a method of eliminating contradictions between simplicity and taking into account the remaining multiple parameters of the system. Each level of the hierarchy corresponds to specific features, functions, laws and principles, terms and concepts, using which it is best possible to predict and describe the functioning of the SPCS.

Keywords: human-machine systems, modeling methods, selection of indicators, apparatus for evaluating the effectiveness of decisions made, induction methods, decomposition methods

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АРНАЙЫ МАҚСАТТАҒЫ БАЙЛАНЫС ЖҮЙЕЛЕРІ

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Аннотация. Мақалада басқарылатын жүйелер класына жататын арнайы мақсаттағы адам-машиналық басқару байланыс жүйелерінің принциптері қарастырылады. Сонымен қатар, авторлардың назары осындай жүйелерді зерттеудің әдістемелік принциптеріне аударылады; үш деңгейлі тұжырымдамалық модель түрінде арнайы мақсаттағы байланыс жүйесінің (АМБЖ) функционалды архитектурасы қарастырылады. Жұмыста қарастырылған байланыс жүйесін зерттеудің ең жалпы әдістемелік принциптері жүйелік тәсіл болып табылады. Осы тәсіл шеңберінде өзара байланысты арнайы мақсаттағы байланыс жүйесі жоғары ретті жүйелерді басқару жүйесінің құрамдас бөлігі ретінде қарастырылады. Авторлар мұндай жүйелерді зерттеу әдістемесі негізінен индукция (жекеден күрделіге) және дедукция (ыдырау) әдістерінің жиынтығына негізделген, яғни жалпыдан жекеге, қарапайымнан күрделіге қарастыру деп санайды. АМБЖ сипаттамасының иерархиясы қарапайымдылық пен жүйенің қалған бірнеше параметрлерін ескере отырып, қайшылықтарды жою әдісі ретінде қолданылады. Иерархияның әр деңгейіне белгілі бір ерекшеліктер, функциялар, заңдар мен принциптер, терминдер мен тұжырымдамалар сәйкес келеді, оларды қолдана отырып, АМБЖ-нің жұмыс істеуін болжауға және сипаттауға болады.

Түйін сөздер: адам-машина жүйелері, модельдеу әдістері, көрсеткіштерді таңдау, қабылданған шешімдердің тиімділігін бағалау аппараты; индукция әдістері, ыдырау әдістері

Дәйексөз үшін: В.К. Клёнов, Ж.Л. Таиров, А.Т. Омаров. АРНАЙЫ МАҚСАТТАҒЫ БАЙЛАНЫС ЖҮЙЕЛЕРІ//Ақпараттық және коммуникациялық технологиялардың халықаралық журналы. 2023. V.4. № 4. Бет 84-91 (орыс тілінде). *https://doi.org/10.54309/IJICT.2023.16.4.008*.

СИСТЕМЫ СВЯЗИ СПЕЦИАЛЬНОГО НАЗНАЧЕНИЯ

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Аннотация. В статье рассмотрены принципы человеко-машинных управляющих систем связи специального назначения, которые относятся к классу управляемых систем. Кроме этого, внимание авторов обращается на методологические принципы исследования таких систем; рассмотрена функциональная архитектура системы связи специального назначения (СССН) в виде трехуровневой концептуальной модели. Наиболее общим методологическим принципом исследования системы связи, рассматриваемым в работе, является системный подход. В рамках такого подхода взаимосвязанная система связи специального назначения рассматривается как составная часть системы управления систем более высокого порядка. Авторы считают, что методология исследования таких систем в основном основана на сочетании методов индукции (от частного к сложному) и дедукции (декомпозиции), то есть рассмотрение от общего к частному, от простого к сложному. Иерархия описания СССН применяется, как метод устранения противоречий между простотой и учетом остальных множественных параметров системы. Каждому уровню иерархии соответствуют специфические особенности, функции, законы и принципы, термины и концепции, используя которые, наилучшим образом возможно прогнозирование и описание функционирования СССН.

Ключевые слова: человеко-машинные системы, методы моделирования, выбор показателей, аппарат оценки эффективности принятых решений, методы индукции, методы декомпозиции

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Введение

В данной статье авторы постарались рассмотреть принципы человеко-машинных управляющих систем связи специального назначения, которые можно отнести к классу управляемых систем. Также авторы обращают внимание на методологические принципы исследования таких систем; рассмотрена

функциональная архитектура системы связи специального назначения (СССН) в виде трехуровневой концептуальной модели. Авторы попытались рассмотреть наиболее общие методологические принципы исследования систем связи. В рамках системного подхода взаимосвязанная система связи специального назначения в статье рассматривается как составная часть системы управления систем более высокого порядка.

Материалы и методы

Одним из частных случаев человеко-машинных систем являются системы связи специального назначения (СССН). Они относятся к классу направленных управляемых систем, управляющая роль в которых принадлежит оператору или лицу, принимающему решение. Этими системами занимается теория исследования операции, как раздел кибернетики. При использовании термина исследование операции, авторы имеют в виду использование способов и методов для моделирования имеющихся свойств систем, а также анализа их характеристик. Стоит обратить внимание, что СССН — это сложная иерархическая структура, которая, в свою очередь, состоит из множества систем связи, разнесенных по ветвям управления. А они могут значительно различаться не только по оперативно-тактическим условиям работы, предъявляемым требованиям, но и в корне отличаться от гражданских систем (Исаков и др., 2017: 22–26).

В процессе подготовки, до принятия решения в первую очередь выявляется определения целей и задач СССН, подбора наилучших показателей для достижения цели, выработку альтернативных путей поведения, а также и выбора из них наилучших. Этот этап характеризуется высокой степенью ответственности за принятые решения. Причем необходимо иметь в виду, что принятые решения могут повлечь за собой достаточно серьезные последствия. В этих условиях особую роль играет выбор способа и метода определения эффективности принятых решений руководителями.

Авторы считают, что системный подход в настоящее время является наиболее общим методологическим принципом исследования СССН. В рамках этого, система связи рассматривается как составная часть общей системы управления операциями. Методология исследования их полагается на сочетании методов индукции и дедукции (декомпозиции). Рассмотрим СССН в рамках структуры, основополагающими признаками которой являются:

- последовательное расположение составляющих сетей связи;
- приоритет и/или право вмешательства систем высшего уровня;
- полная или частичная зависимость работы систем высшего уровня от реального выполнения низшими уровнями своего предназначения.

Рассматривая СССН, необходимо учитывать три вида иерархии:

- иерархия описания;
- иерархия цели;
- иерархия принятия решения.

Иерархия описания СССН применяется, как метод устранения противоречий между простотой и учетом остальных множественных параметров системы.

Каждому уровню иерархии соответствуют специфические особенности, функции, законы и принципы, термины и концепции, используя которые, наилучшим образом возможно прогнозирование и описание функционирования СССН.

Концептуальная модель СССН — это абстрактная модель, которая содержит описание принципов построения и собственно, структуры системы, анализ основных свойств, а также вопросы организации управления СССН в процессе ее работы.

К ее основным элементам можно отнести:

- назначение (цель) системы связи;
- принципы её структуры и работы;
- принципы логики;
- состав элементов, среды функционирования, взаимных связей и их параметров;
- основные свойства СССН;
- характеристики и качественные требования;
- механизм работы и взаимодействия системы со средой;
- результат адекватности модели.

В процессе исследования желательно разбить концептуальную модель на два этапа:

- на первом осуществляется доработка существующей концептуальной модели, определяя наличие проблем и их описания;
- на втором разрабатывается концептуальная модель новой системы, с учетом выявленных проблем.

Полученная модель — это только первый шаг в формировании СССН. Очередной шаг — выработка непосредственно математических моделей и создание содержательной модели. Она рассматривается авторами как отдельная модель, важность которой считается приоритетной по отношению ко всем вместе взятых моделям, принятым для исследования.

Главными признаками, содержательных моделей являются:

- должна выбирать и обосновывать исходящие данные, уточнять их количественные значения, определять степень точность исследования.
- модель должна использоваться как исходная для построения концептуальной.
- содержательная модель создается заведомо шире требуемой.
- содержательная модель не должна иметь описания признаков проблем (Голиков, 2022: 452). Концептуальная модель обязательно должна присутствовать, как при создании структуры общей системы связи, так и в научных исследованиях.

Функциональная схема системы связи специального назначения представлена в виде трёхуровневой концептуальной модели (Рисунок 1).

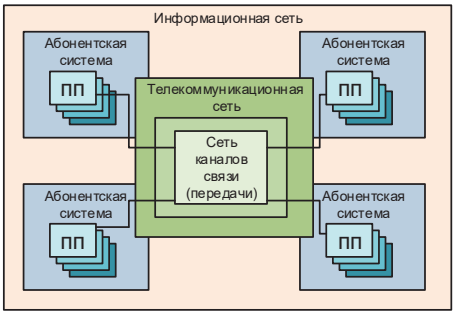

Рисунок 1 - Обобщённо функциональная архитектура СССН

Первый уровень определяет функции и законы взаимосвязи при обработке информации между разделёнными абонентскими системами по физическим каналам связи.

Второй уровень определяет функции и законы обмена информацией во взаимосвязи различных абонентских систем и, поэтому, реализуется телекоммуникационными сетями. Телекоммуникационная сеть — это общая инфраструктура, предназначенная для обмена информацией пользователей сети.

Третий уровень образует совокупность конкретных процессов в удалённых абонентских системах. Абонентские системы — это потребители информации, а также они выполняют её обработку. Третий уровень дополняет первые уровни функциями обработки информации и являются внешней частью всей информационной сети (Кутузов и др., 2012: 3–7).

В дальнейшем предлагаем рассмотреть принципы построения математических моделей, а это позволит сделать вывод о важности математического моделирования в СССН.

Результаты и обсуждение

Создание модели для анализа свойств СССН основывалось на конкретизации цели моделирования (Попов и др., 1983: 64). В основу были положены такие принципы логики:

- не представление СССН, а ее анализ;
- рассмотрение конкретной СССН в конкретных условиях её работы;
- анализ исключительно только тех параметров и связей, которые необходимы в условиях проведения только одной, конкретной операции.

Существует два принципа создания математической модели:

- принцип соответствия между сложностью модели и точностью результатов;
- принцип баланса погрешностей.

Для баланса погрешностей должна быть определена точность вычислений (не менее точности исходных данных).

Весь процесс математического моделирования условно разбит на ряд этапов.

На начальном этапе, определяют содержание и результаты всех предварительных этапов (Короткий, 2005: 102).

Непосредственно построение математической модели начинается с описания взаимосвязей СССН. Сама она (СССН), должна быть описана с позиции системного подхода. В первую очередь определяется совокупность составляющих элементов, их состояния, связь между ними и т.п. (Звонарев, 2019: 112).

На заключительном этапе результаты моделирования переносятся на реальную СССН. До принятия решения о нормальном функционировании системы, прогнозируется её поведение для оптимизации. Прогноз развития СССН — это главная цель моделирования. При этом оценивается поведение всей системы при воздействии на нее всех возможных дестабилизирующих факторов.

В процессе проектирования и построения СССН основную роль выполняет построение как абонентских, так и внутренних сетей таким образом, чтобы должностные лица пунктов управления (ПУ) могли максимально, с достаточно хорошим качеством и максимальным удобством использовать все возможности СССН (Исаков и др., 2017: 133–136).

Выводы

1. Системный подход в настоящее время является наиболее общим методологическим принципом исследования СССН.

2. Концептуальная модель СССН — это абстрактная модель, которая содержит описание принципов построения и собственно, структуры системы, анализ основных свойств, а также вопросы организации управления СССН в процессе ее работы.

3. До принятия решения о нормальном функционировании системы, прогнозируется её поведение для оптимизации.

ЛИТЕРАТУРЫ

Введение в математическое моделирование: уч. пособие/под ред. П.В. Трусова. — М.: Университетская книга, Логос, — 2007. — 440 с.

Голиков А.М. (2022). Модуляция, кодирование и моделирование в телекоммуникационных системах. Теория и практика. — С-Пб: Лань, — 2022. — 452 с.

Звонарев С.В. (2019). Основы математического моделирования: учебное пособие/С.В. Звонарев. — Екатеринбург: Изд-во Урал. ун-та, — 2019. — 112 с.

Исаков Е.Е., Мякотин А.В., Губская О.А. (2017). Оптимальная цифровизация военных систем связи. Современная наука. Актуальные проблемы теории и практики. Серия естественные и технические науки. — 2017. — № 3–4. — Стр. 22–26.

Исаков Е.Е., Мякотин А.В., Жадан А.П., Кривцов С.П., Басулин Д.В. (2017). Оценка необходимых и достаточных значений реальной пропускной способности военных систем передачи информации. Информация и космос. Радиотехника и связь. — С-Пб, — 2017. — Стр. 133–136.

Кутузов О.И., Татарникова Т.М. (2012). Моделирование систем и сетей телекоммуникаций Учебное пособие. — С-Пб, изд. РГГМУ, — 2012. — Стр. 3–7.

Короткий А.И. (2005). Математическое моделирование/А.И. Короткий, Л.Г. Гальперин. — Екатеринбург: Изд-во УГТУ-УПИ, — 2005. — 102 с.

Попов Ю.П., Самарский А.А. (1983). Вычислительный эксперимент. — М.: Знание, —1983. — 64 с.

REFERENCES

Golikov A.M. (2022). Modulation, coding and modeling in telecommunication systems. Theory and practice. — SPb: Lan, 2022. — 452 p.

Isakov E.E., Myakotin A.V., Gubskaya O.A. (2017). Optimal digitalization of military communications systems. Modern science. Actual problems of theory and practice. A series of natural and technical sciences. — 2017. — No. 3-4. — Pp. 22–26.

Isakov E.E., Myakotin A.V., Zhadan A.P., Krivtsov S.P., Basulin D.V. (2017). Assessment of necessary and sufficient values of the real bandwidth of military information transmission systems. Information and space. Radio engineering and communications. — Pp 3–4. — 2017. — Pp. 133–136.

Introduction to mathematical modeling: textbook/ edited by P.V. Trusov. — M.: University book, Logos, — 2007. — 440 p.

Kutuzov O.I., Tatarnikova T.M. (2012). Modeling of telecommunication systems and networks Textbook. — SPb, RGGMU Publishing House, — 2012. — Pp. 3–7.

Korotkiy A.I. Mathematical modeling/A.I. Korotkiy, L.G. Galperin. (2005). — Yekaterinburg: Publishing house of USTU — UPI, — 2005. — 102 p.

Zvonarev S.V. (2019). Fundamentals of mathematical modeling: a textbook/S.V. Zvonarev. Yekaterinburg: Ural Publishing House. unita, — 2019. — 112 p.

Popov Yu.P, Samarskiy A.A. (1983). Computational experiment. — M.: Znanie, — 1983.— 64 p.

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BLOCKCHAIN UTILIZATION IN THE EDUCATION SECTOR: PROSPECTS AND CHALLENGES

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Abstract. Blockchain technology has been attracting attention as a potential solution to address many issues associated with traditional data management systems. The education sector is also exploring its potential to include improving various aspects of education. One of the opportunities of blockchain technology in education is secure and tamper-proof digital record-keeping, which can eliminate the need for physical certificates and transcripts, making the credentialing process more efficient, accurate, and transparent. Blockchain can facilitate micro-credentialing for lifelong learning, creating new opportunities for individuals to acquire and verify specific skills or knowledge. Additionally, transparent and secure funding and donations can be established using blockchain technology, which will help to eliminate fraud and ensure that donations

are used for their intended purpose. However, there are also significant challenges that need to be addressed to make Blockchain a reality in education. These include concerns around the scalability and interoperability of blockchain networks, the need for standards and regulations to ensure the reliability and accuracy of data, and the potential costs and technical expertise required to implement and maintain blockchain systems. In addition, digital literacy and data privacy concerns need to be addressed to ensure that students, teachers, and other stakeholders are equipped to use blockchain technology effectively and responsibly. While the opportunities and challenges of Blockchain in education are significant, careful consideration and collaboration are needed to fully realise its potential. Thus, this paper provides the reader with a solid background about Blockchain and delves into its opportunities and challenges to be utilised in education.

Keywords: Blockchain in education; blockchain applications; distributed ledgers and education; blockchain challenges; decentralised learning

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БІЛІМ БЕРУ САЛАСЫНДА БЛОКЧЕЙНДІ ҚОЛДАНУ: ПЕРСПЕКТИВАЛАР МЕН ҚИЫНДЫҚТАР

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Аннотация. Blockchain технологиясы дәстүрлі деректерді басқару жүйелерімен байланысты көптеген мәселелерді шешудің әлеуетті шешімі ретінде назар аударады. Білім беру секторы сонымен қатар білім берудің әртүрлі аспектілерін жақсартуды қосу үшін өзінің әлеуетін зерттейді. Білім берудегі блокчейн технологиясының мүмкіндіктерінің бірі-физикалық сертификаттар мен транскрипттерді декодтау қажеттілігін жоя алатын, сертификаттау процесін тиімдірек, дәл және мөлдір ете алатын қауіпсіз және рұқсатсыз цифрлық жазбаларды жүргізу. Блокчейн Жеке тұлғаларға нақты дағдыларды немесе білімді игеруге және тексеруге жаңа мүмкіндіктер жасау арқылы өмір бойы оқу үшін микрокредитті жеңілдете алады. Сонымен қатар, алаяқтықты жоюға және қайырымдылықтардың мақсатына сай пайдаланылуын қамтамасыз етуге көмектесетін Blockchain технологиясын қолдана отырып, ашық және қауіпсіз қаржыландыру мен қайырымдылықты орнатуға болады. Сонымен қатар, білім берудегі блокчейнді шындыққа айналдыру үшін шешілуі керек күрделі мәселелер бар. Оларға блокчейн желілерінің ауқымдылығы мен интероперабельділігі туралы алаңдаушылық, деректердің сенімділігі мен дәлдігін қамтамасыз ету үшін стандарттар мен ережелерге қажеттілік, сондай-ақ блокчейн жүйелерін енгізу және оларға қызмет көрсету үшін қажетті шығындар мен техникалық білім жатады. Сонымен қатар, студенттер, оқытушылар және басқа да мүдделі тараптар блокчейн технологиясын тиімді және жауапкершілікпен пайдалануға дайын болуы үшін цифрлық сауаттылық пен деректердің құпиялылығы мәселелерін шешу қажет. Білім берудегі блокчейннің мүмкіндіктері мен қиындықтары маңызды болғанымен, оның әлеуетін толық іске асыру үшін мұқият қарау және ынтымақтастық қажет. Осылайша, бұл мақала оқырманға блокчейн туралы қатты ақпарат береді және оның білім беруде қолдануға болатын мүмкіндіктері мен мәселелерін тереңдетеді.

Түйін сөздер: Білім берудегі Блокчейн; блокчейн қосымшалары; таратылған кітаптар және білім беру; блокчейнге шақыру; орталықтандырылмаған оқыту

Дәйексөз үшін: Мохаммед А. Салех, Али Абд Алмисреб, С.Т. Аманжолова, А.О. Сагымбекова, А. Заурбек. БІЛІМ БЕРУ САЛАСЫНДА БЛОКЧЕЙНДІ ҚОЛДАНУ: ПЕРСПЕКТИВАЛАР МЕН ҚИЫНДЫҚТАР//Ақпараттық және коммуникациялық технологиялардың халықаралық журналы. 2023. V.4. № 4. Бет 92-100 (ағылшын тілінде). *https://doi.org/10.54309/IJICT.2023.16.4.009.*

ИСПОЛЬЗОВАНИЕ БЛОКЧЕЙНА В СЕКТОРЕ ОБРАЗОВАНИЯ: ПЕРСПЕКТИВЫ И ВЫЗОВЫ

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Аннотация. Технология блокчейн привлекает внимание как потенциальное решение для решения многих проблем, связанных с традиционными системами управления данными. Сектор образования также изучает свой потенциал для улучшения различных аспектов образования. Одной из возможностей технологии блокчейн в образовании является безопасное и защищенное от несанкционированного доступа ведение цифровых записей, которое может устранить необходимость в физических сертификатах и расшифровках стенограмм, делая процесс аттестации более эффективным, точным и прозрачным. Блокчейн может облегчить микрокредитование для обучения на протяжении всей жизни, создавая новые возможности для отдельных лиц приобретать и проверять конкретные навыки или знания. Кроме того, прозрачное и безопасное финансирование и пожертвования могут быть созданы с использованием технологии блокчейн, что поможет устранить мошенничество и гарантировать, что пожертвования используются по назначению. Однако существуют также серьезные проблемы, которые необходимо решить, чтобы сделать блокчейн реальностью в образовании. К ним относятся опасения по поводу масштабируемости и

интероперабельности блокчейн-сетей, необходимость в стандартах и нормативных актах для обеспечения надежности и точности данных, а также потенциальные затраты и технические знания, необходимые для внедрения и обслуживания блокчейн-систем. Кроме того, необходимо решить проблемы цифровой грамотности и конфиденциальности данных, чтобы учащиеся, преподаватели и другие заинтересованные стороны были готовы эффективно и ответственно использовать технологию блокчейн. Несмотря на то, что возможности и вызовы блокчейна в образовании значительны, для полной реализации его потенциала необходимы тщательное рассмотрение и сотрудничество. Таким образом, эта статья предоставляет читателю солидную информацию о блокчейне и углубляется в его возможности и вызовы, которые необходимо использовать в образовании.

Ключевые слова: Блокчейн в образовании; блокчейн-приложения; распределенные бухгалтерские книги и образование; блокчейн-вызовы; децентрализованное обучение

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Introduction

Blockchain technology is a transformative and innovative digital ledger system that has gained the attention of businesses, governments, and individuals worldwide. At its core, Blockchain is a decentralised, secure, and transparent system that uses cryptographic techniques to record and verify transactions between multiple parties in a tamper-evident way. Blockchain technology is best known for enabling the creation and functioning of cryptocurrencies, such as Bitcoin and Ethereum. However, the potential applications of blockchain technology extend far beyond just the financial sector. The decentralised nature of blockchain technology has opened up new possibilities for a range of industries, including healthcare, supply chain management, and voting systems, to name just a few. Additionally, the transparency and security of blockchain technology make it an ideal solution for recording, storing, and sharing data in various fields. In the education sector, blockchain technology has the potential to transform traditional systems of record-keeping, data verification, and student credentialing. The use of blockchain technology in education can provide a high level of transparency, security, and authenticity, ensuring the trust and credibility of educational records and certifications. However, implementing blockchain technology in the education sector also presents technical, organisational, and regulatory challenges that must be overcome for successful adoption.

The primary opportunities of blockchain technology in education lie in the areas of credentialing, record-keeping, funding, and micro-credentialing. Blockchain's ability to create a secure and transparent platform for storing and sharing data can help to streamline administrative processes, reduce the risk of data breaches and fraud, and

provide students with a more efficient and accurate way to showcase their academic achievements and qualifications.

In a study (Kamišalić et al., 2019), Blockchain was found to be a promising technology for credentialing and record-keeping in the education sector. The authors found that blockchain-based credentialing can reduce the need for intermediaries and simplify the verification process, making it more efficient and secure. Similarly, the study (Bhatia et al., 2020) explored the use of Blockchain in academic records management, highlighting the potential for the technology to reduce administrative burdens, increase transparency, and provide a secure and immutable platform for sharing academic records. Additionally, Blockchain can facilitate transparent and secure funding and donations, as highlighted in (Liu et al., 2021). The authors proposed a blockchain-based donation platform for education that ensures donations' transparency, accountability, and traceability. Micro-credentialing, another area where Blockchain shows promise, allows individuals to acquire and verify specific skills or knowledge, as outlined in (Alammary et al., 2019).

Overall, the potential benefits of blockchain technology in education are substantial, and the application of this technology is an exciting area of exploration for educators and policymakers alike. In this paper, the related topics in the education sector were studied; section II presents the applications and advantages of blockchain utilisation. In Section III, the challenges of implementing Blockchain in education were highlighted. The conclusion of this paper is depicted in Section V.

Material and methods

Applications of Blockchain in the Education Sector

Blockchain technology has the potential to transform various industries, and education is no exception. The decentralised and immutable nature of Blockchain makes it an ideal solution for many cases in education. Here are some proposed and potential solutions for Blockchain in education. Blockchain was proposed to secure Tamper-Proof Records in education organisations (Shaikh et al., 2022). Educational institutions can use Blockchain to store student records, such as academic credentials, certificates, and diplomas, in a decentralised and immutable system. This ensures that the records are authentic, secure, and cannot be tampered with, thereby reducing the risk of fraud and misrepresentation.

Blockchain technology can increase transparency in the educational ecosystem. Educational institutions can use Blockchain to create a public and verifiable database of student achievements, enabling students, employers, and educational institutions to easily access and verify academic credentials. This ensures that academic credentials are genuine and eliminates the need for third-party verification services, saving time and resources (Lam et al., 2022).

Blockchain technology can reduce the costs associated with academic record-keeping and verification. Educational institutions can use Blockchain to store academic records in a decentralised system, eliminating the need for paper-based record keeping and reducing administrative costs. Moreover, the use of Blockchain for academic record verification eliminates the need for third-party verification services, reducing costs for students and educational institutions (Han et al., 2018).

Blockchain technology can make credential management more efficient by enabling students to control their academic records and share them with potential employers and educational institutions. This eliminates the need for students to request transcripts from their educational institutions and ensures that their academic records are up-to-date and easily accessible (Lam et al., 2022).

Enhanced Data Privacy: Blockchain technology can enhance data privacy by enabling students to control access to their academic records. Students can only share their academic records with the entities they trust, ensuring that their data is secure and not misused (Gilda et al., 2018).

Blockchain is a tool to store academic credentials such as degrees, diplomas, and certificates in a decentralised and secure system. This can help students to verify their credentials easily and prevent fraud. For instance, a university in Malta, the University of Nicosia, has implemented a blockchain-based platform called Blockcerts to issue digital certificates and diplomas (Arenas et al., 2018).

Blockchain is a mean to create a verifiable and tamper-proof record of a student's learning journey. This record can include details of the courses taken, grades achieved, and skills learned. Students can use this record to showcase their skills and achievements to potential employers (Gräther et al., 2018).

Blockchain can facilitate peer-to-peer learning by enabling students to create and share educational content on a decentralised platform. This can create a collaborative and decentralised learning environment, reducing the reliance on traditional centralised learning systems (Vieira et al., 2019).

Blockchain can be used to create a secure and transparent system for student loans. This can help to reduce the risk of fraud and ensure that student loans are issued and repaid in a fair and efficient manner (Gazali et al., 2017). As the technology develops, there will be more opportunities for Blockchain to transform the educational ecosystem, making it more efficient, transparent, and secure.

Results and discussion

Challenges of implementing Blockchain in education

Blockchain is a distributed ledger technology that is often associated with cryptocurrencies like Bitcoin. However, its potential applications go beyond the realm of finance and one area where it could be particularly useful in education. Implementing Blockchain in education could help address various issues such as authentication of certificates and qualifications, record keeping, and data security. However, there are several technical and organisational challenges that need to be addressed for successful implementation.

Scalability: One of the biggest technical challenges of implementing Blockchain in education is scalability. Blockchain technology is still in its early stages, and the current infrastructure is not designed to handle large-scale operations. Education institutions generate a huge amount of data, and current blockchain systems may not be able to handle the volume of data generated (Steiu, 2020).

Interoperability: Another technical challenge is interoperability. Education institutions often use different systems and software, and it is important to ensure

that these systems can work seamlessly with blockchain technology. Interoperability challenges could arise because of different programming languages, data formats, and standards (Mohammad et al., 2022).

Cost: Implementing blockchain technology in education can be costly. The cost of setting up a blockchain system can be high, and educational institutions would need to bear these costs. Institutions will also need to invest in training staff to ensure they have the skills to manage the system (Alammary et al., 2019).

Adoption: The successful implementation of blockchain technology in education relies on adoption by educational institutions. There could be resistance to change from traditional stakeholders, and it may take time to convince them of the benefits of blockchain technology. There may also be concerns about the security of data on the Blockchain, which could lead to resistance from institutions (Dutta et al., 2020).

Governance: Governance is a prominent issue that needs to be addressed in the implementation of blockchain technology in education. There need to be clear guidelines on who has access to the Blockchain, how data is added and removed, and how data is managed. Governance issues can be complex, especially when multiple institutions are involved (Alam et al., 2021).

Data Privacy: Education institutions manage a lot of sensitive data, and it is important to protect this data. Blockchain technology is often viewed as being secure, but it is important to ensure that data is not visible to unauthorised parties. Institutions will need to ensure that data is encrypted and that access is restricted to authorised personnel (Dutta et al., 2020).

Conclusion

Blockchain technology has the potential to transform various aspects of the education sector, from credentialing and certification to student records management and funding. However, there are also significant challenges that must be addressed to ensure the effective and widespread adoption of blockchain technology in education. One of the main opportunities of Blockchain in education is the ability to create a secure and transparent platform for storing and sharing data. This can help to streamline administrative processes, reduce the risk of data breaches and fraud, and provide students with a more efficient and accurate way to showcase their academic achievements and qualifications. At the same time, several challenges must be addressed to make blockchain technology a reality in education. These include concerns around the scalability and interoperability of blockchain networks, the need for standards and regulations to ensure the reliability and accuracy of data, and the potential costs and technical expertise required to implement and maintain blockchain systems. In addition, the education sector will need to address digital literacy and data privacy issues to ensure that students, teachers, and other stakeholders are equipped to use blockchain technology effectively and responsibly. Overall, the opportunities and challenges of Blockchain in education are significant, and the sector will need to navigate these complexities carefully to fully realise the potential of this technology. While there are still many unknowns and obstacles to overcome, it is clear that Blockchain can transform how we approach education and create new opportunities for students and educators alike.

REFERENCES

A. Alammary, S. Alhazmi, M. Almasri and S. Gillani (2019). “Applsci-09-02400.Pdf,” — 2019.

S. Bhatia, E.K. Douglas and M. Most (2020). "Blockchain and records management: disruptive force or new approach?," Records Management Journal. — 2020. — doi: 10.1108/RMJ-08-2019-0040.

R. Arenas and P. Fernandez (2018). "CredenceLedger: A Permissioned Blockchain for Verifiable Academic Credentials," in 2018 IEEE International Conference on Engineering, Technology and Innovation, ICE/ITMC 2018 — Proceedings, — 2018. — doi: 10.1109/ICE.2018.8436324.

A. Alammary, S. Alhazmi, M. Almasri and S. Gillani (2019). "Blockchain-based applications in education: A systematic review," Applied Sciences (Switzerland). — 2019. — doi:10.3390/app9122400.

S. Alam, H. Abdullah, Y. Ayoub, R. Abdulhaq, A. Alshaikh, and A. Hayawi (2021). "A Blockchain-based framework for secure Educational Credentials," Turkish J. Comput. Math. Educ., — 2021.

P. Dutta, T.M. Choi, S. Somani and R. Butala (2020). "Blockchain technology in supply chain operations: Applications, challenges and research opportunities," Transp. Res. Part E-Logistics Transp. Rev. — Vol. 142. — 2020. — doi: 10.1016/j.tre.2020.102067.

S. Gilda and M. Mehrotra (2018). "Blockchain for Student Data Privacy and Consent," in 2018 International Conference on Computer Communication and Informatics, ICCCI 2018, — 2018. — doi: 10.1109/ICCCI.2018.8441445.

H.M. Gazali, R. Hassan, R.M. Nor and H.M. M. Rahman (2017). "Re-inventing PTPTN study loan with blockchain and smart contracts," in ICIT 2017 — 8th International Conference on Information Technology, Proceedings, — 2017. — doi: 10.1109/ICITECH.2017.8079940.

W. Gräther et al. (2018). "Blockchain for Education: Lifelong Learning Passport," Proc. 1st ERCIM Blockchain Work. 2018, Reports Eur. Soc. Soc. Embed. Technol. — Ppp. 1–8. — 2018. — doi: 10.18420/blockchain2018.

A. Kamišalić, M. Turkanović, S. Mrdović and M. Heričko (2019). "A Preliminary Review of Blockchain-Based Solutions in Higher Education," in Communications in Computer and Information Science, — 2019. — doi: 10.1007/978-3-030-20798-4_11.

W. Liu, Y. Li, X. Wang, Y. Peng, W. She and Z. Tian (2021). "A donation tracing blockchain model using improved DPoS consensus algorithm," Peer-to-Peer Netw. Appl. — 2021. — doi: 10.1007/s12083-021-01102-9.

T.Y. Lam and B. Dongol (2022). "A blockchain-enabled e-learning platform," Interact. Learn. Environ. — 2022. — doi: 10.1080/10494820.2020.1716022.

A. Mohammad and S. Vargas (2022). "Challenges of Using Blockchain in the Education Sector: A Literature Review," Appl. Sci. — Vol. 12. — № 13. — Pp. 6380. — 2022.

Z.A. Shaikh et al. (2022). "A Blockchain Hyperledger and Non-Linear Machine Learning: A Novel and Secure Educational Accreditation Registration and Distributed Ledger Preservation Architecture," Appl. Sci. — 2022. — doi: 10.3390/app12052534.

M. Han, D. Wu, Z. Li, Y. Xie, J.S. He and A. Baba (2018). "A novel blockchain-based education records verification solution," in SIGITE 2018 - Proceedings of the 19th Annual SIG Conference on Information Technology Education, — 2018. — doi: 10.1145/3241815.3241870.

P. Vieira, P. Crocker and S.M. de Sousa (2019). "e-Learning, Artificial Intelligence, and Block chain," in PROCEEDINGS OF THE EUROPEAN CONFERENCE ON THE IMPACT OF ARTIFICIAL INTELLIGENCE AND ROBOTICS (ECIAIR 2019), — 2019.

M.-F. Steiu (2020). "Blockchain in education: Opportunities, applications, and challenges," First Monday, — 2020, — doi: 10.5210/fm.v25i9.10654.

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KEY AND PRIVACY MANAGEMENT IN EE 802.16e STANDARD NETWORKS (IN WIMAX TYPE WIRELESS BROADBAND NETWORKS)

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Abstract. Currently, in Kazakhstan, the CIS countries and abtoad, the rapid development of btoad band wireless information transfer netvorks is occurring. On the on hand, the introduction of the most advanced methods of copying, modulating and transmitting information. Principles of networks construction of standard IEEE 802.16 (WiMAX), frequency spectra for Kazakhstan, gradation of user's devices, features of functioning of access level by medium and physical level, and also the problems arising at dynamic resource management in these networks are considered.

Keywords: narrowband, broadband, ultra-wideband wireless networks, network resource management, access control algorithm of the CIS countries by bandwidth

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ЕЕ 802.16e СТАНДАРТТЫ ЖЕЛІЛЕРІНДЕГІ КІЛТТЕР МЕН ҚҰПИЯЛЫЛЫҚТЫ БАСҚАРУ (WIMAX ТИПТІ СЫМСЫЗ КЕҢ ЖОЛАҚТЫ ЖЕЛІЛЕРІНДЕ)

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Аннотация. Қазіргі уақытта Қазақстанда, ТМД елдерінде және алыс қашықтықтағы елдерде кең жолақты сымсыз желілерде ақпараттың жіберілуіне жедел қарқынмен дамуда. Бұл қарқынмен даму, бір жағынан, глобалды интернет желісінің қарқынмен дамуы, басқа жағынан алып қарағанда, заманауй талаптарына сәйкес кодтап, модуляциялап және ақпаратты тасымалдау. Бұл мемлекеттің, аумағы өте үлкен халқының тығыз орналаспауы, кең жолақты сымсыз желі бәсекелестікке қабілетсіз жылдамырақ дамуына, Қазақстанда бағасы жағынанда жиіліктік спектірінің құндылығы төмен. IEEE 802.16 (WiMAX) стандартындағы желіні құру принциптері қарастырылған, Қазақстандағы жиіліктік спектірі, абоненттік құрылғының градациясы, беріліс деңгейінің функционалды ортадағы ерекшелігі, сонымен қатар, желі ресурстарының осы ортадағы динамикалық басқрылуына әсері.

Түйін сөздер: қысқа жолақты, кең жолақты, өте кең жолақты сымсыз желілер, желілердегі ресурстарды басқару, ТМД елдерінің жиілік жолағының ені бойынша қол жеткізуін бақылау алгоритмі

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УПРАВЛЕНИЕ КЛЮЧАМИ И ПРИВАТНОСТЬЮ В СЕТЯХ СТАНДАРТА EEE 802.16e (БЕСПРОВОДНЫХ ШИРОКОПОЛОСНЫХ СЕТЯХ ТИПА WIMAX)

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Аннотация. В настоящее время в Казахстане, странах СНГ и дальнего зарубежья происходит бурное развитие широкополосных беспроводных сетей передачи информации. Предпосылкой этого развития, с одной стороны, явилось интенсивное развитие глобальной сети Интернет, с другой стороны внедрение самых современных методов кодирования, модуляции и передачи информации. Для стран, в которых обширная территория сочетается с невысокой плотностью населения, широкополосные беспроводные сети находятся вне конкуренции по быстроте развертывания, цене и набору приложений. Рассмотрены принципы построения сетей стандарта IEEE 802.16 (WiMAX), частотные спектры для Казахстана, градации абонентских устройств, особенности функционирования уровня доступа к среде и физического уровня, а также проблемы, возникающие при динамическом управлении ресурсами в этих сетях.

Ключевые слова: узкополосные, широкополосные, сверхширокополосные беспроводные сети, управление ресурсами в сетях, алгоритм контроля доступа стран СНГ по ширине полосы частот

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Введение

Существует достаточное количество критериев по классификации беспро-водных сетей. Стандартно они разделяются (Вишневский и др. 2005: 592):

- по ширине полосы пропускания: узкополосные, широкополосные, сверхширокополосные;
- по размещению: стационарные, подвижные;
- по технологии: спутниковые, атмосферные, оптические;
- по методам доступа к беспроводной среде: с пространственным разделением

(SDM), с частотным разделением (FDM), с временным разделением (TDM), с кодовым разделением (CDM). Также используются различные их модификации;

- по протяженности: персональные (WPAN), локальные (WLAN), региональные (городские- WMAN), глобальные (WWAN).

Термин WiMAX (Worldwide Interoperability for Microwave Access) — это коммерческое название стандарта региональных сетей широкополосного беспроводного доступа WMAN-IEEE 802.16. В этом стандарте описываются низшие уровни модели OSI (Шварц 1992: 276), а также уровень доступа к среде передачи MAC (Medium Access Control).

Материалы и методы

Более конкретно-радиоинтерфейсы, методы и способы модуляции и доступа, системы управления различными потоками информации, взаимодействие высшими уровнями (протоколами уровней). Пример структурной схемы и основных протоколов взаимодействия сети стандарта WiMAX представлена на рисунке 1.

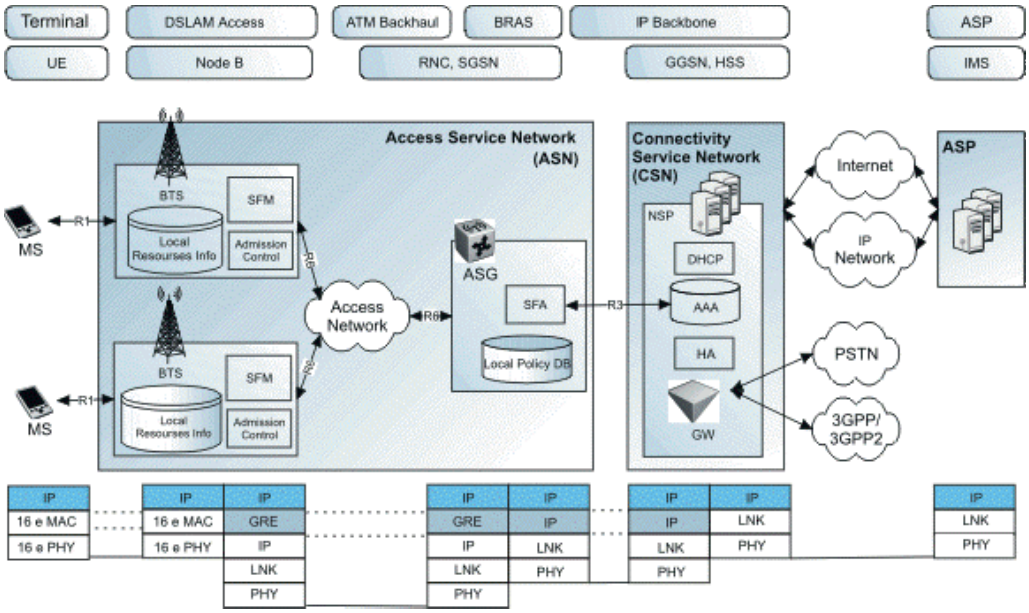

Рисунок 1- Структурная схема беспроводной широкополосной сети типа WiMAX

Изначально для стандарта WiMAX были выделены полосы частот в диапазоне до 66 ГГц, Однако в настоящее время в Казахстане дополнительно даны разрешения на использование полос частот в соответствии с таблицей 1.

Таблица 1 - Основные режимы стандарта IEEE 802.16 в Казахстане

Диапазон частот, ГГц	Разрешенные полосы частот, МГц	Общая ширина выделенных полос, МГц	Тип беспроводного доступа
2,5	2500−2530 2560−2570 2620−2630 2660−2670 2680−2690	70	мобильный
3,5	3400−3450 3500−3550	100	фиксированный
5	5150−5350 5650−5725 5725−6425	975	фиксированный

В сетях WiMAX различаются 3 градации абонентских устройств по мобильности:

- стационарные абонентские устройства (fixed wireless), (фиксированный беспроводный доступ, описываемый стандартом 802.16d-2004);

- портативные (portable, nomadic), которые могут передвигаться со скоростью до 5 км/ч, (полумобильный доступ, стандарт 802.16e-2005);

- мобильные (mobile), обеспечивающие работу при скорости до 120 км/ч, (полная мобильность, стандарт 802.16e-2006).

Авторы стандарта постарались создать общий для всех приложений протокол MAC-уровня независимо от особенностей канала передачи. Данное требование было поставлено из-за того, что пользователям нужны разнообразные сервисы, качество которых должно полностью удовлетворять уровню QoS. MAC-уровень, в свою очередь, разделяется на три подуровня.

Первый подуровень- *подуровень конвергенции* (слияния) — CS (Convergence Sablayer). Он определяет слияние потоков нескольких протоколов, таких, как ATM, IP, Ethernet, VLAN (IEEE 802.1Q-1998) (Лазарев 1996: 224). Потоком называется объем данных, который непосредственно связан с определенным приложением. Каждому из потоков требуется свой класс обслуживания, для этого необходимо выделить необходимую полосу пропускания – можно сказать виртуальный канал, с 16-разрядным идентификатором CID. Современное развитие сетей связи, которые основываются на технологии коммутации пакетов, достигло уровня, когда можно и нужно их широко использовать различными операторами связи. Но некоторые методики расчета сетей типа WiMAX пока еще недостаточно развиты, и при их проектировании необходимо закладывать потребность в большей пропускной способности.

Степени или классы обслуживания WiMAX определяются при подключении станции к сети. Существует 5 классов обслуживания (Tao Yang и др., 391):

- наивысший- *класс доступа по первому требованию UGS* (Unsolicited Grant Service). Этот класс обеспечивает постоянную скорость передачи информации, что и требуется в традиционной телефонии;

- второй – *класс доступа с переменной скоростью с передачей данных в режиме*

реального времени RT-VR rtPS (Real-Time Variable Rate). При этом абонентская станция осуществляет передачу информации с переменной скоростью без потери качества;

- третий – *класс доступа с переменной скоростью без передачи данных в режиме реального времени NRT-VR nrtPS* (Non-Real-Time Variable Rate). Используется для передачи файлов (протоколы FTP, HTTP);

- четвертый – *класс доступа в режиме максимально возможной в данный момент скорости BE* (Best Effort). Используется для передачи данных в сети интернет;

- пятый- *расширенный класс доступа с переменной скоростью с передачей данных в режиме реального времени ERT-VR* (Extended Real-Time Variable Rate). Используется при передаче голосовой информации с подавлением пауз.

Второй подуровень- *основной подуровень* - *CPS* (Common Part Sablayer), на котором образуются протокольные (пакеты) PDU (Protocol Data Unit). Они могут быть либо управляющими, либо информационными. *Информационный PDU* включает в себя 6-байтовый заголовок уровня, управляющие сообщения и информационные данные.

Третий подуровень- *подуровень защиты* (секретности) - *PS* (Privacy Sablayer). В нем осуществляется криптозащита и аутентификация. Уровень безопасности включает два протокола:

- протокол для шифрования пакетов, который включает в себя несколько вариантов пар «шифрование-аутентификация» и правила их применения;

- протокол управления ключами шифрования PKM (Privacy Key Management), который осуществляет распределение ключей от BTS к MS.

Распределение ресурсов каналов - динамическое. MS может запрашивать определенный размер полосы пропускания, или запрашивать об изменении имеющейся полосы. Для практической реализации дуплексного режима применяется либо частотное- FDD (Frequency Division Duplex), либо временное TDD (Time Division Duplex) разделение. Пакеты от BTS к MS следуют без интервалов. В обратном направлении пакеты передаются в специальных тайм-слотах, отведенных именно для виртуальных каналов.

Основным принципом доступа к каналу является доступ по запросу DAMA (Demand Assigned Multiple Access). Существует два режима доступа для каждого соединения в отдельности и для всех соединений одновременно в конкретной MS. Для приложений, которые имитируют коммутацию каналов (Лазарев 1996: 224), периодичность и размер пакетов фиксированы.

Кроме этого, разрабатываются протоколы подтверждения передачи и каналы обратной связи. По каналу обратной связи передаются результаты измерений параметров каналов, информация о перестройке мощности передатчиков.

Определенным стандартом определяются полосы частот и скорости передачи при различных видах модуляции. Эти данные представлены в таблице 2.

Таблица 2- Обязательные схемы кодирования (модуляции) в режиме OFDM

Тип модуляции	Размер блока данных до кодирования, в байтах	Кодер Рида–Соломона	Скорость сверточного кодирования	Суммарная скорость кодирования	Размер блока данных после кодирования, в байтах
BPSK	12	(12, 12, 0)	1/2	1/2	24
QPSK	24	(32, 24, 4)	2/3	1/2	48
QPSK	36	(40, 36, 2)	5/6	3/4	48
16-QAM	48	(64, 48, 8)	2/3	1/2	96
16-QAM	72	(80, 72, 4)	5/6	3/4	96
64-QAM	96	(108, 96, 6)	3/4	2/3	144
64-QAM	108	(120, 108, 6)	5/6	3/4	144

Например, по мере удаления абонента от BTS, или в случае ухудшения метеоусловий, наличия мощного источника помех, для улучшения помехозащищенности производится смена вида модуляции. А это, в свою очередь, снижает скорость передачи.

Большое количество операторов в Казахстане приводит к ограничению частотного ресурса (таблица 1). Каждому оператору в среднем выделяется полоса около 3,5 МГц, а это приводит к взаимным помехам и становится необходимым изменять виды модуляции.

Результаты и обсуждение

В настоящее время в РК не имеется мобильных абонентов WiMAX, и только начинают появляться полумобильные абоненты, с портативным доступом.

При описании математической модели части сети связи WiMAX, рассматривается процесс интенсивностей, управляемый MMPP (Heffes и др., 1986: 856–868), который позволяет достаточно точно описать взаимопозицию нескольких соединений. Предлагаемый критерий принятия соединения на обслуживание получен на основании результатов расчетов модели MMPP/D/1/K (Лагутин и др., 2000: 320).

Разрабатываемый алгоритм распределения доступа соединений является требовательным к вычислительным ресурсам и будет не слишком хорошо масштабироваться при увеличении количества одновременных соединений. Из-за этого возникает необходимость упростить исходную математическую модель. По аналогии с (Tao Yang и др., 391), количество состояний MMPP-процесса при работе снижается до двух (рисунок 2). В одном процессе состояние OL будет точнее соответствовать состоянию при перегрузках, а в другом будет соответствовать состояниям недогруженности сети (UL).

Величина M получается из неравенства: $C/LD-1<M\leq C/LD$, где C – пропускная способность канала связи, L - интенсивность поступления пакетов от одного MMPP-источника в состоянии ON, D - длина пакета.

Для обновленного процесса появляется необходимость определения выражений для четырех его параметров: r_{OL} и r_{UL} - средняя интенсивность выхода из состояния OL и UL; λ_{OL} и λ_{U} - интенсивность пуассоновского процесса наращивания количества пакетов для состояния OL и UL.

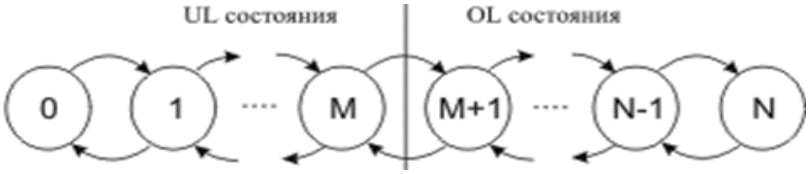

Рисунок 2 - Деление состояний на UL и OL

Параметры λ_{OL} и λ_{UL} получаем, вычисляя среднюю скорость создания пакетов в состоянии OL и UL. Следовательно, аналогично получим формулы для упрощенной MMPP-модели (с двумя состояниями). Исследовав производительность данного алгоритма видим, что указанные формулы не требуют больших вычислительных ресурсов и, соответственно, могут использоваться в составе алгоритма контроля доступа.

Выводы

При работе алгоритма контроля доступа могут возникнуть такая ситуация, когда будет недоставать свободных ресурсов (пропускной способности) для обслуживание нового вызова. В этом случае возможно модифицирование параметров уже имеющихся соединений. Пропускная способность для одного соединения, зависит от класса обслуживания. Поэтому при модифицировании параметров в случае принятия нового соединения возникает необходимость учитывать существующие ограничения на классы обслуживания.

Вопрос очередности модификации параметров является одним из основных вопросов, которые могут возникнуть при разработке алгоритма контроля доступа. Имеется три направления модификации:

- изменение периода пакетизации;
- изменение класса обслуживания и/или принятие соединения на обслуживание без изменений каких-либо параметров.

ЛИТЕРАТУРЫ

Банкет В.Л., Дорофеев В.М. (1988). Цифровые методы в спутниковой связи. — Радио и связь, — 1988.

Вишневский В.М. и др. (2005). Широкополосные беспроводные сети передачи информации. — М.: Техносфер, — 2005.— 592 с.

Гоголева М.А. (2008). Классификация и анализ методов маршрутизации в MESH-сетях // Радиотехника. — 2008. — Вып. 155. — Стр. 173–185.

Лазарев В.Г. (1996). Интеллектуальные цифровые сети. Справочник/Под ред. Н.А. Кузнецова. — М.: Финансы и статистика. — 1996. — 224 с.

Лагутин В.С., Степанов С.Н. (2000). Телетрафик мультисервисных сетей связи. — М.: Радио и связь, — 2000. — 320 с.

Heffes H., Lucantoni D. (1986). A Markov Modulated Characterization of Voice and Data Traffic and Related Statistical Multiplexer Performance// IEEE Journal on Selected Areas in Communications, — September 1986. — Vol. 4. — Issue 6. — Pp. 856–868.

Tao Yang, Danny H.K. Tsang. A Novel Approach to Estimating the Cell Loss Probability in an ATM Multiplexer Loaded with Homogeneous On-Off Sources //Proc. IEEE Globecom'92. — Vol 2. — P. 391.

Шварц М. (1992). Сети связи, протоколы, моделирование и анализ/ Пер. с англ.: — Т 2. — М.: Наука, —1992.— 276 с.

REFERENCE

Banquet V.L., Dorofeev V.M. (1988). Digital methods in satellite communications. — Radio and communications, — 1988.

Vishnevsky V.M. et al. (2005). Broadband wireless information transmission networks. — M.: Technosphere, — 2005.— 592 p.

Gogoleva M.A. (2008). Classification and analysis of routing methods in MESH networks // Radio technology. — 2008. — Issue 155. — Pp. 173–185.

Lazarev V.G. (1996). Intelligent digital networks. Guide/Edited by N.A. Kuznetsov. — M.: Finance and statistics. — 1996. — 224 p.

Lagutin B.C., Stepanov S.N. (2000). Teletraphy of multiservice communication networks. — M.: Radio and communications, — 2000. — 320 p.

Heffes H., Lucantoni D. (1986). A Markov Modulated Characterization of Voice and Data Traffic and Related Statistical Multiplexer Performance// IEEE Journal on Selected Areas in Communications, — September 1986. — Vol. 4. — Issue 6. — Pp. 856-868.

Tao Yang, Danny H.K. Tsang. A Novel Approach to Estimating the Cell Loss Probability in an ATM Multiplexer Loaded with Homogeneous On-Off Sources //Proc. IEEE Globecom'92. — Vol 2. — P. 391.

Schwartz M. (1992). Communication networks, protocols, modeling and analysis/ Trans. from English: — T 2. — M.: Nauka, — 1992.— 276 p.

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МЕЖДУНАРОДНЫЙ ЖУРНАЛ ИНФОРМАЦИОННЫХ И КОММУНИКАЦИОННЫХ ТЕХНОЛОГИЙ

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