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ARTIFICIAL INTELLIGENCE IN E-COMMERCE: MAIN DIRECTIONS, BENEFITS, AND POTENTIAL RISKS

ШТУЧНИЙ ІНТЕЛЕКТ В ЕЛЕКТРОННІЙ КОМЕРЦІЇ: ОСНОВНІ НАПРЯМКИ, ПЕРЕВАГИ ТА ПОТЕНЦІЙНІ РИЗИКИ

Abstract. Introduction. *The article examines the role of artificial intelligence (AI) in the development and transformation of e-commerce, as well as its impact on key aspects of business in the modern digital environment, analyzes the benefits of integrating AI into e-commerce, such as improved customer satisfaction, increased operational efficiency, and enhanced decision-making capabilities, and the role of AI in improving marketing strategies through targeted advertising and recommendation systems, leading to a more personalized shopping experience.* ***Purpose.*** *The aim of the article is to identify areas of use of artificial intelligence in e-commerce, highlight and substantiate threats and obstacles in this process, as well as offer a proposal for cooperation between AI and e-commerce specialists.* ***Methods.*** *The basis for solving the set goal were the methods of comparative analysis, survey, generalization and grouping, statistical analysis, modeling, forecasting and empirical calculation.* ***Results.*** *The article systematizes the main areas of application of AI in e-commerce, in particular, personalization of purchases, which allows creating individualized offers for users, automation of customer service through chatbots and virtual assistants, effective inventory management through demand forecasting and analysis of large volumes of data. Along with the benefits, attention is also paid to the potential risks that companies face when implementing AI. These may include increasing market inequality due to the concentration of technological capabilities in large corporations, as well as potential unemployment due to the automation of jobs. The paper provides a comprehensive analysis of how AI can change the e-commerce landscape, in particular to increase its efficiency and competitiveness, but also emphasizes the need for a cautious approach to the implementation of new technologies. It stresses the importance of ensuring that AI systems are transparent, explainable, and accountable in order to gain consumer trust. The article highlights the importance of establishing clear regulatory frameworks and ethical guidelines to ensure that AI is used responsibly and transparently in business operations. The article also suggests the importance of ongoing research and development to address the emerging challenges related to AI implementation. Finally, an example of a simulation model developed in Python that can be used in e-commerce to optimize logistics and warehousing is provided, demonstrating the practical application of AI to improve business processes.*

Keywords: *artificial intelligence, e-commerce, threats, personalization, privacy, simulation models.*

Анотація. *У статті розглядається роль штучного інтелекту (ШІ) у розвитку та трансформації електронної комерції, а також його вплив на ключові аспекти бізнесу в сучасному цифровому середовищі. Аналізуються переваги інтеграції штучного інтелекту в електронну комерцію, такі як підвищення задоволеності клієнтів, підвищення операційної ефективності та розширення можливостей прийняття рішень, а також роль ШІ у вдосконаленні маркетингових стратегій за допомогою цільової реклами та систем рекомендацій, що забезпечує більш персоналізований досвід покупок. У статті систематизовано основні сфери застосування ШІ в електронній комерції, зокрема, персоналізація покупок, що дозволяє створювати індивідуальні пропозиції для користувачів, автоматизація обслуговування клієнтів через чат-боти та віртуальних помічників, ефективне управління запасами через прогнозування попиту та аналіз*

великих обсягів даних. Поряд із перевагами, увага також приділяється потенційним ризикам, з якими стикаються компанії під час впровадження ШІ. Це може бути збільшення ринкової нерівності через концентрацію технологічних можливостей у великих корпораціях, а також потенційне безробіття через автоматизацію робочих місць. Також розглядаються етичні аспекти, пов'язані з використанням штучного інтелекту, включаючи питання конфіденційності даних і потенційне маніпулювання вподобаннями споживачів. Крім того, потенційні алгоритмічні зміщення в системах штучного інтелекту можуть призвести до недобросовісних практик або результатів виключення для певних сегментів клієнтів, посилюючи існуючу соціальну нерівність. У статті міститься всебічний аналіз того, як штучний інтелект може змінити ландшафт електронної комерції, зокрема для підвищення її ефективності та конкурентоспроможності, але також наголошується на необхідності обережного підходу до впровадження нових технологій. Він наголошує на важливості забезпечення того, щоб системи ШІ були прозорими, зрозумілими та підзвітними, щоб завоювати довіру споживачів. У статті підкреслюється важливість встановлення чіткої нормативної бази та етичних принципів для забезпечення відповідального та прозорого використання ШІ в бізнес-операціях. Також наголошується на важливості постійних досліджень і розробок для вирішення нових проблем, пов'язаних із впровадженням ШІ. Наприкінці наведено приклад імітаційної моделі, розробленої на Python, яку можна використовувати в електронній комерції для оптимізації логістики та складування, демонструючи практичне застосування ШІ для вдосконалення бізнес-процесів.

Ключові слова: *штучний інтелект, електронна комерція, загрози, персоналізація, конфіденційність, імітаційні моделі.*

Statement of the problem. Artificial intelligence (AI) is becoming a key technology that is transforming various areas of life, including e-commerce. The use of AI in this field creates new opportunities for businesses, significantly improves efficiency, enhances user experience, and allows for the automation of many processes, such as inventory management, personalized offers, data analysis, and customer service. This boosts efficiency, reduces costs, and improves customer interactions. However, along with the benefits of AI come risks and threats that need to be addressed. This requires new research, careful analysis of AI's role, and restricting access to the databases it works with.

Analysis of recent research and publications. Among the researchers who have explored the integration of artificial intelligence into various aspects of e-commerce, the works of Jason L. Anderson, Mark Newman, Ruchika Gupta, Seth Earley, and Mike Grigsby stand out.

In his book Jason L. Anderson offers a step-by-step guide for businesses aiming to implement AI, with a focus on strategy, resources, and the technical aspects necessary for successfully utilizing AI in business. Mark Newman's examines personalization technologies, emphasizing the significance of the personalization process in enhancing user interactions and achieving business goals through an individualized approach. Ruchika Gupta provides an overview of chatbots and conversational AI, highlighting the importance of these technologies in automating customer interactions and improving user experiences. Seth Earley's article focuses on the use of ontologies in business to improve decision-making, automation, and achieve greater efficiency with artificial intelligence. Mike Grigsby offers a practical guide to marketing analytics, particularly on how to use marketing data to make informed decisions and achieve better results.

Ukrainian researchers are also actively investigating various aspects of artificial intelligence applications in e-commerce. Their studies cover topics such as personalization, recommender systems, customer service automation, inventory management, and ethical challenges associated with the implementation of AI. Among the recent domestic research on this subject, the following can be highlighted: the articles by V.I. Zagarchuk, O.S. Klym, and I.M. Antokhov [5] and A. Zakrevsky [6], which analyze AI applications in trade and digital commerce; M. Kuchynska's work [7], which predicts how artificial intelligence will revolutionize e-commerce in the future; V.I. Serbin's article [17], which provides an algorithm for creating dynamic product descriptions in e-commerce using AI; the research by T.O. Muzychenko, O.A. Skorba, and A.A. Shevchuk [14], dedicated to the optimization of business trade through AI; the works of L.A. Romanchuk, O.M. Shchytov, M.. Mormul, and D.M. Shchytov [16], which address the threats related to AI usage; article [1], which explores various role-playing applications of artificial intelligence; and the studies by O.V. Sydorenko, O.Yu. Mogilevska, A.M. Slobodyanyk, and V.P. Bigday [18], who investigate the use of AI in building consumer trust in e-commerce. Additionally, Ya.M. Shumylo's article [22] proposes specific AI tools for managing the behavior of economic agents in marketing activities, while N.V. Proskurnina's work [15] focuses on the integration of marketing and AI.

However, many aspects remain unexplored, particularly the threats and potential negative consequences of using AI or its individual functions. This makes each new study on this topic highly relevant.

The purpose of the article is to identify the directions for the use of artificial intelligence in e-commerce, highlight and justify the threats and obstacles in this process, and propose suggestions for collaboration between AI and e-commerce professionals.

Materials and Methods. The materials for the research include: 1) works by domestic and international authors conducting scientific and practical research in the field of artificial intelligence in electronic commerce; 2) survey of domestic businessmen; 3) the practical experience of the authors in managing e-commerce.

The following scientific methods were used in the research: 1) comparative; 2) survey; 3) generalization and grouping; 4) empirical; 5) statistical analysis; 6) forecasting; 7) modeling.

Presentation of the main research material. Artificial intelligence is usually defined as a set of information technologies, using which it becomes possible to perform complex complex tasks, guided by existing systems of research methods and information processing algorithms [7, p. 355]. Although it is believed that it is unable to fully imitate human cognitive abilities: not only due to a lack of computing resources or limitations in algorithmic design, but also due to a lack of comprehensive contextual understanding and ethical issues [3, p. 604].

AI is able to perform tasks that require human intelligence: from recognizing speech or images,

creating models, texts, drawings or music (imitation of creative activity), to games, solving complex problems of process management or decision-making to controlling mobile vehicles (car, drone, airplane, rocket, space station, etc.). Of course, there are no obstacles to using it in e-commerce.

Artificial intelligences are categorized based on their task-solving capabilities and level of intelligence as follows [11]: 1) weak AI – designed for solving specific, simple tasks; 2) strong AI – capable of solving complex tasks; 3) narrow AI – specialized in solving limited tasks within a particular domain; 4) generalized (or Generative) AI – can apply knowledge and skills acquired in one area to other domains, adapt to changing conditions, and tackle a variety of tasks; 5) specialized AI – intended for solving specific tasks within a fairly narrow field.

In e-commerce, strong and generalized AI are used (e.g., the ChatGPT chatbot – Generative Pre-trained Transformer), and sometimes specialized AI is employed (for advertising, market trend analysis, and demand forecasting for various products) [8, p. 621].

If we look at statistics, then in 2023-2024, the most popular AI services among Ukrainian companies were: ChatGPT (88%) – a generative AI chatbot, Midjourney (56%) – a generative AI for creating digital images based on textual descriptions, Grammarly (50%) – an AI tool for assisting with English language communication, Notion AI (21%) – a GPT-3 wrapper for translations, writing articles, and programming, DALL-E (16%) – a neural model for generating digital images based on natural language descriptions, Stable Diffusion (8%) – a deep learning model for transforming text into images [10, p. 362].

Designers, copywriters, marketers, and PR specialists are the most active users of these AI tools (see Figure 1).

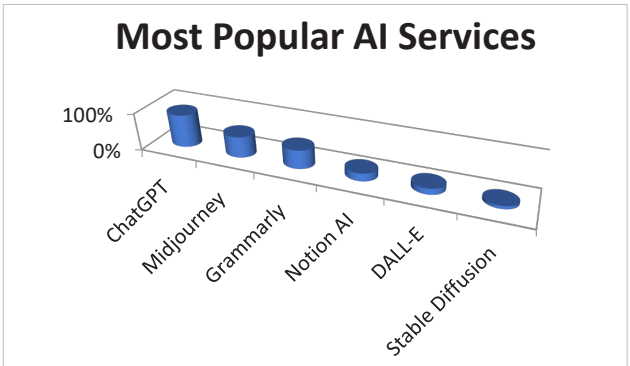

Figure 1. Usage of AI Services in Ukraine in 2023

Source: [10; 21]

AI-based systems can handle large volumes of data about user behavior, preferences, and purchase history to provide personalized recommendations. For example, machine learning algorithms can predict which products may interest a particular user based on their previous searches and purchases. Integrating AI into database systems helps improve query optimization and resource allocation, providing solutions that can adapt to dynamic workloads and changing data structures [2, p. 591].

In Ukraine, several companies have successfully integrated AI into their business processes. According to the Ukrainian Business Award, the top 10 companies in 2023 included those specializing in software development, information security, IT operations, and consulting. These companies are SoftServe, N-ix (an outsourcing firm), Infopulse, Intellias, GlobalLogic, Sigma, Data Science UA, Lemberg Solutions, Artelogic, and Innovecs. These businesses are leading the way in AI implementation within their respective fields [20].

The companies in the e-commerce sector are not yet represented on this list. Therefore, it is essential to prioritize the swift integration of AI into e-commerce businesses and address the potential challenges that may arise during this process. As AI continues to evolve, companies in e-commerce need to harness its capabilities to improve customer experiences, streamline operations, and enhance competitiveness. Overcoming the hurdles related to AI adoption – such as data privacy concerns, technological infrastructure, and resistance to change – will be key to unlocking its full potential in the sector.

The key aspects of its use in online trading are highlighted in Table 1.

The integration of Artificial intelligence to e-commerce offers businesses numerous benefits, such as improved efficiency, enhanced user experience, and the automation of tasks like inventory management, personalized offerings, data analysis, and customer service. These advancements help reduce costs, boost productivity, and improve interactions with customers. These improvements help reduce operational costs, increase productivity, and lead to better customer relationships.

However, along with the benefits of AI come risks and threats that need to be addressed. To ensure its successful integration into business processes, companies must prioritize data security, take measures to prevent biases, and find a balance between automation and human interaction. Additionally, they must be prepared to face potential legal and social challenges that could arise. Careful planning and strategic adaptation are essential for minimizing these risks and fully leveraging the benefits that AI can provide. Some of these threats are outlined in Table 2.

Another existential threat is the possibility of AI taking control of many processes, potentially becoming a "master of the world" or of a specific sphere, as depicted in various dystopian films: Stanley Kubrick's "2001: A Space Odyssey" (1968), Joseph Sargent's "Colossus: The Forbin Project" (1970), James Cameron's "Terminator" (1984), the Wachowski brothers' "The Matrix" (1999), Paul Anderson's "Resident Evil" (2002), Alex Proyas' "I, Robot" (2004), Wally Pfister's "Transcendence" (2014), serials "Black Mirror" (2011), "Love, Death & Robots" (2013) and "Mrs. Davis" (2023) [16, p. 104-106]. To prevent this threat, AI is restricted in certain fields and denied access to specific databases [4].

There are several models that simulate the use of AI in e-commerce. These models can vary widely and cover different aspects of business processes, such as predictive analytics for customer behavior, AI-powered chatbots for customer support, recommendation systems for personalized shopping experiences, and AI tools for inventory optimization. Each of these models illustrates how AI can be applied to enhance decision-making, improve efficiency, and create more engaging customer experiences (Table 3).

Table 1

Applications of Artificial Intelligence in E-commerce*

№	Application Area	Comment
1.	Personalization	AI (such as quickchat.ai, ChatGPT) enables companies to create personalized experiences for users. For example, machine learning-based recommendation systems analyze customer behavior (e.g., views, purchases, search queries) and suggest products that match their interests, increasing the likelihood of a sale and customer satisfaction.
2.	Natural Language Processing (NLP)	AI in e-commerce uses NLP to automate customer communications. Chatbots and virtual assistants can respond to inquiries, provide product information, process orders, and even resolve issues without human intervention. This reduces customer service costs and improves response times.
3.	Data Analysis	AI can analyze large volumes of data to identify patterns and trends. This allows companies to better understand consumer behavior, forecast product demand, and optimize inventory. Predictive analytics also helps identify potential issues or opportunities for business expansion.
4.	Pricing	AI-based tools can automatically adjust product prices based on market conditions, competition, demand, and other factors. This helps companies remain competitive and maximize profits.
5.	Fraud Detection and Security	AI helps detect suspicious transactions and fraudulent activities by analyzing anomalies in data and user behavior. AI-based systems can respond instantly to potential threats, ensuring higher security for payment processing and protecting customer data.
6.	Supply Chain Management	AI can assist in supply chain management by forecasting inventory needs and optimizing logistics processes. This includes automating procurement processes, monitoring suppliers, and managing inventory to reduce costs and improve efficiency.
7.	Creative Content	AI can also be used to create content, such as automatically writing product descriptions, generating advertising materials, or creating personalized emails. This reduces the workload on creative teams and ensures faster content production.
8.	Advertising Campaign Management	AI enables real-time adjustments of advertising campaigns, budget optimization, ad performance analysis, and targeted advertising to specific audience segments. This improves advertising effectiveness and reduces marketing costs.
9.	Product Delivery	AI can be involved in product delivery via drones, which companies are gradually implementing in practice, such as American companies (Domino's, Pizza, Amazon) and Ukrainian ones (Nova Poshta, Ukrposhta, Dronarium).
10.	Design	AI can generate images for websites (products, processes, diagrams, etc.) and create various combinations of these visuals.
11.	Forecasting	Machine learning algorithms can help businesses predict future trends, such as product demand, customer behavior, market changes, new technologies, risks, and opportunities. This allows companies to better prepare for potential changes and develop more effective strategies.
12.	Strategy Evaluation	– McKinsey uses AI to forecast product and service demand, helping clients improve their product portfolios. – Walmart applies AI to optimize the supply chain, predict demand, and personalize prices and offers, enhancing customer engagement and loyalty. – Amazon uses AI for demand forecasting and warehouse automation, making the supply chain more efficient.
13.	Information, Document Creation, Coding, Slogans	ChatGPT (or rytr.me or copy.ai) can create: – Information materials (newsletters, posts, internal messages, official documents) based on key points. – Working code or a simple application in Java, Python, C++, JavaScript. – Slogans and ideas for advertising materials based on keywords (naming and brainstorming).

Source: [1; 13; 18; 21] and author's experience

Table 2

Threats in the Use of Artificial Intelligence in E-commerce

№	Threat	Comment
1	2	3
1.	Data Protection and Privacy	AI processes large volumes of personal and financial user data, increasing the risk of data breaches and misuse. Inadequate security measures can lead to privacy violations and threats to the personal information of customers.
2.	Fraud and Manipulation	AI can be used to create fake profiles, manipulate prices, or even carry out automated attacks on e-commerce websites. AI-based systems can also be vulnerable to attacks that exploit algorithmic weaknesses for fraud.
3.	Ethical Issues and Bias	AI algorithms may reflect or amplify existing biases and stereotypes if trained on biased data. This can lead to unfair decisions or discrimination in recommendations or pricing.
4.	Dependency on Technology	Over-reliance on AI may cause problems if systems fail or malfunction. This can affect business operations, especially in critical areas such as automated inventory management or payment processing.
5.	Loss of Human Interaction	Increased automation through AI may reduce the level of personal contact between companies and customers, potentially lowering the quality of service and customer satisfaction for those who prefer a personal approach.

Continue Table 2

1	2	3
6.	Inaccurate or Incorrect Information	AI systems may sometimes provide inaccurate or erroneous recommendations and results if trained on incorrect data or if there are defects in the algorithms. This can affect customer satisfaction and trust in the brand.
7.	Cost of Implementation and Maintenance	Implementing and maintaining AI technologies can be expensive. Small and medium-sized enterprises may face financial challenges in adopting and sustaining complex AI systems.
8.	Legal and Regulatory Issues	Companies may encounter legal challenges related to the use of AI, such as data protection and ensuring transparency in algorithms, in line with new regulations and standards.
9.	Labor Market Changes	Automation through AI may lead to job reductions, particularly in areas where processes can be automated. This could have social consequences and require a reevaluation of professional skills and training.
10.	Inequality and Unemployment	The adoption of AI may cause labor market inequality and increase unemployment, especially in e-commerce sectors, as automated systems could replace many jobs, reducing the need for workers.
11.	Privacy and Security Concerns	The widespread use of AI could threaten the privacy and security of personal information. Inadequate data protection could result in leaks of confidential information or its misuse.
12.	Impact on Jobs and the Economy	The widespread adoption of AI will change the nature of jobs and require new skills from workers. This may necessitate retraining and reskilling, impacting employment structure and wage levels.

Source: [1; 19]

Table 3

Simulation Models of AI Use in E-commerce

№	Model Name	Description
1.	Demand Forecasting Mode	Used to analyze product demand based on historical sales data, consumer behavior, seasonality, and other factors. This model can be built using machine learning algorithms such as regression analysis, decision trees, neural networks, and ensemble learning methods. It is applied for inventory optimization, production planning, and logistics management.
2.	Recommendation System Model	Designed for personalized product or service recommendations based on user behavior, preferences, and purchase history. The most common models include collaborative filtering, content-based filtering, and hybrid approaches. It is used to increase conversion rates, customer retention, and average order value.
3.	Sentiment Analysis Model	Used to analyze customer reviews, comments, and other textual data. These models are based on natural language processing (NLP) methods and machine learning. It is applied for brand reputation monitoring, customer service management, and product improvement.
4.	Dynamic Pricing Model	Determines optimal product prices in real-time based on demand analysis, competition, time of day, day of the week, and other factors. Algorithms may include linear programming, machine learning, and game theory elements. It is used to maximize profit and maintain market competitiveness.
5.	Fraud Detection Model	Identifies suspicious transactions or behavioral patterns that may indicate fraudulent activities. This model uses classification algorithms such as logistic regression, decision trees, neural networks, or ensemble methods. It is applied to protect against financial losses and enhance payment system security.
6.	Customer Service Automation Model	Uses chatbots (or virtual assistants) to automatically resolve customer inquiries. It can be based on NLP algorithms, speech recognition systems, and machine learning. It is applied to improve the efficiency of customer support operations and reduce customer service costs.
7.	Logistics and Warehouse Optimization	AI models assist in planning and managing supply chains, demand forecasting, and optimizing inventory and warehouse operations to reduce costs and improve customer service, as well as optimizing delivery routes to minimize delivery times.
8.	Risk Calculation and Minimization Model	The algorithm for calculating and minimizing risks using AI in e-commerce provides a systematic approach to identifying, assessing and managing risks [23].
9.	The model for selecting the best strategies	This model is based on the methodology of multi-criteria analysis of e-commerce alternatives and determining the best strategies.

Source: author's development

The listed models help businesses automate, optimize, and improve various aspects of their operations, thereby enhancing competitiveness and customer satisfaction. To provide a better understanding of how this works, below is the Python code for a logistics and warehouse optimization model (item 7) (Figure 2).

This code solves a basic VRP where the goal is to find the shortest path for a vehicle that needs to deliver goods to several locations. The distance matrix represents the distances between different locations. The OR-Tools solver finds the optimal route that minimizes the total distance traveled.

Conclusions. The conducted study allows for the following conclusions regarding the role of AI in e-commerce:

1. The implementation of AI in e-commerce covers various aspects, including user behavior analysis, warehouse process automation, offer personalization, and price management. This enables companies to create more attractive and tailored products for their customers.

```
# Solve the problem
solution = routing.SolveWithParameters(search_parameters)

# Print solution on console
if solution:
    print('Objective: {}'.format(solution.ObjectiveValue()))
    index = routing.Start(0)
    plan_output = 'Route:\n'
    route_distance = 0
    while not routing.IsEnd(index):
        plan_output += ' {} ->'.format(manager.IndexToNode(index))
        previous_index = index
        index = solution.Value(routing.NextVar(index))
        route_distance += routing.GetArcCostForVehicle(previous_index, index, 0)
    plan_output += ' {}\n'.format(manager.IndexToNode(index))
    print(plan_output)
```

```
from ortools.constraint_solver import pywrapcp
from ortools.constraint_solver import routing_enums_pb2

# Create the data for the VRP
def create_data_model():
    data = {}
    data['distance_matrix'] = [
        [0, 2, 9, 10],
        [1, 0, 6, 4],
        [15, 7, 0, 8],
        [6, 3, 12, 0],
    ]
    data['num_vehicles'] = 1
    data['depot'] = 0
    return data

data = create_data_model()

# Create the routing index manager
manager = pywrapcp.RoutingIndexManager(len(data['distance_matrix']), data['num_vehicles'],
```

Figure 2. The code for a logistics and warehouse optimization model

Source: author's development

2. Despite its advantages, the use of AI can have potential negative consequences. Automation may lead to job reductions and increased unemployment in certain sectors. This creates a need for retraining workers and changing skill sets, which requires active support policies. AI may also pose threats to privacy and the security of personal data.

3. To ensure the sustainable development of e-commerce with the use of AI, it is important to consider not only technological but also social aspects.

In the future, a similar approach could be applied to other sectors of the economy. This would allow for the exploration of the benefits AI can bring, the identification of potential risks and threats, and the development of strategies to mitigate them.

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