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INTEGRATION TRENDS IN THE DEVELOPMENT OF E-COMMERCE: ACCOUNTING AND CONTROL ASPECT

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Abstract.

Introduction. *Under modern conditions of digitalization, the development of computer-communication technologies significantly influenced the transformation of e-commerce formats and the enhancement of consumer interaction tools. E-business, driven by innovative technologies, focuses on maximizing customer satisfaction while also supporting the implementation of new informational priorities for a broad range of stakeholders.*

Purpose. *The article aims to identify integration trends in the development of e-commerce in the context of improving accounting and control under the influence of innovative information processing technologies.*

Results. *Integration trends in e-commerce development have been analyzed and systematized, based on the application of innovative computer-communication technologies such as artificial intelligence, fintech solutions, chatbots, social media, cloud services, virtual and augmented reality, and blockchain. The comprehensive application of these technologies contributes to the transformation of e-business, particularly in accounting and control. Key directions of this transformation include customer-centricity, payment gateway integration, the development of social commerce, commerce as a cloud service, globalization of trade, implementation of commercial activity within metaverses, use of cryptocurrencies, and strengthening of cybersecurity. Integration of multiple information-processing technologies creates a synergistic effect that ensures qualitative improvement of accounting and control for effective management of commercial and settlement operations in e-commerce enterprises.*

Prospects*. The integration of modern information-processing technologies into e-commerce positions accounting and control as a foundation for unifying financial, product, and logistics flows into a single commercial cycle that meets both consumer and informational interests of society. Further research is required to explore the interconnection between settlement, trade, and logistics processes in the context of their accounting and control, which will define the focus of future scientific inquiry.*

Keywords: *accounting, control, e-commerce, e-business, integration trends, information technologies.*

Formulas: 0, fig.: 1, tabl.: 1, bibl.: 15.

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Introduction. E-commerce is a key sector of economic activity that has laid the foundation for the digital economy. The evolution of computer and communication technologies has significantly influenced the transformation of e-commerce formats. Electronic business is increasingly characterized by customer centricity, complexity, multi-format engagement, innovation, and the remote delivery of goods, services, and works. Through integration with other areas of entrepreneurship and communication with all participants of the goods market, e-commerce has become a tool for identifying and addressing consumer priorities.

However, public interest is no longer limited to goods, services, or works – it also extends to the information environment in which e-business operates. Integration trends in e-commerce involve the transformation of accounting and control functions as essential information-based tools for managing electronic business processes. All these integration-driven changes in e-commerce directly affect the accounting and control mechanisms of e-commerce enterprises. The positive transformations resulting from the integration of modern computer and communication technologies underscore their systemic nature, influencing both the trade and settlement activities and the accounting and control processes of online retailers.

Analysis of research and publications. The theoretical and practical aspects of accounting and control in e-commerce have been explored in numerous academic studies. However, the prospects for applying innovative technologies in e-commerce with the aim of improving accounting and control systems remain underexplored within the academic community.

For example, Chew Jiajia et al. refined the methodology for using artificial intelligence (AI) to integrate accounting systems into the management of financial risks in e-commerce [1]. Related studies by Cao Pan focused on the application of AI to personalize e-commerce services based on accounting data [2]. Moenandar Pandu, Syahrial Irzan, and Kayo Amrizal examined the specifics of digital wallet adoption across enterprises of different sizes in the context of enhancing accounting practices in e-commerce [3]. This line of research was extended by Panasiuk V. M., Halchak K. R., and Bosyi V. A., who developed principles for accounting in e-commerce involving virtual assets and cryptocurrencies used for payments [4].

Li Qiang proposed an integrated application of cloud services and Big Data processing methods to enable real-time accounting in e-commerce [5]. He Fan et al. justified the need to ensure information security in e-commerce accounting systems, emphasizing the necessity of involving various information technologies [6]. Muravskyi V. developed a set of solutions for cybersecurity based on accounting infrastructure, with a focus on future prospects in various areas of e-business [7]. The importance of technologies for analytical processing of accounting data in the future development of e-business was emphasized by Kulinich M., Matviichuk I., and Hadzevych A. [8].

Monteiro Albertina and others investigated the relationship between accounting and management control in the context of digitalization to enhance the efficiency of e-business enterprises [9]. Shi Wenquan emphasized the intermediary role of automated accounting and network technologies in integrating e-business with other economic systems [10]. Miqbas Fahdil, Zuliyati, and Handayani Retno identified the influence of fintech solutions and innovative software on the digitalization of accounting processes in small and medium-sized e-commerce enterprises [11]. Kurgan N. V. explored the digitalization prospects of accounting in export-import operations amid the development of international partnerships in e-commerce [12].

Nonetheless, these studies are fragmented and address only isolated aspects of accounting and control digitalization in e-commerce. The need for an integrated conceptual framework assessing the impact of innovative technologies on the transformation of accounting and control practices in e-commerce shapes the aim of this research.

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The aim of the article is to identify the integration trends in the development of e-commerce in the context of improving accounting and control systems under the influence of innovative information processing technologies.

Results. The advancement of innovative technologies in e-commerce has given rise to new formats for the delivery of goods, works, and services. These innovative forms of commercial activity are associated with comprehensive transformations in payment systems, marketing strategies, product information dissemination, logistics of last-mile delivery, and the overall management of the e-business cycle.

As a result, current transformation trends in the development of e-commerce are characterized by the integrated application of computer and communication technologies. The evolution of e-commerce reflects the following key integration trends: focus on customer-centricity, integration of payment gateways, growth of social commerce, positioning of e-commerce as a cloud-based service, globalization of commercial operations, deployment of commercial activities within metaverses, utilization of cryptocurrencies, and enhancement of cybersecurity measures (Fig. 1).

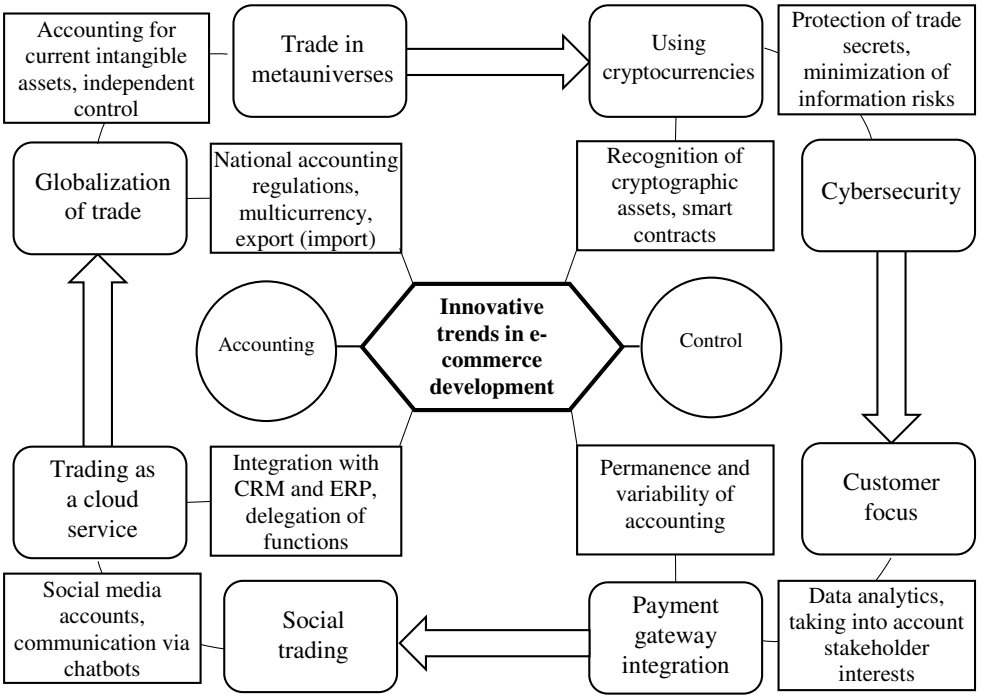

Fig. 1. Integration trends in the development of electronic commerce and their impact on accounting and control.

Source: compiled by the authors.

With the advancement of artificial intelligence (AI) technologies, e-commerce is evolving into a highly customer-centric method of addressing public consumer interests. Monitoring customer behavior on online platforms for the sale of goods, works, and services serves as the foundation for shaping pricing and sales policies in electronic business. The development

of marketing strategies is impossible without behavioral assessments of consumer motivations and actions within the digital business environment. The personalization of e-commerce has resulted in the creation of customized products and services, as well as tailored promotional campaigns and pricing offers [13].

This shift contributes to the increased analytical depth of accounting. In the realm of e-business, management is required to handle multidimensional accounting data segmented by product categories, customer groups, pricing schemes, counterparties, contracts, and other parameters.

The consumer is now perceived as a bearer of individual purchasing characteristics and informational attributes. However, consumer interests in electronic business extend beyond physical products and encompass the informational environment in which e-commerce enterprises operate [14]. AI technologies can also be employed to meet the informational priorities of stakeholders. Based on methodologies for studying users' informational interests, it is advisable to offer optimized volumes of accounting data, alternative interpretations, and suitable formats for visual presentation.

Electronic communications in commerce are used simultaneously for conducting business operations and supporting accounting processes. The relevance of accounting information, aligned with stakeholder informational priorities, enhances the quality of electronic business management and supports the optimization of financial outcomes from commercial operations.

An integral component of e-commerce is the system of electronic transactions. E-payments finalize the commercial cycle of product realization. The financial closure of an electronic transaction is embedded within the e-commerce process. However, since electronic transactions can occur at any stage of the commercial workflow, the receipt of funds does not always represent the final stage of the business cycle.

The constant expectation of executing electronic financial transactions necessitates the continuous accounting of cash inflows. To support uninterrupted accounting of electronic money transfers, e-commerce platforms have integrated multiple flexible payment gateways. The development of fintech services has enabled various methods of payment for goods, services, and works within electronic business environments. Customers are offered diverse payment methods and instruments, which help attract a broader customer base and enhance the overall user experience of online shopping platforms.

The integration of flexible payment gateways and fintech services into e-commerce ensures real-time and automated recording of cash inflows. Primary accounting documents and entries can be promptly generated within electronic transaction systems. Similarly, automated communication with tax authorities is enabled, including the calculation of tax liabilities based on data from trade and settlement operations. The timeliness of recording settlements with counterparties creates conditions for effective control over the emergence and repayment of liabilities in e-commerce enterprises. The ultimate outcome of digitalizing the accounting of electronic financial transactions is the establishment of payment discipline and the efficient management of cash flows in electronic business operations [15].

The proliferation of flexible payment options for goods, services, and works in e-commerce has contributed to the rise of commerce via social networks and messaging platforms. Most major online communication platforms now provide opportunities for product advertising

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and even direct sales. Buyer–seller interactions related to product selection, payment, and delivery are increasingly conducted through private messages. A revolutionary shift in e-commerce has been the integration of chatbots into social networks. Modern electronic communication systems not only gather data on customer preferences but also fully execute trade and settlement transactions. AI-powered chatbots embedded in messaging platforms now enable the automated sale of goods, services, and works without the direct involvement of enterprise personnel. All operations – including customer consultations, order placement and payment, and last-mile delivery – can occur automatically.

The expansion of e-commerce through social networks and messengers is transforming the functional responsibilities of accounting personnel. Accounting professionals can now exchange data in real time, enabling remote management of e-business operations. AI-powered chatbots can monitor the information needs of accounting staff and generate data sets sufficient for performing their official duties. Each employee may be provided with accounting information via secure messenger platforms in accordance with their access rights to commercial confidentiality.

Chatbots are also capable of rapidly identifying errors in the processing and interpretation of accounting data based on the content of user queries. To mitigate errors or intentional manipulation of accounting information, chatbots should be empowered to notify designated security personnel and suggest relevant upskilling or training for employees. Furthermore, chatbots can be used to deliver real-time accounting guidance regarding changes in both internal and external operational conditions affecting e-commerce enterprises. As a result, messaging platforms are becoming advisory, supervisory, and informational tools in the management of electronic business.

Traditionally, online stores operate via cloud-based services that provide hosting infrastructure. The website of the store is hosted in a cloud environment, while data processing is carried out by the company's in-house employees. However, the current level of cloud service penetration in the digital economy is transforming approaches to data hosting and processing. Cloud technologies now encompass not only product selection and order placement but also facilitate the digitalization of all accounting and management aspects of e-commerce operations. The market for cloud services offers comprehensive solutions for automated processing of information flows. Maximum integration of cloud services into the commercial cycle enables the outsourcing of all stages of trade management.

The most critical components of an integrated cloud-based environment include CRM systems (for managing settlements with counterparties) and ERP systems (for managing product flows and warehouse inventories). Both platforms, when implemented in a cloud infrastructure, perform accounting and management functions without direct human involvement. In such an environment, accounting data processing is fully delegated, reducing the need for in-house staff. With comprehensive cloud services, functions such as payment processing and product delivery can be outsourced, creating the foundation for a fully automated e-business model. Accounting and management professionals can receive summarized reports on e-business performance directly from cloud-based systems.

Global transformations in the digital economy have laid the groundwork for the internationalization of e-business. The erosion of national borders in e-commerce facilitates the seamless entry of goods, services, and works into foreign markets. Information published

online is not subject to national restrictions, thereby promoting free-market competition. Global logistics and payment solutions support international flows of goods and capital, simplifying e-business operations regardless of the physical location of production facilities or warehouses.

Integrating online trading platforms into the global market space requires compliance with the national legislation of countries where end-users reside. Consequently, cloud-based services for digitalizing trade and settlement operations must remain adaptable to national tax laws and accounting standards. For instance, during the selection of suppliers or buyers and the identification of their country of origin, income and expenses must be recalculated in accordance with the enterprise's foreign economic activities. Most cloud services are capable of transforming reporting formats to meet national accounting standards. This flexible adaptation of accounting data to foreign regulations facilitates the international harmonization of information systems and their integration into the global economic landscape.

The globalization of trade and settlement activities in electronic form necessitates the ability to handle multiple currencies within the accounting system. Multicurrency operations introduce constraints to the accounting infrastructure of e-business, particularly the requirement to consolidate financial data into a unified currency. Most e-commerce websites offer real-time currency conversion. Regardless of the selected payment currency for goods, services, or works, the accounting system ensures the simultaneous presentation of financial information in multiple national and digital currencies.

Since currency conversion gives rise to commissions and exchange rate differences, accounting systems are responsible for accurately recording them. The digitalization of accounting for foreign economic operations facilitates the automatic generation of accounting entries related to currency conversions, commissions, exchange rate gains or losses, customs duties, and tax payments.

A key driver of e-commerce intensification is the development of virtual and augmented reality (VR/AR) technologies. Visual effects have long been used in commerce to attract consumer attention and stimulate demand for goods, works, or services. The virtualization of trade and settlement processes has led to the emergence of metaverses – immersive digital environments where communication, product selection, and even consumption occur exclusively in virtual space. Business interactions are conducted between digital accounts (avatars) of buyers, intermediaries, and sellers. The outcomes of e-commerce within the metaverse may involve the consumption of virtual goods or the physical delivery of items purchased through VR/AR technologies.

Frequently, the traded item within the metaverse is a virtual asset in the form of a non-fungible token (NFT). Accounting for such tokens presents a significant challenge in terms of asset recognition and classification as intangible items. As intangible assets are part of a company's non-current assets, it is not appropriate to classify NFTs as «inventory» by default. A more accurate approach is to treat NFTs consumed within one year as current intangible assets. For this purpose, it is advisable to distinguish between current and non-current intangible assets within the active section of the balance sheet. The use of current intangible assets may be equated to trade operations, allowing for their accounting as part of commercial activities within the metaverse.

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At the same time, a vital task of accounting is to generate complete and timely information about trade and settlement operations within the metaverse. Since all participants in a virtual transaction lack face-to-face interaction, a robust mechanism is required to verify the accuracy of data related to goods and settlements. This necessitates the creation of an independent control system to validate the accounting data generated by participants in metaverse-based electronic transactions. External control can be implemented by auditing firms, which act as guarantors of commercial credibility. Based on reliable reporting and positive track records, the business reputation of each counterparty can be confirmed. The metaverse operator functions as an intermediary in transferring goods and funds during virtual trade. Efficient accounting and control enhance trust and ensure the legitimacy of transactions in virtual environments, ultimately contributing to the increased frequency of electronic trade agreements in the near future.

The existence of metaverses is based on blockchain technology and cryptographic assets. Cryptographic currencies and digital assets are widely used in e-commerce. The use of cryptocurrencies offers significant advantages for e-commerce, including confidentiality, rapid transaction execution, and the elimination of intermediaries. The mutual benefits of cryptocurrency use promote their adoption in electronic transactions.

In accounting systems across various countries, cryptocurrencies may be recognized as intangible assets, investment instruments, or cash equivalents. In the context of commercial and settlement operations, it is more appropriate to treat cryptocurrencies as monetary equivalents used for the purchase of goods, works, and services. As a result, cryptocurrency transactions are often equated with foreign currency operations, requiring the identification and accounting of exchange rate differences.

The use of blockchain technology and related cryptographic currencies enables the automation of contract performance monitoring in trade. For instance, when inventory levels fall below a predetermined threshold, blockchain-based systems can automatically initiate restocking, place purchase orders with suppliers, execute fund transfers, and – upon receipt of confirmation from a logistics provider – transfer ownership rights to the assets. To carry out trade and settlement transactions without direct human involvement, e-commerce enterprises must pre-configure smart contracts.

A smart contract specifies a sequence of actions that, when triggered, automatically initiates corresponding management mechanisms. The setup of such contractual arrangements requires mandatory participation from accounting and management professionals. The company's accounting policy must define the quantitative and monetary thresholds for which specific trade and settlement operations are permitted to execute autonomously. In cases where transaction parameters exceed the permissible attributes outlined in the smart contract, it is advisable to implement an instant notification system that queries the accounting personnel for approval or rejection. The deployment of smart contracts facilitates the digital automation of recurring events in e-commerce and supports the automated generation of relevant accounting entries.

Furthermore, blockchain technology creates strong prerequisites for ensuring cybersecurity in digital commerce. Since e-commerce is conducted entirely via the Internet, it remains particularly vulnerable to cyberthreats. However, the structural and security advantages of blockchain-based data organization significantly enhance the resilience of

an enterprise's information system against both internal and external malicious intrusions. Reliable cyber protection mechanisms have a direct positive impact on the financial sustainability of online stores.

Minimizing incidents such as data breaches, falsification or distortion of accounting records, denial-of-service attacks, theft of digital assets and funds, information manipulation, and fraud reduces the likelihood of substantial financial losses in e-business operations. As a result, the manifestation of integration trends in the development of e-commerce has become achievable due to the comprehensive application of computer-communication technologies (Table 1).

The manifestation of any integration trend in the development of e-commerce implies the simultaneous application of multiple innovative computer-communication technologies. The establishment of the digital economy across its various forms and sectors of economic activity cannot rely on a single information-processing technology. Breakthrough effects in modern formats of e-business become possible only through comprehensive implementation of digitalization trends in trade and settlement operations.

Table 1

Matrix of the influence of computer and communication technologies on the integration trends of e-commerce development

	Artificial Intelligence	Fintech	Social Networks	Chatbots	Cloud Services	VR/AR	Blockchain
Customer-centricity	+	+	+	+			
Payment gateway integration		+					+
Social commerce	+		+	+	+		
Commerce as a cloud service				+	+		+
Globalization of commerce	+		+	+	+		
Trade in metaverses		+				+	+
Using cryptocurrencies		+				+	+
Cybersecurity				+	+		+

Source: developed by the authors.

For instance, ensuring customer-centricity in e-commerce requires a combination of technologies: Artificial intelligence for analyzing consumer and stakeholder informational preferences, Fintech services to enable diverse payment methods, Social media for convenient communication during consultation and purchasing, Chatbots for automated customer service. The joint deployment of computer-communication technologies generates synergistic improvements in accounting and control, enhancing the efficiency of e-commerce enterprise management.

Conclusions. The advancement of computer-communication technologies has led to the transformation of e-commerce formats. The ultimate objective of modern e-business is to maximize the satisfaction of consumer needs for goods and services. However, the

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innovative technologies integrated into digital commerce are also capable of addressing the informational priorities of a wide range of stakeholders. The integrated trends in the development of e-commerce are driven by the application of technologies such as: Artificial intelligence, Fintech, Chatbots, Social media, Cloud services, Virtual and augmented reality, Blockchain etc. The comprehensive use of innovative technologies leads to a positive transformation of e-business, with direct implications for accounting and control, particularly in the following areas:

– Customer-centricity: enhanced data analytics, consideration of stakeholder interests;

– Payment gateway integration: continuous and multi-source accounting of financial inflows;

– Social commerce: accounting for transactions through social platforms and chatbot communication;

– Commerce-as-a-cloud-service: integration with CRM and ERP systems, reallocation and delegation of staff responsibilities;

– Globalization of trade: alignment with national accounting standards, multi-currency accounting, and accounting for cross-border transactions;

– Commerce in metaverses: accounting for virtual current intangible assets, independent validation and control of accounting indicators;

– Use of cryptocurrencies: recognition of cryptographic assets, smart contract processing;

– Cybersecurity: protection of trade secrets, mitigation of informational risks.

The integration trends in the evolution of e-commerce are characterized by the simultaneous use of multiple information technologies, generating a synergistic enhancement of accounting and control processes to support the efficient management of trade and settlement operations within digital business enterprises.

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ІНТЕГРАЦІЙНІ ТЕНДЕНЦІЇ РОЗВИТКУ ЕЛЕКТРОННОЇ КОМЕРЦІЇ: ОБЛІКОВО-КОНТРОЛЬНИЙ АСПЕКТ

Анотація.

Вступ*. У сучасних умовах цифровізації розвиток комп'ютерно-комунікаційних технологій суттєво вплинув на трансформацію форматів електронної торгівлі й удосконалення інструментів взаємодії зі споживачами. Електронний бізнес в умовах використання інноваційних технологій орієнтується на максимальне задоволення потреб покупців, водночас сприяючи реалізації нових інформаційних пріоритетів для широкого кола стейкхолдерів.*

Мета статті *полягає у виокремленні інтеграційних тенденцій розвитку електронної комерції у контексті удосконалення обліку і контролю під впливом використання інноваційних технологій обробки інформації.*

Результати. *Проаналізовано та систематизовано інтеграційні тренди розвитку електронної комерції, що базуються на використанні інноваційних комп'ютерно-комунікаційних технологій, зокрема: штучного інтелекту, фінтех-рішень, чат-ботів, соціальних мереж, хмарних сервісів, технологій віртуальної та доповненої реальності, блокчейн. Обґрунтовано, що комплексне застосування таких технологій сприяє трансформації електронного бізнесу, зокрема в аспектах обліку та контролю. Виокремлено напрями забезпечення цієї трансформації: клієнтоорієнтованість, інтеграція платіжних шлюзів, розвиток соціальної торгівлі, торгівлі як хмарного сервісу, глобалізація комерції, впровадження торговельної діяльності в метавсесвітах, застосування криптовалют, посилення кібербезпеки. Доведено, що інтеграція кількох технологій обробки інформації формує синергетичний ефект, що забезпечує якісне удосконалення обліку й контролю для ефективного управління торговельно-розрахунковою діяльністю суб'єктів електронної комерції.*

Перспективи. *Інтеграція сучасних технологій обробки інформації в електронну торгівлю пов'язана з позиціонуванням обліку і контролю як підґрунтям для об'єднання грошових, товарних та логістичних потоків у єдиний комерційний цикл забезпечення споживчих та інформаційних інтересів громадськості. Подальших досліджень потребує взаємозв'язок між розрахунковими, торговельними та логістичними процесами у контексті їх обліку і контролю, що буде предметом майбутнього наукового пошуку.*

Ключові слова: *облік, контроль, електронна комерція, електронний бізнес, інтеграційні тенденції розвитку, інформаційні технології.*

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