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DEVELOPMENT OF INFRASTRUCTURE FOR CASHLESS PAYMENTS IN FINTECH REVOLUTION CONTEXT

РОЗВИТОК ІНФРАСТРУКТУРИ ДЛЯ БЕЗГОТІВКОВИХ ПЛАТЕЖІВ У КОНТЕКСТІ ФІНТЕХ-РЕВОЛЮЦІЇ

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The article emphasizes an active transition towards a cashless economy and that this process is widespread, largely driven by the rapid development of financial technologies (FinTech). In this context, the article aims to identify the features of infrastructure development for cashless payments against the backdrop of significant changes in the financial sector, driven by the rapid growth of a new industry that leverages modern technologies to simplify and enhance financial services. The study demonstrates that the infrastructure for cashless payments is a constantly evolving network that facilitates financial transactions without using cash. At the same time, since all components of this infrastructure must operate synchronously at a global level, supporting transactions involving different currencies, regulatory requirements, and security standards, its evolution is driven by blockchain, artificial intelligence, and biometric data.

Keywords: financial technologies, blockchain, artificial intelligence, biometric data, payment systems, payment terminals.

Наголошується, що наразі відбувається активний перехід до безготівкової економіки. Цей процес є повсюдним і значною мірою зумовлений бурхливим розвитком фінансових технологій (FinTech). У цьому контексті мета статті полягає у визначенні особливостей розвитку інфраструктури для безготівкових платежів на фоні масштабних змін у фінансовому секторі, спричинених швидким розвитком нової галузі, яка використовує сучасні технології для спрощення та покращення фінансових послуг. У межах дослідження доведено, що інфраструктура для безготівкових платежів є невпинно еволюціонуючою мережною, яка забезпечує проведення фінансових операцій без використання готівки. Оскільки всі компоненти окресленої інфраструктури повинні працювати синхронно на глобальному рівні, підтримуючи транзакції з використанням різних валют, регуляторних вимог та стандартів безпеки, драйверами її еволюції наразі є технології блокчейн (оскільки вони пропонують новий підхід до зберігання та обробки транзакцій,

забезпечуючи високий рівень безпеки, прозорості та децентралізації), штучний інтелект (оскільки він дозволяє аналізувати великі обсяги даних про платежі, виявляти шахрайство, персоналізувати пропозиції та оптимізувати процеси), та біометричні дані (оскільки використання унікальних біологічних характеристик для аутентифікації відкриває нові можливості для підвищення безпеки платежів та спрощення процедур авторизації). Констатовано, що драйвери еволюції інфраструктури для безготівкових платежів (а саме технології блокчейн, штучний інтелект і біометричні дані) чинять системний вплив на фінансовий сектор і суспільство в цілому через збільшення фінансової інклюзії, підвищення ефективності фінансових систем, покращення безпеки платежів (зокрема, зменшення ризику шахрайства та кібератак) і розвиток нових бізнес-моделей. Доведено, що незважаючи на значний прогрес, перед інфраструктурою для безготівкових платежів все ще стоїть ряд викликів, серед яких забезпечення кібербезпеки, регулювання та цифрова грамотність. Зростання кількості кібератак вимагає постійного вдосконалення систем захисту даних. Швидкий розвиток технологій потребує гнучкої адаптації законодавства та регуляторних норм до нових реалій. Посилення вимог до ефективності використання нових технологій потребує постійного підвищення рівня фінансової грамотності населення.

Ключові слова: фінансові технології, блокчейн, штучний інтелект, біометричні дані, платіжні системи, платіжні термінали.

Problem statement. Since the beginning of the FinTech revolution (from the early 2000s, when the first major digital solutions in finance emerged), the world has been rapidly moving towards a cashless economy, where traditional payment methods are gradually being replaced by cashless, digitally-driven solutions. Although statistical data may vary depending on which payments are considered (cards, e-wallets, mobile payments, etc.), in most countries, the share of cashless payments exceeds 50%, and in some, it reaches 80% or more. Specifically, in most EU countries, the number of transactions using payment cards and mobile wallets like Apple Pay, Google Pay, and banks' proprietary solutions reaches 78%. In Ukraine, according to data from the National Bank of Ukraine (NBU), the share of payment card transactions issued by Ukrainian banks, both within the country and abroad, reached 63.3% of the total transaction value in the third quarter of 2023, with the number of transactions reaching 93.5%. In the second quarter of 2023, these figures were 62.1% and 92.8%, respectively [4]. According to current global statistics, the transition to a cashless economy is widespread and is largely driven by the rapid development of financial technologies (FinTech). Modern consumers increasingly prefer convenient and secure payment methods, which opens new opportunities for businesses and society. However, despite the positive aspects, the infrastructure for cashless payment development is a complex process that requires coordinated actions from the government, banking institutions, and financial service providers.

The analysis of recent researches and publications. The challenges of applying digital technologies in the financial services market are the subject of in-depth research by leading domestic and foreign scientists. Among the researchers who have focused their scientific interests on the development of infrastructure for non-cash payments (in particular, payment systems, terminals, and mobile applications), it is worth noting T. Mulik, O. O. Lyakhova, O. M. Yurkevych, and K. R. Korets. A comprehensive approach to developing the core components of non-cash payment infrastructure is presented in the works of O. Maslyhan O., Liba N., Korolovych O., Vovchenko O., and Kvasnytska R.

Yet, infrastructure development occurs concurrently with various changes in the financial sector, which are the result of the interplay of numerous factors (evolutionary drivers). A significant challenge lies in the insufficient research into these drivers and their impact on shaping the characteristics of financial sector development.

Goal setting (formulation of goals of the article). The article aims to identify the features of infrastructure development for cashless payments in the context of significant changes in the financial sector driven by the rapid advancement of technologies. The term "FinTech revolution" combines the words "finance" and "technology" and reflects the process of transforming traditional banking services under the influence of innovations.

The paper main body with full reasoning of academic results. The study emphasizes that the infrastructure for cashless payments is not only a collection of technologies, systems, processes, and institutions but an ever-evolving network that facilitates financial transactions without using cash. This system encompasses everything from banking systems to mobile applications, enabling users to pay for goods and services using payment cards, e-wallets,

mobile phones, and other digital tools. In the context of the FinTech revolution, the main components currently transforming the profile of this infrastructure are (see Table 1) banking systems, FinTech startups, various payment systems, payment terminals, mobile applications, e-wallets, online banking, and software.

The infrastructure components we outlined facilitate actions such as initiating a payment (when the customer selects a product or service and decides to pay cashlessly), processing the payment (when payment data is transmitted through the network to the bank), authorization (when the bank or other operator checks if there are sufficient funds in the account or wallet to complete the payment), and executing the payment (if funds are available, the bank or other operator authorizes the payment and transfers the money to the seller). This combination of initiation with authorization and execution allows transactions to be conducted quickly, conveniently, and securely. At the same time, all components of this infrastructure must operate synchronously on a global level, supporting transactions involving different currencies, regulatory requirements, and security standards, its evolution is driven by blockchain, artificial intelligence, and biometric data.

Thanks to the drivers of evolution, there are significant changes in the financial sector, particularly in the development of cashless payment infrastructure. Currently, the following key areas of this development can be identified [1–2]:

1. Deepening the integration of cashless payments with the Internet of Things (IoT). This direction essentially involves integrating financial transactions with other devices and systems connected to the internet.
2. Strengthening the role of biometric data in cashless payments (this direction involves using unique biological characteristics of individuals, such as fingerprints, facial recognition, and voice, for authentication and authorization of payments).
3. Deepening the integration of cashless payments and machine learning. This direction involves using machine learning algorithms to analyze large volumes of payment data and create personalized financial products. This makes interactions with financial services more individualized.
4. Expanding financial inclusion, specifically by providing access to financial services for the unbanked population, especially in remote areas. Mobile payments and agent networks play a key role in this process.

These directions are not exhaustive, but they demonstrate how technologies are transforming the way we make payments. Thanks to these

Table 1

Key components of cashless payment infrastructure

Components of digital infrastructure	Features of using the infrastructure component	Operational fatures
Banking systems	Banks and other entities (focused on specific market segments or niches) – operators handle transactions, store funds, and provide a range of financial services	Foundation for cashless transactions
Fintech startups		
Payment systems	Networks that connect various financial and non-financial institutions and enable the transfer of funds. Examples of such systems include Visa, Mastercard, and SWIFT	Agency network for cashless payments
Payment terminals	Devices installed in stores, restaurants, and other retail locations that allow for the acceptance of cashless payments	Devices and applications for connecting to cashless payment networks
Mobile apps	Mobile applications from banks and financial companies enable users to make payments from their smartphones	
Digital wallets	These are digital versions of traditional wallets that allow users to store funds and make payments through the internet or mobile applications.	Systems and software for data management
Online banking	Systems that allow customers to manage their accounts and make payments online	
Software	Various software used for processing payments, ensuring security, and analyzing data	

Source: formulated by the author based on [1–2; 6]

advancements, payments are becoming more convenient, secure, and accessible. Therefore, let us examine each of the highlighted directions in more detail.

Deepening the integration of cashless payments with the Internet of Things (IoT) directs a gradual transition to a world where every object can be connected to the internet and linked with the cashless payment infrastructure. This integration occurs through "smart" devices and micropayments (see Table 2). Note that these connections drive the emergence and effectiveness of cashless payment infrastructures such as the "smart home" (which allows for automatic payment of household expenses), the "smart store" (which not only employs self-service systems but also cashless technologies that offer options like contactless and automated purchases), and "smart checkouts" (which enable cashless mobility [2]).

For example, there are already so-called cashless stores where cameras and sensors track customers' movements and automatically deduct funds from their accounts. Additionally, Google Pay and Apple Pay currently allow users to add transit cards to their phone wallets and pay for travel using NFC technology. Many transportation companies or even cities are developing mobile apps that enable ticket purchases, track transportation, and offer personalized promotions. These examples, along with many others, clearly demonstrate that integrating cashless payments with the Internet of Things (IoT) through "smart" devices and micropayments opens new horizons for transactions, making them more convenient, faster, and more secure. However, to successfully realize this potential, several challenges must be addressed, including security (as the risk of cyberattacks increases, it is crucial to ensure robust data protection) and trust (consumers want to be confident in the security of their financial data). Additionally, there is a growing need to develop unified standards for the interoperability of different devices.

The increasing role of biometric data in cashless payments is driven by simplifying authentication and personalization (see Table 3).

In fact, instead of passwords and PIN codes, fingerprints, facial recognition, or voice authentication are increasingly used. This enhances both security and convenience. Additionally, biometric data can be utilized to create personalized offers and services. For example, Apple

Table 2

Features of integrating cashless payments with the IoT through "Smart" devices and micropayments

Action of IoT	Direction of action	Features of developing cashless payment infrastructure through integration with the IoT
Automation of household payments	Utility payments	The integration of smart meters with payment systems enables automatic reading and payment for consumed resources (such as electricity, gas, and water).
	Subscription services	Payments for subscriptions to streaming services, internet, mobile communications, and other services can be automatically charged to a linked bank card
	Device maintenance payments	Smart devices can independently order maintenance services or replacement of consumables.
Contactless and automated purchases	Self-service	Scanning products using smartphones or specialized devices, automatically determining the cost, and making payments through a mobile app
	Cashless stores	Using cameras and sensors to track customer movements and automatically deduct funds from their accounts
	Personalized offers	Analyzing purchase data allows stores to offer personalized discounts and recommendations
Cashless mobility	Transit payments	Using mobile apps or special cards for paying transit fares.
	Parking	Automatic parking payment via mobile apps or integrated systems in vehicles.
	Electric vehicle charging	Automatic vehicle identification and charging costs deducted from a linked bank card.

Source: formulated by the author based on [1–2; 6]

Table 3

Features of the increasing role of biometric data in cashless payments

Action of biometric data	Direction of action	Features of developing cashless payment infrastructure through the increasing role of biometric data
Authentication Payment terminals in stores are increasingly enabling payments through biometric data	Smartphones	Most modern smartphones come equipped with fingerprint scanners or facial recognition systems for unlocking the device and making payments.
	ATMs	Many banks offer the ability to withdraw cash using fingerprint or facial recognition.
	Payment Terminals	Payment terminals in stores are increasingly enabling payments through biometric data.
Personalization	Recommendations	By analyzing purchase history and other data, systems can offer personalized product and service recommendations.
	Marketing	Biometric data can be used to create more effective marketing campaigns.

Source: formulated by the author based on [2–3; 6]

Pay and Google Pay enable payments using fingerprints or facial recognition. Some banks also offer access to personal accounts through biometric data. Moreover, biometric data can be used to manage access to physical spaces [6]. Indeed, biometric data is playing an increasingly important role in the modern world, especially in the realm of financial technology. It not only enhances security but also allows for the creation of more personalized and convenient cashless payment services. However, for the successful development of this technology, several challenges must be addressed, including security (as there are always risks of biometric data spoofing [2-3]) and privacy.

Deepening integration of cashless payments with Artificial intelligence through data analysis and chatbots (see Table 4). In particular, AI enables the analysis of large volumes of payment data, detecting fraudulent activities, and offering personalized financial products. Currently, AI can analyze card images to identify counterfeits. It can assist customers in budgeting and forecasting future expenses. AI can automatically categorize transactions (e.g., groceries, transportation, entertainment). AI-based chatbots can provide 24/7 customer support and assist with financial inquiries.

Artificial intelligence enhances security, personalizes services, and creates more efficient financial systems. However, the successful development of this technology requires addressing several challenges, including data quality (specifically, the need for large volumes of high-quality data) and privacy. Additionally, many AI models operate as "black boxes," making it difficult to understand why a model made a particular decision. This lack of transparency can raise concerns about accountability in the event of errors related to AI models. Finally, the absence of explainability can diminish customer trust in AI-based systems.

Mobile payments and agent networks play an increasingly important role in expanding financial inclusion, especially in regions where access to traditional banking services is limited. This is facilitated through mobile payments and agent networks (see Table 5). Specifically, mobile payments enable individuals without bank accounts to access financial services, while the expansion of agent networks provides financial services in remote areas.

Mobile payments and agent networks are powerful tools for expanding financial inclusion. They not only enhance the accessibility of financial services but also simplify procedures, reduce costs, and contribute to improving financial literacy among the population. Thanks to these technologies, millions of people around the world are gaining the opportunity to improve their financial situation. However, a significant challenge for expanding financial inclusion is the inadequate provision of stable internet access in remote areas. Additionally, there is an increasing need to establish an effective regulatory framework for mobile payments and agent networks.

It is evident that the drivers of the evolution of cashless payment infrastructure (namely block-chain technology, artificial intelligence, and bio-metric data [2]) have a systemic impact on the financial sector and society as a whole through:

Table 4

Features of the impact of Artificial intelligence on the infrastructure of cashless payments

Action of AI	Direction of action	Features of the development of cashless payment infrastructure through Integration with AI
Data analysis and fraud detection [1]	Risk profile	AI analyzes large volumes of transaction data, allowing for the creation of detailed risk profiles for each customer. This helps to detect suspicious activity at early stages and prevent fraud
	Machine learning	Machine learning algorithms are continually refined by analyzing new data and detecting emerging patterns of fraudulent activity. This enables the identification of even the most complex fraud schemes.
	Real-Time	AI enables real-time transaction analysis, allowing for the immediate blocking of suspicious payments.
Personalization of financial products [2]	Recommendations	AI can analyze transaction history, demographic data, and other factors to offer customers personalized financial products, such as loans, investments, or insurance.
	Targeted offers	AI enables banks to create more precise and effective marketing campaigns by offering customers products that genuinely interest them.
A new level of customer service [3]	24/7 Support	AI-powered chatbots can provide 24/7 support to customers, addressing common questions and resolving simple issues.
	Personalization	Chatbots can address customers by name and use their interaction history with the bank to provide more accurate responses.
	Automation of routine tasks	Chatbots can automatically handle many routine tasks, such as blocking a card, changing a password, or obtaining a statement.

Note

[1] Data analysis and fraud detection are crucial components of many business processes, particularly in financial institutions, insurance companies, and e-commerce. The primary goal of this process is to identify suspicious or anomalous behaviors that may indicate fraud.

[2] Personalization of financial products is the process of tailoring and customizing financial products and services according to the individual needs, preferences, and financial situations of each client. The primary goal of this process is to create an optimal financial solution for each client, enhancing their experience and satisfaction.

[3] A new level of customer service is an approach that involves not just traditional service delivery, but also the integration of cutting-edge technologies, strategies, and concepts to provide the most positive and effective customer experience. The primary goal of this process is to create exceptional, personalized, and memorable interactions with clients.

Source: formulated by the author based on [2–3; 5–6]

increasing financial inclusion (by enabling more people to access financial services, regardless of location and income level [3]); improving the efficiency of financial systems (as process automation and cost optimization enhance the effectiveness of financial systems [3]); enhancing payment security (by reducing the risk of fraud and cyberattacks [5]). Development of new business models (as they stimulate the creation of innovative financial products and services).

Conclusions from this study and prospects for further exploration in this direction. Within the scope of the research, it has been established that the infrastructure for cashless payments is an ever-evolving network that facilitates financial transactions without the use of cash. The author has made and systematically justified the following conclusions:

1. The current drivers of evolution are: blockchain technology (as it offers a new approach to storing and processing transactions, providing a high level of security, transparency, and decentralization), artificial intelligence (as it enables the analysis of large volumes of payment

Table 5

Features of the impact of financial inclusion on the infrastructure of cashless payments

Action of mobile payments and agent networks	Direction of action	Features of the development of cashless payment infrastructure through the expansion of financial inclusion
Availability of financial services [1]	Increased number of access points to financial services in remote areas through agent networks	Agents working in rural areas provide services such as money transfers, bill payments, and more
	The ability to access financial services via mobile phone anytime and anywhere.	Payment for goods and services using mobile apps, and money transfers between mobile wallets
Simplification of procedures [2]	Simplification of the account opening and payment processes through mobile applications.	Opening a mobile bank account in minutes and paying bills with just a few clicks
	Reduction in the number of required documents for accessing financial services.	Client identification using biometric data or other remote methods
Reduction of the cost of financial services [3]	Reduction in account maintenance and payment costs due to the absence of the need to visit physical bank branches.	No fees for certain types of payments when using mobile apps
	Increased competition among financial institutions, leading to lower service fees..	Offering special tariff plans for clients who use mobile apps
Enhancement of financial literacy [4]	Provision of information about financial products and services through mobile apps and agent networks	Financial literacy sessions conducted by agents and online courses on financial literacy available in mobile apps
	Promotion of the development of financial literacy among the population.	Conducting events aimed at increasing trust in financial institutions

Note

1 Expanding the range of financial services through mobile phones and agent networks involves providing a variety of financial services and products using mobile technologies and through a network of agents who are not traditional banking institutions. The primary goal is to make financial services more accessible, convenient, and tailored to the consumer needs .

2 Streamlining the procedure for cashless payments involves enhancing the processes related to conducting financial transactions without using cash. The primary goal is to make these processes faster, more convenient, and safer for users.

3 Reducing the cost of financial services involves decreasing the expenses that consumers incur when using financial products and services. The primary goal is to lower fees, interest rates, charges, or other costs associated with bank accounts, loans, insurance, etc.

4 Improving financial literacy is the process of acquiring knowledge and skills that help individuals manage their finances effectively. The primary goal is to develop an understanding of fundamental financial concepts.

Source: formulated by the author based on [1–2; 6]

data, fraud detection, personalized offers, and process optimization), and biometric data (as the use of unique biological characteristics for authentication opens new possibilities for enhancing payment security and simplifying authorization procedures).

2. The drivers of the evolution of cashless payment infrastructure (namely blockchain technology, artificial intelligence, and biometric data) have a systemic impact on the financial sector and society as a whole through increased financial inclusion, enhanced efficiency of

financial systems, improved payment security (as the risk of fraud and cyberattacks is reduced), and the development of new business models.

3. Despite significant progress, the cashless payment infrastructure still faces several challenges, including cybersecurity, regulation, and digital literacy. The increase in cyberattacks necessitates constant improvements in data protection systems. The rapid development of technologies requires the adaptation of legislation and regulatory standards. Additionally, there is a need to enhance financial literacy among the population to effectively use new technologies.

The infrastructure for cashless payments is continually evolving under the influence of technological progress. It plays a key role in the development of the financial sector and society. Thus, future research prospects include identifying ways to maximize the effective use of new technologies' potential, as well as addressing challenges related to security, regulation, and human capital development.

REFERENCES:

1. Lyakhova O. O., Yurkevych O. M., Korets' K. R. (2023) Suchasnyy stan fintekh-rynku v Ukrayini Rynok fintekh v Ukrayini: potochni umovy [The current state of the fintech market in Ukraine fintech market in ukraine: current conditions]. *Prychornomors'ki ekonomichni studiyi – Black Sea Economic Studies*, vol. 79, pp. 180-195.

2. Maslyhan O., Liba N., Korolovych O., Vovchenko O. and Kvasnytska R. (2022) Modelling the Performance of the Financial Market. *Economic Affairs*, vol. 67, No. 04, pp. 631-642.

3. Mulyk T. (2022) Formation and development of fintech in Ukraine. *Economics & Education*, vol. 7, no. 1, pp. 25–33.

4. Natsional'nyy bank Ukrayiny: Stratehiya rozvytku fintekhu v Ukrayini do 2025 roku [National Bank of Ukraine: Fintech development strategy in Ukraine until 2025]. Available at: https://bank.gov.ua/ua/about/develop-strategy/fintech 2025 (accessed: 11.02.2023).

5. Rubanov P. M. (2020) Transformatsiyni protsesy v natsional'niy ekonomitsi pid vplyvom FinTech innovatsiy [Transformational processes in the national economy under the influence of FinTech innovations]: monohrafiya [a monograph]. Sumy: Sums'kyy derzhavnyy universytet, 452 p. (in Ukrainian)

6. Rubanov P. (2018) Economic Security of the State in the Information Economy: the Impact of E-business and Digital Finance. *National Security & Innovation Activities: Methodology, Policy and Practice. Ruda Śląska*, pp. 46–56.

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ:

1. Ляхова О. О., Юркевич О. М., Корець К. Р. Сучасний стан фінтех-ринку в Україні fintech market in ukraine: current conditions. *Причорноморські економічні студії.* 2023. Вип. 79. С. 180-195.

2. Maslyhan O., Liba N., Korolovych O., Vovchenko O. and Kvasnytska R. Modelling the Performance of the Financial Market. *Economic Affairs.* 2022. Vol. 67, No. 04, pp. 631-642.

3. Mulyk T. Formation and development of fintech in Ukraine. *Economics & Education.* 2022. Vol. 7, no. 1. P. 25–33.

4. Національний банк України: Стратегія розвитку фінтеху в Україні до 2025 року. URL: https://bank.gov.ua/ua/about/develop-strategy/fintech 2025 (дата звернення: 11.02.2023).

5. Рубанов П. М. Трансформаційні процеси в національній економіці під впливом FinTech інновацій: монографія. Суми : Сумський державний університет, 2020. 452 с.

6. Rubanov P. Economic Security of the State in the Information Economy: the Impact of E-business and Digital Finance. *National Security & Innovation Activities: Methodology, Policy and Practice. Ruda Śląska,* 2018. P. 46–56.