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DIGITAL TRANSFORMATION OF SME BUSINESS PROCESSES BASED ON BLOCKCHAIN TECHNOLOGIES IN THE CONDITIONS OF POST-WAR ECONOMIC RECONSTRUCTION

ЦИФРОВА ТРАНСФОРМАЦІЯ БІЗНЕС-ПРОЦЕСІВ МСП НА ОСНОВІ БЛОКЧЕЙН-ТЕХНОЛОГІЙ В УМОВАХ ПІСЛЯВОЄННОЇ ВІДБУДОВИ ЕКОНОМІКИ

Summary. The article examines digital transformation of SME business processes in the context of Ukraine's post war recovery. It substantiates blockchain as a tool for enhancing transparency, security, and efficiency under economic instability. Key applications include financial transactions, supply chain management, electronic document management, and smart contracts. Global experience shows that blockchain reduces costs, strengthens trust, and ensures traceability. The main barriers in Ukraine include financial, technological, legal, and human resource constraints. The study outlines prospects for improving financial transparency, logistics, and cooperation between business, government, and international partners. Blockchain integration enhances SME competitiveness, sustainability, and global value chain integration.
Keywords: digital transformation, blockchain, SMEs, business processes, post-war economy.

Анотація. У статті розглядаються особливості цифрової трансформації бізнес-процесів малих та середніх підприємств (МСП) у контексті повоєнної економічної відбудови України. Обґрунтовано роль блокчейн-технологій як ефективного інструменту для підвищення прозорості, безпеки та операційної ефективності підприємств в умовах економічної нестабільності та ресурсних обмежень. У дослідженні визначено основні напрямки застосування блокчейну в діяльності МСП, включаючи фінансові операції, управління ланцюгами поставок, електронний документообіг та договірні відносини на основі смарт-контрактів підприємств. Особлива увага приділяється аналізу світового досвіду впровадження блокчейн-рішень, який демонструє їх здатність знижувати транзакційні витрати, підвищувати довіру між економічними агентами та забезпечувати відстежуваність ресурсів. Систематизовано ключові бар'єри для впровадження блокчейн-технологій в Україні, включаючи фінансові, технологічні, правові та кадрові обмеження, які суттєво обмежують їх широке використання серед МСП.Окреслено перспективи розвитку блокчейн-технологій у контексті повоєнного відновлення, підкреслено їхню важливість для забезпечення прозорості фінансових потоків, підвищення ефективності логістики та посилення взаємодії між бізнесом, урядом та міжнародними

партнерами. Стверджується, що інтеграція блокчейну в бізнес-процеси може сприяти підвищенню конкурентоспроможності та стійкості малих і середніх підприємств, полегшуючи їхню інтеграцію в глобальні ланцюги створення вартості. Результати дослідження можуть бути використані для розробки стратегій цифрової трансформації та підвищення ефективності управління в малих і середніх підприємствах. Практичне значення дослідження полягає в можливості застосування запропонованих підходів у реальних бізнес-умовах для підтримки економічного відновлення та довгострокового розвитку. Крім того, отримані результати сприяють теоретичному розумінню процесів цифрової трансформації в перехідних економіках, та можуть бути використані фахівцями у подальшій розробці.

Ключові слова: цифрова трансформація, блокчейн, МСП, бізнес-процеси, післявоєнна економіка.

Problem statement. The current stage of development of the Ukrainian economy is characterized by deep structural transformations caused by the consequences of a full-scale war, the destruction of production and logistics infrastructure, disruption of supply chains, a decrease in investment activity and an exacerbation of financial and economic instability. In the conditions of post-war reconstruction, the main driver of economic growth is small and medium-sized businesses, which ensure the flexibility of the economy, job creation and rapid adaptation to changes in the external environment. At the same time, the activities of SMEs are accompanied by a number of systemic problems, among which the low level of digitalization of business processes, insufficient transparency of business operations, high transaction costs, limited access to financial resources, as well as increased risks of fraud and data loss are of particular importance.

Under such conditions, traditional approaches to organizing and managing business processes are not effective enough, which necessitates the search for innovative solutions capable of increasing the level of trust between economic agents, optimizing operational activities and reducing costs. One of the promising areas is the implementation of blockchain, which, thanks to its characteristics – decentralization, immutability of records, transparency, and a high level of information protection – creates fundamentally new opportunities for transforming business processes.

Despite the significant potential of blockchain technologies, their practical application in the activities of SMEs in Ukraine remains limited. This is due to both objective factors, in particular, the insufficient level of digital infrastructure, lack of financial resources, lack of a clear regulatory framework and low level of digital competencies of entrepreneurs, and subjective ones – distrust of new technologies, lack of successful cases and difficulty in integrating innovative solutions into existing business models. In addition, in the post-war period, the issues of ensuring transparency in the use of financial resources, tracking flows of tangible and intangible assets, as well as increasing the efficiency of interaction between the state, business and international partners are becoming more relevant, which further strengthens the significance of studying the possibilities of applying blockchain technologies. There is an objective need for a comprehensive study of theoretical and practical aspects of digital transformation of SME business processes based on blockchain in the conditions of post-war economic reconstruction. Substantiation of directions for implementing this technology, determination of its impact on the efficiency of enterprises, as well as formation of approaches to overcoming barriers to its use are of particular relevance. This determines the feasibility of further scientific explorations in this direction and determines the content and logic of this study.

Analysis of recent research and publications. The issues of digital transformation of business processes and the implementation of blockchain technologies are actively studied by both domestic and foreign scientists. In particular, Nebava O. M. studies the impact of digitalization of business processes on the transformation of enterprise activities, focusing on increasing management efficiency and optimizing operational activities [1].

Foreign researchers, in particular Peter C. Verhoef et al., consider digital transformation as a complex interdisciplinary process that encompasses changes in business models, client strategies, and organizational structures [2]. In turn, Gregory Vial systematizes approaches to understanding digital transformation and identifies key areas for further scientific research in this area [3].

Considerable attention is paid to the study of blockchain technologies and their application in business. Thus, Saberi S. and co-authors analyze the role of blockchain in ensuring sustainable supply chain management [4]. Casino F. and colleagues systematize existing blockchain solutions and determine the main directions of their development [5].

Separate studies are devoted to issues of security and trust. In particular, Nir Kshetri substantiates the role of blockchain in ensuring cybersecurity and data protection [6]. The works of Queiroz M. M. and Samuel Fosso Wamba examine the barriers to the implementation of blockchain technologies in the business processes of enterprises [8].

In addition, Don Tapscott and Alex Tapscott consider blockchain as a fundamental technology that changes the principles of the functioning of the economy and business [9], while Zibin Zheng et al. analyze the main challenges and prospects for the development of blockchain systems [10].

At the same time, despite a significant number of scientific works, the issues of applying blockchain technologies in the activities of SMEs in the conditions of post-war reconstruction of the economy of Ukraine remain insufficiently studied, which determines the relevance of this study.

The purpose of the article is to study the theoretical and practical aspects of the digital transformation of business processes of small and medium-sized enterprises based on blockchain in the conditions of post-war reconstruction of the economy of Ukraine, to substantiate the key areas of application of this technology in the activities of enterprises, to identify the main barriers to its implementation, as well as to determine the prospects for the development of blockchain solutions and their impact on increasing the efficiency, transparency, and competitiveness of SMEs.

Presentation of the main material of the study. Digital transformation of business processes of small and medium-sized enterprises (SMEs) is a complex multidimensional phenomenon that reflects profound changes in the methods of organization, management and implementation of economic activity in the conditions of the formation of the digital economy. In the scientific literature, digital transformation is considered not only as the introduction of information technologies, but as a systemic process that encompasses the transformation of business models, management approaches, organizational structures and interaction with the external environment. In particular, digital transformation of business processes is understood as complex changes aimed at optimizing the production, management and communication processes of the enterprise through the integration of digital technologies.

The essence of digital transformation of business processes is the transition from traditional, predominantly linear models of enterprise functioning to flexible, platform-oriented and customer-centric models based on the use of data, automation and digital ecosystems. It involves not just improving individual operations, but the formation of new ways of creating value that ensure increased competitiveness of enterprises in the global environment. As noted in scientific research, digital transformation encompasses comprehensive changes in enterprise management, business process optimization, and interaction with customers and partners, which indicates its systemic nature.

Digital transformation of business processes of small and medium-sized enterprises (SMEs) is a complex and multidimensional process that reflects systemic changes in the functioning of enterprises under the influence of the development of digital technologies. In modern scientific research, it is interpreted as a comprehensive transformation of business models, organizational structures and management approaches, which goes beyond the simple implementation of information and communication technologies. In particular, digital transformation is defined as the process of deep integration of digital technologies into all aspects of the enterprise's activities in order to increase its efficiency and competitiveness [1].

The essence of digital transformation of business processes is the transition from traditional business models to digitally oriented ones, which are based on the use of data, automation and integrated information systems. This approach ensures the optimization of internal processes, cost reduction and increased speed of management decision-making, as well as the formation of new sources of value creation. At the same time, digital transformation contributes to increasing the productivity of enterprises, expanding their market opportunities and strengthening innovative activity, which is especially important for SMEs [2].

The leading component of the theoretical approach is the definition of the principles of digital transformation of business processes. The key principles include: systematicity, which involves covering all levels of the enterprise's activities; integration of digital solutions; customer orientation; adaptability to changes in the external environment; use of data as a strategic resource; and ensuring information security. The implementation of these principles creates the prerequisites for increasing the efficiency of the functioning of enterprises and the formation of their long-term competitive advantages [3].

Digital transformation is of particular importance for SMEs, which, despite limited resources, are characterized by high flexibility and the ability to quickly adapt to changes. The use of digital technologies allows SMEs to optimize business processes, reduce transaction costs, improve management quality and improve interaction with customers and partners.

In the context of the development of the modern economy, digital transformation is one of the key drivers of economic growth, as it contributes to the formation of new markets, changes in the employment structure and an increase in the role of innovation. For SMEs, this opens up opportunities for integration into global value chains and ensuring sustainable development. At the same time, the effectiveness of digital transformation largely depends on the level of development of digital infrastructure, the availability of relevant competencies and institutional support.

In modern conditions of digitalization of the economy, blockchain is considered one of the key tools for transforming business processes, in particular for small and medium-sized enterprises (SMEs), which play a decisive role in the recovery of economies after crises and military shocks. Global

experience shows that blockchain technologies can be effectively applied not only by large corporations, but also adapted to the needs of SMEs through the use of platform solutions, partner ecosystems and cloud services. In the context of post-war economic recovery, blockchain characteristics such as transparency, data immutability and the ability to track resources are of particular importance. This allows for control over financial flows, humanitarian aid, investment resources and supply chains, which is critically important for countries recovering from conflicts. For SMEs, this opens up opportunities for integration into recovery processes through participation in transparent digital ecosystems (Table 1).

Analysis of international practices allows us to conclude that blockchain technologies have significant potential for transforming the business processes of SMEs, but their implementation occurs mainly through integration into existing digital platforms, rather than through the creation of their own solutions. This is explained by the limited financial, human and technological resources of small and medium-sized businesses. The key trend is the transition from individual implementation of technologies to the use of ecosystem models, within which SMEs gain access to blockchain solutions through cloud services or industry platforms. This approach significantly reduces the barriers to entry and allows small businesses to enjoy the benefits of technology without significant investments. In the context of post-war economic recovery, the ability of blockchain to ensure transparency and accountability of resource use is of particular importance. This is critically important for attracting international aid and investment, as it increases the level of trust in economic processes. SMEs integrated into such systems are able to participate in recovery projects, expand their activities and enter new markets. At the same time, it should be noted that in order to effectively use global experience, it is necessary to adapt technological solutions to national conditions, in particular the development of digital infrastructure, regulatory and legal support, and the level of digital competencies of entrepreneurs. Without this, even the most successful international practices may be ineffective.

In today's digital economy, blockchain is a tool for transforming key business processes of small and medium-sized enterprises (SMEs), ensuring their efficiency, transparency, and security. For SMEs operating under limited resources and increased risks, especially in the context of post-war economic reconstruction, the use of blockchain technologies opens up new opportunities for optimizing operations and integrating into digital economic ecosystems (Figure 1).

Analysis of the main areas of application of blockchain technologies shows that their implementation in the activities of SMEs is comprehensive and can ensure systemic modernization of business processes. At the same time, the greatest effect is achieved not from the implementation of individual solutions, but from their integration into a single digital ecosystem of the enterprise.

In the context of post-war economic reconstruction, areas related to financial transparency, resource control and restoration of logistics chains are of particular importance. It is these areas that determine the speed of economic recovery and the level of trust from international partners and investors. A promising approach for SMEs is the use of ready-made platform solutions (in particular, cloud services), which allows significantly reducing the costs of implementing the technology. In addition, an important condition for the effective use of blockchain is state support, the development of digital infrastructure and increasing the level of digital competencies of entrepreneurs.

In the current conditions of digital transformation of the Ukrainian economy, blockchain is considered a promising tool for increasing the efficiency of business processes of small and medium-sized enterprises (SMEs). At the same time, the practical implementation of this technology is accompanied by

Table 1 – Global practices in the application of blockchain technologies with potential for SMEs

Case / platform	Scope of application	Adaptation for SMEs	Significance for post-war recovery
IBM Food Trust	Supply chains	SMEs can connect to the product tracking platform	Ensuring transparency in the food supply
Microsoft Azure Blockchain	Cloud services	Access Blockchain-as-a-Service without significant investment	Rapid deployment of digital solutions in recovery
Maersk (TradeLens)	Logistics	Simplifying document flow for small exporters	Restoring international trade
Everledger	Asset verification	SMEs can confirm the origin of goods	Fighting shadow markets
Ethereum	Smart contracts	Transaction automation for small businesses	Reducing risks and costs in reconstruction
Hyperledger	Business solutions	Developing corporate solutions for SMEs	Building transparent digital systems

Source: compiled by the author based on [4; 5]

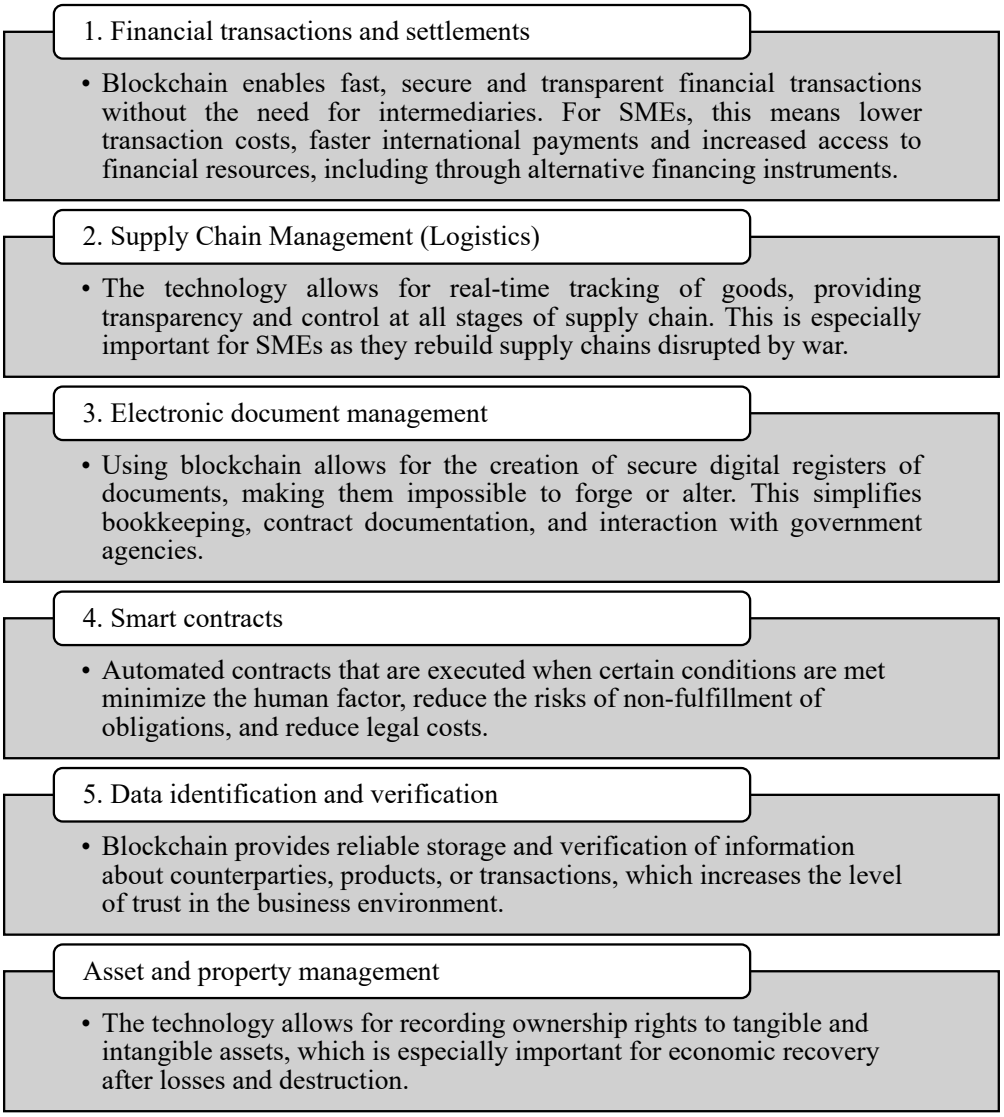

Figure 1 – Directions of blockchain application in SME business processes

Source: author's own development based on [6; 7]

a number of significant barriers that limit its spread, especially in the context of post-war economic reconstruction. SMEs are characterized by limited financial, human and technological resources, which significantly complicates the integration of innovative solutions. In addition, the specifics of the post-war period, in particular the instability of the economic environment, increased risks and the need for rapid recovery, exacerbate the impact of existing restrictions. In this context, it is advisable to systematize the key barriers to the implementation of blockchain technologies in the activities of SMEs (Table 2).

The analysis of the above barriers shows that the implementation of blockchain technologies in the activities of Ukrainian SMEs has a complex nature of restrictions that are interconnected. The most critical are financial and personnel barriers, since they determine the ability of enterprises to implement innovations in principle. In the context of post-war economic reconstruction, the importance of these barriers is increasing, since the resources of enterprises are directed primarily to the restoration of core activities, rather than to the implementation of new technologies. At the same time, it is blockchain that can ensure transparency in the use of resources and increase trust from international partners, which creates a certain paradox: the technology is necessary, but its implementation is complicated.

The key way to overcome these barriers is the development of platform solutions (Blockchain-as-a-Service), which allow SMEs to use the technology without significant initial investments. An important role is also played by state policy aimed at forming a clear regulatory framework, supporting the digitalization of business and developing digital competencies. It is advisable to create partner ecosystems within which SMEs can integrate into

Table 2 – Main barriers to implementing blockchain technologies in Ukrainian SMEs

Barrier group	Characteristic	Impact on SMEs
Financial	High implementation costs, limited access to investment	They inhibit innovative activity and technology adoption
Technological	Insufficient level of digital infrastructure, complexity of integration	Makes it difficult to adapt blockchain to existing business processes
Legal	Regulatory uncertainty	Create risks for using technology in business
Personnel	Lack of digital specialist	Limits the ability to implement and support systems
Organizational	Resistance to change, low level of digital culture	They slow down the process of business process transformation
Security	Concerns about data protection and cyber threats	Reduce trust in new technologies

Source: compiled by the author based on [8]

common digital platforms, which significantly reduces barriers to entry and accelerates the process of digital transformation. Overcoming barriers to the implementation of blockchain technologies is a necessary condition for the effective digital transformation of SMEs and their active participation in the processes of post-war economic recovery in Ukraine.

In the current conditions of reconstruction of the national economy of Ukraine, the implementation of innovative digital solutions that can ensure transparency, efficiency and sustainability of economic processes is of particular importance. One of the key tools of such transformation is blockchain, which opens up new opportunities for modernization of the business environment, in particular the small and medium-sized enterprise (SME) sector, which is a basic element of post-war economic recovery.

The prospects for the development of blockchain technologies in Ukraine should be considered through the prism of strategic directions of their application, which meet the key challenges of the post-war period. First of all, this concerns ensuring transparency in the use of financial resources, including international aid, investments and budget funds. In this context, blockchain allows for the creation of immutable digital transaction registers, which significantly increases the level of trust from international partners and investors and contributes to attracting additional financial resources to the reconstruction process.

The second important strategic direction is the digitalization of supply chains and logistics processes. In the context of infrastructure destruction and disruption of traditional supply chains, blockchain provides the ability to track the movement of goods in real time, which helps to increase logistics efficiency, reduce costs and minimize risks. For SMEs, this creates the prerequisites for integration into new, more transparent and efficient value chains.

An equally important direction is the development of digital document management and e-government. The use of blockchain technologies in this area allows for reliable storage and processing of data, protection against fraud and simplification of interaction between business and the state. In the post-war period, this is of particular importance for restoring trust in institutions and increasing the efficiency of administrative procedures.

The introduction of smart contracts as a tool for automating economic relations deserves special attention. Their use allows you to reduce transaction costs, minimize the risks of non-fulfillment of obligations, and increase the speed of concluding and executing agreements. For SMEs, this is an important factor in increasing the efficiency of activities and reducing operational risks.

At the same time, the prospects for the development of blockchain technologies are closely related to the formation of an appropriate institutional and technological base. This includes the development of digital infrastructure, improving regulatory and legal regulation, and increasing the level of digital competencies of entrepreneurs. Without proper state support and coordination, these processes may be fragmented and not provide the expected effect.

The expected effects of the introduction of blockchain technologies in the post-war economy of Ukraine are complex. First, it is an increase in transparency and accountability of economic processes, which is critically important for the effective use of resources. Second, it is a reduction in transaction costs and an increase in the efficiency of business processes, which will contribute to the growth of enterprise productivity. Thirdly, increasing the level of trust between participants in economic relations, including the state, business and international partners. Fourthly, creating conditions for innovative development and integration of Ukraine into the global digital economy.

In the context of the development of small and medium-sized enterprises, blockchain technologies can become a catalyst for structural changes, contributing to the transition to more efficient and transparent business models. It is especially important

that their use allows SMEs to compensate for limited resources by increasing management efficiency and access to new markets.

Conclusions. As a result of the study, it was established that the digital transformation of business processes of small and medium-sized enterprises based on blockchain is an important direction for increasing the efficiency of enterprises in the post-war reconstruction of the economy of Ukraine. It is substantiated that blockchain technologies create fundamentally new opportunities for ensuring transparency, security and optimization of business processes, in particular in the areas of financial transactions, logistics, electronic document management and contractual relations.

The global experience of using blockchain solutions has been analyzed, which indicates their effectiveness in increasing the level of trust between economic entities, reducing transaction costs and ensuring control over the movement of resources. It has been established that for SMEs, integration into existing digital platforms and the use of cloud solutions is the most appropriate, which allows minimizing the costs of implementing innovations.

The main directions of application of blockchain technologies in the activities of SMEs are determined, among which the digitalization of financial processes, the restoration of logistics chains, the introduction of electronic document management and the use of smart contracts are of key importance. It is proven that their comprehensive application ensures the systematic modernization of business processes and increases the competitiveness of enterprises.

At the same time, it was found that the introduction of blockchain technologies in the activities of Ukrainian SMEs is constrained by a number of barriers, in particular financial, technological, legal and personnel. It is substantiated that overcoming these limitations requires the development of digital infrastructure, improving regulatory and legal support, increasing the level of digital competencies and active state support for business digitalization processes.

The prospects for the development of blockchain technologies in the post-war economy of Ukraine are associated with their use to ensure the transparency of financial flows, effective resource management, digitalization of logistics processes and the development of e-government. It is expected that their implementation will contribute to increasing the level of trust in the economic system, attracting investments, reducing costs and creating the prerequisites for sustainable economic development.

Thus, blockchain technologies can become one of the key tools for the digital transformation of SMEs and an important factor in ensuring the effective post-war reconstruction of the Ukrainian economy.

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