

Digitalisation of accounting of agricultural enterprises: National and international experience

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Abstract. The study aimed to analyse the peculiarities of the introduction of digital technologies in the field of accounting at agricultural enterprises, in particular, the analysis of national and international experience. The study analysed the process of digitalisation of accounting at agricultural enterprises in Ukraine, which is an important step towards improving management efficiency, reducing operating costs and ensuring compliance with modern regulatory requirements. The analysis of the main trends in the implementation of automated accounting and financial accounting systems demonstrated that such systems allow agricultural enterprises to automate routine processes, reduce the number of errors and reduce the time for preparing financial statements. The study

Article's History:

Received: 10.08.2024

Revised: 18.10.2024

Accepted: 10.12.2024

Suggested Citation:

Potryvaieva, N., Dubinina, M., Cheban, Yu., Syrtseva, S., & Luhova, O. (2024). Digitalisation of accounting of agricultural enterprises: National and international experience. *Ukrainian Black Sea Region Agrarian Science*, 28(4), 41-53. doi: 10.56407/bs.agrarian/4.2024.41.

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also revealed several challenges towards the full digitalisation of accounting, including insufficient technical infrastructure, lack of qualified personnel, and low digital literacy. Insufficient funding and regulatory barriers are also serious challenges for businesses. Particular attention was devoted to cybersecurity issues, which are increasingly relevant due to the growth of digital data. The study compared the Ukrainian experience with the experience of the European Union, the United States, and Canada, where the digitalisation of accounting has reached a high level. The study proposed recommendations for the successful implementation of digital technologies in accounting processes at agricultural enterprises in Ukraine, addressing the existing limitations and opportunities. The study emphasised the importance of auditing the existing digital infrastructure, investing in equipment upgrades, staff training, gradual introduction of new technologies, and partnerships with leading digital solution providers. The findings emphasise the significant potential of digitalisation to increase the efficiency, transparency, and competitiveness of Ukrainian agricultural enterprises, but achieving these goals requires a balanced approach to the introduction of new technologies, government support, and appropriate educational training. The results obtained in this study can be used to improve the digitalisation of accounting at Ukrainian agricultural enterprises, increase the efficiency of financial management and adapt international standards to local conditions

Keywords: digital technologies; electronic systems; accounting automation; economic efficiency; audit and control

INTRODUCTION

Digitalisation in the modern world has become an indispensable part of any part of the economy, including the agricultural sector. Changes in financial and accounting processes management are caused by global digital transformation, affecting all aspects of enterprises. Accounting, being central in enterprise management, is also affected by these changes. As such, the issue of digital technology implementation into accounting becomes especially relevant. The agricultural sector is one of the most dynamic and yet highest-risk sectors of the economy, where proper accounting is critical in the stability and efficiency of an enterprise. However, due to the specifics of agricultural enterprises, especially seasonal nature, dependency on natural conditions and high competition, traditional accounting approaches are often insufficiently effective. Therefore, the implementation of digitalisation is required for proper accuracy, speed and transparency of accounting processes. One of such key issues is lacking most agricultural enterprises from overall digital transformation processes. This is caused by several reasons, such as insufficient funding, improper personnel training, lack of required infrastructure and cybersecurity concerns. In addition, there is an issue of integrating new digital solutions with existing accounting systems, which requires additional resources and time.

Digitalisation of accounting involves the integration of modern information systems that automate accounting and reporting processes. This includes employment of software to manage financial flows, maintain electronic documents and ensure timely reporting. National and international experience in this area is also an important aspect. Countries that are actively implementing digital technologies in accounting are showing significant progress in increasing the efficiency

of agricultural production and reducing operating costs. The use of automated accounting systems helps to unify processes and ensure high accuracy and reliability of financial reporting. At the same time, the experience of advanced countries can be useful for adapting these practices in the national context.

Thus, the study of Ukrainian and international experience in the field of digitalisation of accounting at agricultural enterprises is important for developing effective strategies for the introduction and adaptation of new technologies, which will help to increase the competitiveness and sustainability of the agricultural sector. Several authors described the trends, challenges and prospects for the introduction of digital technologies. F. Costa *et al.* (2023) analysed the impact of digital technologies on the efficiency of financial accounting in the agricultural sector. As determined, businesses that implement automated accounting systems have fewer errors in their financial statements and can reduce their accounting services costs. K. Poppe *et al.* (2023) reviewed the experience of agricultural companies in the digitalisation of accounting, focusing on the importance of compliance with regulatory requirements. As demonstrated, automation of accounting processes increases the transparency of financial reporting and reduces the risk of financial sanctions. V. Goi *et al.* (2023), in turn, investigated the role of cybersecurity in the process of digitalisation of accounting. The authors highlighted that data protection is critical to maintaining the confidentiality of financial information. D.M. Coman *et al.* (2022) also analysed the digitalisation of accounting, finding that one of the main problems is the lack of sufficient infrastructure.

M. Petchenko *et al.* (2023) studied the impact of digitalisation on the financial statements of enterprises

and concluded that enterprises that implement artificial intelligence technologies demonstrate increased efficiency in resource management. A.M. Ciruela-Lorenzo *et al.* (2020) addressed peculiarities of introducing digital technologies into the accounting systems of agricultural enterprises. The authors identified that agricultural companies are actively integrating software solutions to automate financial processes, but face difficulties due to the lack of adaptation of the software to local conditions. D. Radicic & S. Petković (2023) analysed the impact of accounting digitalisation on small and medium-sized businesses in the agricultural sector. The authors noted that small businesses have difficulty implementing digital systems due to limited financial resources and a lack of qualified specialists.

I. Lomachynska *et al.* (2023) concluded that digital technologies can help improve environmental performance through more accurate resource planning and accounting. M. Eulerich *et al.* (2024) determined that automation of accounting processes contributes to an increase in the level of internal control and a reduction in financial fraud. H.J.P. Marvin *et al.* (2022) addressed the role of artificial intelligence in the digitalisation of accounting in the agricultural sector. Their results show that the use of AI technologies can significantly improve accounting accuracy and reduce the time required to prepare financial statements.

Previous research confirms that the digitalisation of accounting is an important and complex process that requires a comprehensive approach, accounting for national peculiarities and international experience. However, the analysed studies insufficiently address the specifics of the digitalisation of accounting at small and medium-sized agricultural enterprises, especially in the context of their impact on competitiveness and long-term sustainability. There is also a lack of research on the integration of artificial intelligence into agricultural accounting systems, considering regional peculiarities and legislative requirements.

The study aimed to analyse the impact of accounting digitalisation on the competitiveness of agricultural enterprises, considering regional peculiarities and legislative requirements. Moreover, the study analysed the impact of accounting digitalisation on the productivity of small and medium-sized agricultural enterprises, as well as assessed the opportunities and challenges of integrating artificial intelligence into accounting systems in the agricultural sector, considering regional peculiarities.

MATERIALS AND METHODS

A comprehensive methodology that included both primary and secondary sources of information was employed. The main materials of the research were

legislative and regulatory acts of Ukraine, analytical reports, studies, and a review of software products implemented by agricultural enterprises for accounting automation. The first step was to study the legal framework governing accounting in Ukraine. In particular, the Law of Ukraine No. 996-XIV (1999), which is the main document defining the principles of accounting and financial reporting, and the Law of Ukraine No. 851-IV (2003), which regulates the use of electronic documents in commercial activities, were analysed in detail. In addition to these laws, several bylaws and regulations address specific aspects of digitalisation, such as electronic reporting standards, data protection requirements and other regulations that affect the process of transition to digital accounting methods (Tax Code of Ukraine, 2010; Order of the Ministry of Finance of Ukraine No. v0433201-13, 2013; Law of Ukraine No. 2155-VIII, 2017). Legislation governing state support for the agricultural sector, including financing and subsidy programmes, as well as rules defining agricultural insurance mechanisms, were also reviewed in detail (Law of Ukraine No. 1877-IV, 2004; Law of Ukraine No. 4391-VI, 2012).

Particular attention was also devoted to the analysis of software products used by agricultural enterprises to automate accounting. Such solutions as MASTER, BAS ERP, QuickBooks, Xero, M.E.Doc, and other software products that are most common on the market were addressed. The analysis covered the functionality of these programmes and the level of adaptation to the needs of Ukrainian agricultural enterprises. The functionality of these systems, the level of their adaptation to the needs of Ukrainian agricultural enterprises, and their effectiveness in different conditions, such as limited Internet access in rural areas or the need to work with large amounts of data, were assessed. The current state of digitalisation of accounting globally was also addressed, emphasising the comparison of Ukrainian achievements with international standards. Analysis of digitalisation practices in countries such as Estonia (Dubinina *et al.*, 2022), Germany (Tiberius & Hirth, 2019), Sweden (E-Invoicing in Sweden, 2023), Italy (SDI Italy..., 2021), USA (McCumiskey & Wolfson, n.d.), Canada (Dhaliwal *et al.*, 2023) and Ukraine (Koval & Lyshak, 2024) has revealed important aspects and new approaches in the field of accounting. The study of practices in these countries helped to identify opportunities for adapting these approaches to the Ukrainian context. The study determined which of these international practices can be effectively used to improve the digitalisation of accounting at Ukrainian agricultural enterprises, accounting for the specific conditions and requirements of the local market.

RESULTS

At a time when digital technologies are increasingly penetrating all spheres of life, the agricultural sector remains on the sidelines of the digitalisation process. This is especially true in Ukraine, where agricultural enterprises are one of the key sectors of the economy. The digitalisation of accounting at such enterprises is becoming an integral part of their operations, as it can increase management efficiency, reduce operating costs, and ensure compliance with modern regulatory requirements (Knudsen, 2020). One of the main trends in the digitalisation of accounting in the agricultural sector of Ukraine is the introduction of automated accounting and financial management systems. These systems can be used to automate routine accounting processes, reduce errors and shorten the time required to prepare financial statements in agricultural enterprises. The use of specialised software around the world, such as MASTER, BAS ERP and other solutions, was used to integrate all financial processes into a single system, ensuring transparency and control over all aspects of accounting.

Another important aspect of the Ukrainian experience is the active introduction of electronic document management. The transition from paper to electronic documents greatly simplifies financial information processing, speeds up the exchange of data between different departments of the enterprise and ensures more reliable data storage. This is especially true for agricultural enterprises, where large amounts of information require efficient management and quick access to data. Another trend is the integration of accounting with other enterprise information systems, such as production, logistics and human resources management systems. This integration allows for the creation of a single information ecosystem where all processes are interconnected and can be effectively managed (Syrtseva *et al.*, 2022). This contributes to more accurate planning and analysis of financial flows, which is key to the successful functioning of an agricultural enterprise in a constantly changing market environment.

The digitalisation of accounting at agricultural enterprises has significant potential to increase efficiency, transparency and competitiveness. However, there are several problems and challenges on the way to full integration of digital technologies that need to be addressed. One of the most pressing issues is the lack of technical infrastructure, especially in rural areas where most agricultural enterprises are located. Insufficient access to high-speed internet, outdated computers, and limited opportunities to upgrade equipment pose serious obstacles to the effective implementation of digital technologies in accounting. Without modern infrastructure, businesses cannot

fully use software solutions that automate accounting processes and integrate them with other business systems. In addition to technical limitations, the problem of staff shortages and low levels of digital literacy is acute. Implementation of new accounting systems requires specialists who are well-versed in digital technologies and able to manage automation processes. However, many agricultural enterprises, especially small ones, do not have sufficient resources to train employees or hire IT specialists. This limits opportunities for full digitalisation and increases the risk of errors in financial accounting.

Another obstacle to digitalisation is the inadequacy of the legal framework and regulatory barriers. The rapid development of digital technologies is outpacing legislative updates, which creates legal conflicts and complicates the work of businesses. Existing accounting standards are often not adapted to the digital environment, making it difficult to apply them in practice. In addition, regulatory requirements for the storage and protection of electronic data may be overly complex or not fully defined, creating additional challenges (Gonçalves *et al.*, 2022). As the volume of digital data increases, another serious problem arises – cybersecurity concerns. Agricultural enterprises that switch to digital accounting become more vulnerable to cyberattacks, which can lead to the loss or compromise of confidential financial information. Implementing effective cybersecurity systems requires significant investment, which is not always affordable for small and medium-sized enterprises. Many companies are not sufficiently aware of modern cyber threats, which increases risks in this area (Sontowski *et al.*, 2020).

An equally important challenge is the unwillingness to change and organisational barriers that arise in the process of digitalisation. Changes to familiar workflows, the transition to new technologies and the need to train employees are often met with distrust and resistance. Many managers and employees prefer traditional accounting methods, which slows down the digital transformation process. In addition, the high cost of implementing digital solutions is a significant obstacle for many agricultural enterprises. Software licences, the purchase of new equipment and staff training require significant financial investments (Scholkmann, 2021). For many enterprises, this becomes a critical barrier, forcing them to postpone the introduction of new technologies or limit themselves to minimal investments in digitalisation.

The level of digitalisation of accounting for agricultural enterprises in Ukraine varies depending on the scale of the enterprises, their financial condition, regional characteristics and access to modern

technologies. At large agricultural enterprises, especially those that export or cooperate with international partners, the digitalisation of accounting has already reached a high level. Such companies actively employ specialised software solutions, such as Enterprise Resource Planning (ERP) systems, which allow them to integrate accounting with other business processes, ensuring automation of routine operations and transparency of financial reporting.

The level of digitalisation in small and medium-sized agricultural enterprises is much lower. The main reason for this is limited financial resources that do not allow investing in the implementation of modern IT solutions. Many small agricultural enter-

prises still use traditional accounting methods, such as paper-based documentation and local computer programs, which significantly reduces the efficiency of accounting processes and increases the risk of errors. This also creates difficulties when integrating with other management systems or when it comes to complying with new regulatory requirements. The digitalisation of accounting at agricultural enterprises in Ukraine is a complex and multifaceted process that requires consideration of numerous regulations (Table 1). These acts create a legal framework for the introduction of digital technologies, define accounting standards, regulate the exchange of electronic data, and ensure the protection of financial information.

Table 1. The main legal acts regulating the process of digitalisation of accounting of agricultural enterprises in Ukraine

Legal act	Content
Law of Ukraine No. 996-XIV "On Accounting and Financial Reporting in Ukraine" (1999)	Defines the basic principles of accounting, and the obligations of companies to keep records and prepare financial statements. Allows the use of electronic documents in accounting and sets out the rules for the use of electronic signatures.
Law of Ukraine No. 851-IV "On Electronic Documents and Electronic Document Management" (2003)	Regulates the procedure for creating, storing and using electronic documents and establishes their legal force. Allows agricultural enterprises to use electronic document management to exchange financial data with counterparties and government agencies.
Law of Ukraine No. 2155-VIII "On Electronic Identification and Electronic Trust Services" (2017)	Establishes the legal framework for the use of electronic signatures, seals and other means of electronic identification. Ensures the security and authenticity of electronic documents used in the process of digitalising accounting.
Tax Code of Ukraine (2010)	Enables the submission of tax reports digitally, which simplifies the interaction of agricultural enterprises with the tax authorities. This is relevant for companies with a complex taxation system related to different types of activities.
Order of the Ministry of Finance of Ukraine No. v0433201-13 "On the Approval of Methodological Recommendations for Filling Out Financial Reporting Forms" (2013)	Approves the Methodological Recommendations for the preparation of financial statements, accounting for the possibility of using electronic accounting systems. Determines the specifics of reflecting financial transactions in the reporting concerning digital technologies.
Law of Ukraine No. 1877-IV "On State Support of Agriculture of Ukraine" (2004)	Establishes provisions on the accounting of agricultural activities that should be addressed during the digitalisation of accounting at agricultural enterprises.
Law of Ukraine No. 4391-VI "On the Peculiarities of Insurance of Agricultural Products with State Support" (2012)	Includes provisions affecting the accounting of agricultural activities, in the context of the digitalisation of accounting processes at agricultural enterprises.

Source: compiled by the authors

Digitalisation of accounting is one of the key trends transforming modern businesses, particularly in the European Union (EU). In this area, European countries demonstrate advanced approaches to the introduction of digital technologies that increase transparency, efficiency and accuracy of accounting (Dubinina et al., 2022). The experience of EU countries can be used as an example for other countries seeking to modernise accounting systems. One of the leading examples is Estonia, which is known for its advanced digital infrastructure. Estonia was one of the first countries to implement a full electronic document management system at the state level, including accounting. All businesses can submit financial statements and other documents exclusively in electronic format through special

platforms such as X-Road. This simplifies accounting procedures and interaction with government agencies, ensuring efficiency and convenience for business. This approach reduces administrative costs and speeds up inspection and audit processes.

Germany also demonstrates successful experience in the field of digitalisation of accounting. One of the most important initiatives is the introduction of electronic reporting through the Elektronische Steuererklärung (ELSTER) system, which allows for the submission of tax returns electronically. This system is widely used by businesses and individuals, which helps to increase the efficiency of tax administration and reduce errors associated with manual data processing. In addition, Germany is actively developing electronic

data interchange standards, such as ZUGFeRD, which are used to automate invoice processes (Tiberius & Hirth, 2019).

In Sweden, a country with one of the most developed digital economies, the digitalisation of accounting is also at a high level. Sweden actively supports the electronic submission of accounting reports and uses systems for automated data exchange between businesses and government agencies. For instance, using the Pan-European Public Procurement On-Line (PEPPOL) platform, businesses can exchange electronic invoices and other financial documents, which simplifies accounting and reporting management processes (E-Invoicing in Sweden, 2023). Italy also introduced mandatory e-reporting for businesses through the Sistema di Interscambio (SDI) system, which is used to submit invoices electronically. This system provides for the automatic exchange of data between businesses and tax authorities, which contributes to the efficiency of accounting processes and reduces opportunities for tax evasion (SDI Italy..., 2021).

The United States of America is a leader in the adoption of digital technologies in accounting due to the widespread use of cloud-based platforms and automated financial management systems. Systems such as QuickBooks and Xero are widely used in the US to help small and medium-sized enterprises automate accounting processes, reduce human errors and ensure the accuracy of financial reports. Another important aspect is the introduction of eXtensible Business Reporting Language (XBRL) standards, which provide

a standardised format for financial reports and their automated processing. In the United States, this process is guided by the Sarbanes-Oxley Act, which requires transparency and accuracy of financial reports, as well as the Gramm-Leach-Bliley Privacy Act, which regulates the protection of financial information (McCumiskey & Wolfson, n.d.). Canada also has significant advancements in the field of accounting digitalisation. This country actively uses platforms for electronic filing of financial statements and tax returns, such as the CRA's My Business Account, which simplifies the interaction between businesses and tax authorities. In addition, Canada supports initiatives to develop standards for the automated exchange of financial data, such as CPA Canada's Accounting Technology Framework. The regulatory framework includes the Canadian Corporate Financial Reporting Act and the Information Privacy Act, which govern the processing and protection of financial data (Dhaliwal *et al.*, 2023).

In Ukraine, the main systems for digitalising accounting are InfoTAX, iFin, and MASTER: Accounting, which are widely used by enterprises. These solutions automate the accounting of financial transactions, electronic document management and integration with government systems, such as the tax reporting system. Considerable attention is paid to the use of electronic signatures for the legal authenticity of documents, as well as cloud technologies for data storage and exchange (Koval & Lyshak, 2024). Table 2 compares the experience of different countries in the development of the digitalisation of accounting.

Table 2. Comparison of accounting digitalisation features in different countries as of 2024

Country	Key systems and technologies	Source	Main features
Estonia	X-Road	M. Dubinina <i>et al.</i> (2022)	Full electronic document management, including interaction between government agencies and businesses, reduction of paperwork through integration of the system with central registries, access to all public services online, and a high level of data protection through cryptographic technologies.
Germany	ELSTER, ZUGFeRD	V. Tiberius & S. Hirth (2019)	Electronic reporting with the ability to file tax returns and other reports online, electronic data exchange standards that automate the exchange of information between businesses and government agencies, and integration with banking systems to simplify financial transactions.
Sweden	PEPPOL	E-Invoicing in Sweden (2023)	Automated data exchange between companies and government agencies, electronic invoices to reduce paperwork, e-commerce standards that provide a unified data format for interaction, and widespread adoption of e-government for business convenience.
Italy	Sistema di Interscambio (SDI)	SDI Italy: The E-Invoicing Regulations (and what it means for businesses) (2021)	Mandatory electronic reporting for all companies, including automatic data exchange with tax authorities, electronic invoices, and the mandatory use of a special platform for submitting tax documents, ensures real-time monitoring of tax transactions.

Table 2, Continued

Country	Key systems and technologies	Source	Main features
USA	QuickBooks, Xero, XBRL	M. McCumiskey & A. Wolfson (n.d.)	Cloud-based platforms for financial and accounting management, XBRL standards for automating financial reports, which allow for uniform formats for presenting financial information, integration with various third-party applications and systems to improve business process management, and a high level of automation of accounting processes.
Canada	CRA's My Business Account, CPA Canada's Accounting Technology Framework	S.B. Dhaliwal <i>et al.</i> (2023)	Electronic filing of reports through the CRA's My Business Account platform, standards for automated data exchange that integrate tax systems with cloud platforms to simplify accounting and reporting, and support for various forms of electronic documents and payment transactions.
Ukraine	InfoTAX, iFin, MASTER: Accounting	O. Koval & O. Lyshak (2024)	Implementation of systems for electronic document management and accounting automation, integration of accounting systems with government services for reporting and tax payment, support for electronic signatures for the legal force of documents, use of cloud solutions for data exchange and information storage, specific adaptation to the needs of the agricultural sector in Ukraine.

Source: compiled by the authors

The introduction of artificial intelligence and automation is one of the main trends in the digitalisation of accounting. Artificial intelligence (AI) can significantly improve the accuracy of financial data processing, automate routine tasks and predict financial performance based on large amounts of data. For instance, AI can automatically analyse invoices, detect errors or fraudulent transactions, and provide detailed financial reports (Hasan, 2021). However, the implementation of such technologies requires large investments in software and hardware, as well as specialised knowledge to set up and maintain the systems. Moreover, agricultural enterprises may face problems integrating new technologies into existing accounting systems, which may require additional effort and time. Ukraine is characterised by a large agricultural sector, with the majority of businesses located in rural areas with limited access to high-quality internet and modern IT infrastructures. This poses additional challenges for AI and automation implementation, as even the most advanced technologies require a stable and fast internet connection to work with cloud services, update software, and maintain uninterrupted data exchange. For instance, in areas with poor internet connectivity, agricultural enterprises may face difficulties integrating AI into their accounting systems, which can lead to delays in automation processes and reduced efficiency.

Accounting outsourcing is substantial in the modern business environment, especially for agricultural enterprises, providing effective management of financial processes without the need for an in-house accounting department. Businesses can focus on core functions by outsourcing accounting to professional companies that

ensure a high level of accuracy and compliance with legal requirements. Accounting outsourcing can also reduce the cost of managing accounting processes, provide access to the latest technology and expertise, and increase flexibility in adapting to changing market and regulatory conditions (Asatiani *et al.*, 2019). However, all these challenges are also accompanied by opportunities. Investments in modern technology can significantly increase the efficiency of accounting processes, reduce human errors, and provide greater transparency in financial transactions. Agricultural enterprises that successfully implement these technologies can gain competitive advantages, such as higher accuracy of financial forecasts and optimisation of resources (Li & Gao, 2022). Thus, although the process of digitalisation of accounting is accompanied by certain challenges, its potential benefits make it an important step towards modernising the agricultural sector and ensuring its sustainable development.

In the context of active digitalisation of business processes, Ukrainian agricultural enterprises can significantly improve their financial reporting, management efficiency and market competitiveness. However, these goals require a balanced approach to the introduction of new technologies. Based on the above information, the following recommendations are made, which can help agricultural enterprises successfully adapt to digital transformation. The first step towards digitalisation is to assess the current state of the IT infrastructure. Agricultural enterprises should conduct a detailed audit of their information systems, including assessing the condition of servers, network devices, workstations and software. For instance, if a business uses outdated

versions of accounting software, this can make it difficult to integrate new technologies. An audit can identify weaknesses and be used to plan for necessary upgrades.

After the audit, IT investments are required. This includes purchasing modern accounting software that supports process automation and integration with other business systems. For instance, platforms such as Debit Plus, IT-Enterprise, and Bookkeeper provide comprehensive solutions for automating accounting and financial processes. They offer tools for digital document management, which significantly reduces paperwork and increases accounting efficiency. These systems can also be used to integrate accounting with other enterprise management systems, such as ERP systems, which help better coordinate financial and production processes. IT Enterprise supports the large amounts of data required by large agricultural companies, while Debit Plus and Bookkeeper are particularly useful for medium and small enterprises, offering user-friendly interfaces and tailored solutions for a variety of industries, including the agricultural sector. Increasing reliance on digital technologies increases the risk of cyberattacks, therefore effective cybersecurity is essential. This includes using data encryption, installing anti-virus software, setting up firewalls and implementing multi-factor authentication for access to accounting systems. The introduction of new technologies requires skilled personnel who can use modern tools effectively. Agricultural enterprises should invest in employee training, providing them with the necessary knowledge and skills. For instance, organising courses on the use of accounting automation software or the basics of cybersecurity can significantly increase work efficiency and reduce the risks associated with human error.

Cloud technologies can significantly simplify accounting management by providing access to data from anywhere and increasing the flexibility of business processes. Cloud-based platforms such as QuickBooks or Xero can be used to automate accounting, store financial data in a secure environment, and reduce the cost of maintaining local infrastructure. For agricultural businesses operating in remote regions or with limited IT resources, cloud-based solutions may be the best choice. Agricultural enterprises are advised to introduce new technologies gradually, testing them on individual business processes. This will help identify potential problems at an early stage and avoid significant financial losses. For instance, a company may initially automate only a part of accounting operations, such as cost accounting or invoicing, and after successful testing, extend automation to other processes.

Cooperation with leading IT solution providers can provide access to the most advanced technologies and

expert support. This will allow agricultural enterprises to implement new technologies faster and with less risk (Hedvall *et al.*, 2019). For instance, partnerships with companies specialising in ERP systems or cybersecurity can facilitate the digitalisation process and ensure its success. Government programmes and grants can be an important source of funding for the digitalisation of agricultural enterprises. Ukraine already has support programmes for small and medium-sized businesses that can cover part of the costs of implementing new technologies. Agricultural enterprises should actively engage in such programmes to get the necessary resources for modernisation. These recommendations will help Ukrainian agricultural enterprises to successfully adopt international experience in digitalising accounting, increase their efficiency and competitiveness, and ensure the sustainability and security of their financial systems.

DISCUSSION

The results obtained indicate significant prospects for the digitalisation of accounting in the agricultural sector of Ukraine, but the process has its challenges that require attention and solutions. The main trends identified in the study indicate the active implementation of automated accounting and financial management systems that help reduce errors and increase the efficiency of financial flow management. Specialised software such as MASTER and BAS ERP can integrate financial processes into a single system, ensuring transparency and control over all aspects of accounting. M.A. Dayioğlu & U. Turker (2021) investigated the impact of digital transformation on increasing the productivity of agricultural enterprises in different regions. The authors argued that the introduction of Industry 4.0 technologies increased productivity. The current results partially coincide with the authors' findings, as productivity growth was also recorded, which may be due to different conditions and the degree of technology adoption in different regions.

M. Lezoche *et al.* (2020) studied the impact of digital technologies on grain supply chains. The authors noted that the use of blockchain technologies can increase the transparency and efficiency of these chains. The current results did not reveal such a significant impact of blockchain. Instead, the focus was on the efficiency of logistics process automation. Despite the obvious benefits of digitalisation, agricultural enterprises face several significant challenges that slow down this process. One of the key challenges is the lack of technical infrastructure, especially in rural areas where most agricultural enterprises are located. Inadequate access to high-speed internet, outdated equipment and limited opportunities for upgrading it pose serious obstacles to the effective implementation of digital technologies.

This confirms the need to develop technical infrastructure in the regions as one of the priorities of state policy.

Another significant problem is the shortage of qualified personnel and the low level of digital literacy. The introduction of new accounting systems requires specialists who are well-versed in digital technologies and can manage automation processes. However, many agricultural enterprises, especially small ones, do not have sufficient resources to train employees or hire IT specialists. This limits opportunities for full digitalisation and increases the risk of errors in financial accounting. L. Xie *et al.* (2021), on the other hand, focused on the challenges of digitalising accounting in small agricultural enterprises. Authors emphasised that the main obstacles to digital transformation are insufficient staff qualifications and limited access to the necessary software. D.F. Setiawan *et al.* (2024) noted that many small businesses do not have the financial means to purchase modern software solutions and, therefore, cannot effectively integrate new technologies into their accounting processes. The current results partially confirm the authors' conclusions, as these problems were also identified, but in the current study, more emphasis was placed on the need to modernise IT infrastructure, which was less prominent in the authors' work.

H. Guo *et al.* (2020) addressed the impact of digitalisation on small and medium-sized agricultural businesses, noting the positive effect of digital solutions on their competitiveness. In contrast to the current findings, where digitalisation had a more uniform impact on enterprises of different sizes, authors argued that small enterprises gained the greatest efficiency gains due to greater adaptability and flexibility in adopting new technologies. I. Zambon *et al.* (2019), in turn, analysed the implementation of Industry 4.0 in the agricultural sector in terms of reducing dependence on human resources. The authors found that automation has a significant effect on reducing operating costs, but its results showed lower efficiency compared to other technologies, such as drones or sensor systems, which significantly improve resource management. This is different from the current results, where it was noted that automation is a key factor in improving the overall efficiency of agricultural enterprises.

In addition to technical and human resource constraints, inconsistencies in the legal framework and regulatory barriers are also relevant. The rapid development of digital technologies is outpacing legislative updates, which creates legal conflicts and complicates the work of businesses. For instance, existing accounting standards are not always adapted to the digital environment, making it difficult to apply them in practice. This requires not only updating the legal framework

but also raising awareness of new requirements and standards among businesses. J. MacPherson *et al.* (2022) studied the role of state support in the process of digitalisation of the agricultural sector. As argued without active government support, the process of digital transformation is much slower, especially in small and medium-sized enterprises. R. Abbasi *et al.* (2022) also emphasised the need for incentive programmes to help these enterprises introduce new technologies. The current findings confirm these conclusions but also indicate that large agricultural enterprises, with their resources, were able to advance in the digitalisation process even without significant state support.

The issue of cybersecurity, which is becoming increasingly relevant in the context of digitalisation, is notable. The introduction of digital technologies increases the vulnerability of enterprises to cyberattacks, which can lead to the loss or compromise of sensitive financial information. Implementation of effective cybersecurity systems requires significant investments, which are not always affordable for small and medium-sized enterprises. This underscores the need not only for technical solutions but also for the development of a cybersecurity culture in enterprises. X. Yang *et al.* (2021) studied cybersecurity in the agricultural sector in the context of rapid digitalisation. The study highlighted that with the introduction of new digital technologies in agriculture, cyber threats have increased dramatically. Z. Angyalos *et al.* (2021) noted that most agricultural companies are not prepared for such challenges, as they do not have adequate protection against cyber threats, and there is a lack of understanding of the importance of cybersecurity among management and employees. The authors also emphasised that the agricultural sector is becoming an increasingly attractive target for cybercriminals since most of the systems being implemented are interconnected and automated, which opens new attack vectors. The current results are consistent with their findings, showing a similar increase in cyber threats, but also highlighting the need for more cyber security training. This highlights the importance of not only implementing technology but also ensuring its security through training and competence development in this area.

Organisational barriers and unwillingness to change arising from digitalisation are also noteworthy. The transition to new technologies and the need to train employees are often met with distrust and resistance from management and employees. The high cost of implementing digital solutions is also a significant obstacle for many agricultural enterprises, forcing them to postpone the introduction of new technologies or limit themselves to minimal investments in digitalisation.

The results of the study highlight the complexity and multifaceted nature of the digital transformation of the agricultural sector. Comparison with other studies shows that while many challenges are common, especially in terms of cybersecurity, digitalisation of accounting, and the role of government support, there are also unique aspects that require additional attention. In particular, the successful digitalisation of agricultural enterprises requires not only the introduction of modern technologies but also the development of human capital through staff training and the modernisation of IT infrastructure, which is particularly relevant for small and medium-sized enterprises. In summary, the digitalisation of accounting in the Ukrainian agricultural sector has great potential but requires a comprehensive approach that includes the development of technical infrastructure, staff training, adaptation of legislation and cybersecurity. Only under such conditions successful implementation of digital innovations that will help increase the competitiveness of the agricultural sector in the modern economy is possible.

CONCLUSIONS

The study of the digital transformation of accounting in the agricultural sector of Ukraine identified key trends, challenges and opportunities along the way. The analysis showed that the digitalisation of accounting is critical to improving management efficiency, reducing costs and ensuring compliance with modern regulatory requirements. The introduction of automated accounting systems such as MASTER and BAS ERP have become a major trend that helps agricultural enterprises automate routine processes, reduce errors and speed up the preparation of financial statements. The use of specialised software was used to integrate all financial processes into a single system, which ensures transparency and control.

Active implementation of electronic document management is another important component of digitalisation. The transition from paper to electronic documents simplifies the work with financial information, speeds up the exchange of data between different business units and ensures more reliable data storage. Integration of accounting with other enterprise information systems, such as production, logistics and HR, can be used to create a single information ecosystem where all processes are interconnected and can be effectively managed. However, there are substantial issues on the way to full digitalisation. Insufficient technical in-

frastructure and outdated equipment are substantial problems. In addition, the lack of qualified personnel and low level of digital literacy significantly complicate the implementation of new accounting systems. Other challenges include the inadequacy of legislative support for the rapid development of digital technologies and the increased risk of cyber threats.

In Ukraine, the regulatory framework governing the digitalisation of accounting includes legislation on electronic documents and electronic document flow, accounting and reporting standards, and acts regulating the activities of agricultural enterprises. Legislation on electronic signatures and their use in electronic document management creates the basis for automating accounting processes. International experience, including that of the European Union, the United States, and Canada, demonstrates successful practices of digitalisation that can serve as a guide for Ukraine. Technologies such as electronic document management, automated financial systems and artificial intelligence are already being actively used in these countries to improve accounting and management efficiency.

To improve the digitalisation of accounting in the agricultural sector of Ukraine, it is recommended to conduct a detailed audit of the IT infrastructure, invest in upgrading technical equipment, implement cybersecurity systems, train staff and consider the use of cloud technologies. It is also important to actively use government programmes and grants to support digital transformation. These steps will help to increase the efficiency, transparency and competitiveness of agricultural enterprises, which is key to their sustainable development in the modern market.

The study did not address the impact of regional peculiarities of the Ukrainian agricultural sector, which may limit the applicability of the results to all regions. No in-depth analysis of the environmental aspects of digitalisation was conducted, which requires a separate study. Further research could focus on analysing regional differences in the adoption of digital technologies, as well as on the integration of environmental and social aspects into the process of digitalisation of accounting in the agricultural sector.

ACKNOWLEDGEMENTS

None.

CONFLICT OF INTEREST

None.

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Діджиталізація бухгалтерського обліку підприємств аграрного сектору: національний та міжнародний досвід

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Анотація. Мета дослідження – аналіз особливостей впровадження цифрових технологій у сфері бухгалтерського обліку на підприємствах аграрного сектору, зокрема на аналіз національного та міжнародного досвіду. Проаналізовано процес цифровізації бухгалтерського обліку на аграрних підприємствах України, який є важливим кроком для підвищення ефективності управління, зниження операційних витрат та забезпечення відповідності сучасним нормативним вимогам. Аналіз основних тенденцій у впровадженні автоматизованих систем бухгалтерського та фінансового обліку показав, що такі системи дозволяють аграрним підприємствам автоматизувати рутинні процеси, зменшити кількість помилок та скоротити час на підготовку фінансової звітності. Дослідження також виявило низку проблем, які виникають на шляху до повної цифровізації обліку, серед яких недостатня технічна інфраструктура, брак кваліфікованих кадрів та низький рівень цифрової грамотності. Недостатнє фінансування та нормативно-правові бар'єри також створюють серйозні виклики для підприємств. Особливу увагу приділено питанням кібербезпеки, які стають все більш актуальними у зв'язку із зростанням обсягів цифрових даних. Порівняно український досвід із досвідом країн Європейського Союзу, США та Канади, де цифровізація обліку досягла високого рівня. В дослідженні запропоновано рекомендації для успішного впровадження цифрових технологій в облікові процеси на аграрних підприємствах України, враховуючи наявні обмеження та можливості. Зокрема, зазначається важливість проведення аудиту існуючої цифрової інфраструктури, інвестування в оновлення обладнання, навчання персоналу, поступового впровадження нових технологій та партнерства з провідними постачальниками цифрових рішень. Отримані результати підкреслюють значний потенціал цифровізації для підвищення ефективності, прозорості та конкурентоспроможності аграрних підприємств України, проте досягнення цих цілей потребує збалансованого підходу до впровадження нових технологій, підтримки з боку держави та відповідної освітньої підготовки. Отримані у дослідженні результати можна застосувати для вдосконалення цифровізації бухгалтерського обліку на українських аграрних підприємствах, підвищення ефективності управління фінансами та адаптації міжнародних стандартів до місцевих умов

Ключові слова: цифрові технології; електронні системи; автоматизація обліку; економічна ефективність; аудит і контроль