



Challenges and obstacles to the digitalisation of logistics at the local level

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Abstract. The article examined the challenges and barriers arising from the rapid development of digitalisation, which is significantly transforming the business environment and creating new obstacles for enterprises at the local level. In the contemporary context, addressing these challenges is essential for the effective implementation of digital technologies to enhance enterprise competitiveness and mitigate potential risks. The study aimed to systematise and analyse the key challenges and obstacles to the digitalisation of logistics at the local level and to develop strategies for overcoming them. This research was based on an analysis of academic publications and statistical data. Methods of comparative analysis, systematisation, and generalisation were applied. The main challenges and obstacles were categorised into five key groups – economic, technological, organisational, legal, and social – which hinder the adoption of digital solutions. Economic challenges are associated with limited financial resources and the high cost of technology. Technological aspects include inadequate infrastructure and information security issues. Organisational challenges stem from resistance to change and a lack of strategic vision, while legal challenges arise from inconsistencies in legislation and the ambiguous conceptual framework of the digital economy. Social challenges are linked to the need for workforce retraining and staff shortages. A strategy has been proposed to address each group of challenges, including the development of government programmes, improved access to digital technologies, and the introduction of educational initiatives. The practical value of the study lies in the potential application of the proposed strategies by enterprises and organisations to enhance logistics processes within the context of digital transformation. The findings may serve as a basis for developing a strategy for the digitalisation of logistics processes, taking regional specificities into account

Keywords: digital transformation; logistics processes; logistics automation; business models; digital tools; overcoming strategies; region

Introduction

Digitalisation has emerged as a dominant trend since the 2020s, showing no signs of slowing down. Technology companies are set to be the primary investors in the continued advancement of digitalisation, permeating all aspects of life, particularly the business environment. These companies are setting the standards and conditions which businesses must acknowledge to remain competitive and

profitable amidst rapid informational changes. Logistics is a particularly popular area for improving the implementation and integration of digital technologies. Companies are actively working to increase the speed of material flow deliveries, reduce information flow processing times, and enhance end-user service to maintain their economic position and boost profitability. In doing so, they are deploying

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a wide range of digital technologies and solutions. The convergence of digital technologies and tools has led to changes in traditional business model formation. These shifts require analysis to understand the capabilities of these models and the next steps for their adaptation and sustainable development, including identifying and addressing challenges and obstacles. Cloud technologies and artificial intelligence are becoming integral to business operations, and companies must recognise these changes to ensure the accuracy and effectiveness of these integrations.

The process of adapting business models to the digital economy and the correct selection of implementation strategies encounters challenges and obstacles that have also changed and transformed, reflecting the pace of digitalisation. Since 2010, there has been a surge in research dedicated to adapting business models to the needs of the digital economy and the associated complexities. C.E. Fernandez Rea (2023), in examining digital technologies in agricultural enterprises, identified limitations such as high integration costs, the need for specialised knowledge and skills, and the potential for technology failure. M.H. Khaustova (2023) explored and highlighted risks and negative elements in the ongoing process of digitalisation, noting unauthorised access to information, cybersecurity threats, and digital inequality. Researchers O.V. Ptashchenko & O.M. Sokhatska (2022) argued that digital transformation significantly impacts not only technology but also work and consumption culture. They emphasised that high implementation costs for new technologies, the need for specialised knowledge, and the necessity for changes in internal company structures are major challenges faced by businesses in the context of digitalisation. According to M. Cichosz *et al.* (2020), key barriers to digital transformation in the logistics sector include the complexity of managing logistics networks, resource limitations, resistance to change, cybersecurity issues, and difficulties in adapting to new technologies. These researchers indicated that overcoming these obstacles requires strong leadership, organisational support, engagement of personnel and partners, as well as process standardisation and data integration.

Researcher D. Bodnar (2022) concluded in their study that digital logistics plays a key role in economic transformation, enhancing business competitiveness through the optimisation of logistical processes, automation of activities, and implementation of electronic documents such as e-CMR and e-AWB. They emphasised that developing digital platforms for interaction among logistics chain participants is crucial, but the level of logistics digitalisation in Ukraine remains low. To improve this, it is necessary to adapt innovative technologies to European Union (EU) standards, conduct in-depth process analysis, and automate processes. L.O. Kustrich (2023) noted that the digitalisation of logistics management creates significant management challenges, particularly due to the need to integrate technologies like the Internet of Things (IoT), blockchain, and automation. She also highlighted that a major obstacle is the lack of unified standards for digital

systems, which complicates process integration and reduces management efficiency. According to T. Nakonechna & N. Hryniv (2021), one of the most significant challenges in implementing cutting-edge technologies like IoT is the need to mitigate risks caused by human factors, specifically errors stemming from insufficient knowledge or experience. While these technologies can minimise reliance on human intervention, the process of adapting staff to work with them remains a substantial obstacle.

Despite the existing scholarly research, approaches, and summaries in the academic literature, there is a need to analyse and systematise the general challenges and obstacles that arise during the digitalisation of logistics at the local level. Regional aspects of implementing digital technologies, which account for the specifics of local infrastructure, economic environments, and social factors, are under-researched. There is a lack of in-depth analysis of effective strategies to overcome these challenges and obstacles, which would enable businesses to adapt successfully to the conditions of digital transformation. This article aimed to identify, systematise, and analyse the existing challenges and obstacles to the digitalisation of logistics at a local level.

Materials and Methods

This study employed a comprehensive set of methods to provide a thorough analysis of the challenges of logistics digitalisation at the local level, with a specific focus on the Vinnytsia Region. The use of diverse methodologies allowed for an in-depth exploration of the aspects of digital transformation, the identification of key challenges and obstacles, and the proposal of potential solutions. The method of analysis was applied to examine available academic publications, official reports, statistical data, and other sources directly related to the digitalisation of logistics. This included a detailed analysis of publications concerning the implementation of digital technologies in the logistics sector, such as the study of M. Cichosz *et al.* (2020), which highlights the barriers to digital transformation. This analysis allowed for the identification of the main problems in implementing digital technologies in logistics. Data was also gathered from information resources such as Ukrinform (31 investment projects..., 2023), which provided current information on the state of digitalisation in Ukraine, and the Lviv Chamber of Commerce and Industry (Grants from the..., n.d.), which outlines trends in the implementation of advanced technologies.

The method of systematisation was used to organise the data obtained, allowing for the classification of challenges and obstacles to logistics digitalisation into several key groups: economic, technological, social, organisational, and legal. This approach provided a clear understanding of the diverse problems faced by businesses during digital transformation. For example, economic barriers include the high costs of technology implementation, while social barriers include the insufficient level of digital skills among staff. The method of synthesis was used to integrate heterogeneous data from various sources. This allowed for the

formation of a comprehensive understanding of the situation in the region, combining information on the impact of digitalisation on logistics with an analysis of its local specificities. The synthesis method was particularly important for identifying potential strategies to overcome challenges, as it facilitated the integration of data from various sectors and sources.

One crucial aspect of this research was the examination of the investment climate in the Vinnytsia Region. This line of inquiry focused on assessing the regions potential for implementing digital technologies, which is critical for the effective digitalisation of logistics. The analysis of the investment climate included an evaluation of infrastructure availability for the digital transformation of logistics and the study of investment levels in the logistics sector. This allowed for an assessment of the regions capacity to adapt to digital challenges and an analysis of measures implemented by regional authorities to stimulate digitalisation, including government support programmes for businesses focused on implementing innovative solutions. To obtain statistical data, specialised resources were used, including data on the number of internet providers in the region (Internet providers – Vinnytsia, n.d.) and a comprehensive study of the IT industry (IT VN Research, 2021). This information allowed for an evaluation of the current state of digital infrastructure development and its ability to support the implementation of modern technologies in logistics. The comprehensive approach to selecting methods and incorporating diverse data sources ensured a deep and thorough understanding of the challenges and obstacles to logistics digitalisation at the local level.

Results and Discussion

Digital transformation has led to the emergence of the concept of “digital logistics”, which is an integral part of the digital economy. Digital logistics is an innovative form of logistics that significantly reduces costs associated with logistical processes, such as order processing, and accelerates their

execution (Shostak, 2020). Digital technologies enable the development of new logistical solutions, optimise production, warehousing, transportation, and other processes, and accelerate asset turnover, assigning digital logistics a leading role in the digital economy. Digital technologies encompass all aspects of the logistics process, from electronic waybills, used to reduce document processing time and costs and simplify communication between different links in the logistics chain, to artificial intelligence, which is used for demand forecasting and automating routine processes. This leads to the emergence of key features of logistical activities in the context of digitalisation, including increased data processing speed and quality, the development of ecommerce and expansion of distribution channels, and the advancement of autonomous logistics technologies (Minakova & Grigori, 2023). Among the diverse range of digital technologies, blockchain and digital platforms stand out for their use in logistics process management. Blockchain technology is a decentralised database that operates across multiple computers and is updated using cryptographic methods. The advantages of using blockchain in the logistics sector include reduced risk of errors, enhanced data security, and improved transparency and openness.

Logistics process management systems allow for the monitoring of cargo movement and control of warehouse and delivery management processes. The logistics platform Trans.eu (3 steps a..., 2020) connects freight forwarders, shippers, and carriers, providing real-time cargo location monitoring, simplified application processing and filing, reduced transportation costs, and optimised financial expenses for the company. The digitalisation of logistics at the local level encounters specific features and characteristics of this local level, namely, large variability in available resources, technological infrastructure, and staff qualifications, which are due to regional differences. It is necessary to identify groups by which the systematisation of challenges and obstacles will be conducted, primarily economic, technological, organisational, legal, and social groups (Table 1).

Table 1. Challenges and obstacles to logistics digitalisation

Group Name	Challenge Description
Economic	Limited financial resources for implementing new technologies
	Lack of investment in digital infrastructure at the local level
	High cost of implementing new digital solutions
	Absence of government support or programmes to stimulate digitalisation
	Restrictions on the purchase of foreign equipment and software in the absence of Ukrainian analogues
Technological	Insufficient development of digital infrastructure
	Low level of technical training of personnel to work with digital tools
	Compatibility problems of new digital solutions with existing logistics systems
	Limited access to high-speed internet and digital platforms
	Lack of modern digital tools at the local level
	Low level of information security
Organisational	Lack of a strategic vision for digitalisation at the local level
	Low level of management readiness for digital changes
	Resistance to change among employees and problems adapting to new technologies
	Lack of motivation from company leadership to implement digital technologies

Continued Table 1

Group Name	Challenge Description
Legal	Inconsistency of current legislation with the needs of the new technological order
	Data protection problems in logistics processes, especially when using digital platforms
	The problem of identifying and determining the legal status of involved digital market entities
	Absence or ambiguity of the conceptual apparatus of the digital economy
Social	Increased unemployment due to automation
	Shortage of qualified personnel and specialists and the constant need for retraining
	Increased socio-economic inequality due to uneven informatisation of society

Source: compiled by the author based on K. Verhal (2020), E. Khusainova *et al.* (2021)

Having identified the main risk categories, it is important to note that derivative risks will also emerge, such as environmental risks (stemming from increased electricity consumption and greenhouse gas emissions) and educational risks (lack of programmes for staff retraining and upskilling). These challenges affect businesses embarking on the path of logistics digitalisation and business in general. In response to these challenges, it is necessary to consider the opportunities and strategies for overcoming these obstacles to successfully implement logistics digitalisation. The identified groups of challenges are difficult to prioritise, given that they appear at every stage of the logistical chains digital transformation. Therefore, they should be analysed in the order previously outlined.

When considering ways to overcome economic challenges, it is crucial to analyse the regions investment climate to gain a clear understanding of the situation at the local level. Looking at the investment climate in the Vinnytsia Region can be interpreted as favourable due to the implementation of government policies aimed at supporting Ukrainian businesses. Thanks to this climate, 31 investment projects were successfully implemented in 2023 (31 investment projects..., 2023), with a total value of nearly 1.44 billion UAH. This encourages the continued attraction of investments through investment appeal. The second approach to overcoming this barrier is to utilise government programmes or grants. The Digital Europe programme (Grants from the..., n.d.), introduced by the EU, aims to create a unified European digital market and includes six areas, four of which are accessible to Ukraine: high-performance computing, artificial intelligence, information technologies in the economy and society, and digital skills. These strategies focus on attracting funds to cover automation costs. Investments can also address and resolve technological challenges, but first, it is necessary to assess the technological state at the local level.

Internet coverage in the city of Vinnytsia is provided by a large number of internet service providers (over 250), offering various tariff plans (Internet providers – Vinnytsia, n.d.) with the option to use rented equipment. Providers have accommodated periodic power outages by ensuring uninterrupted internet access. Collaboration with IT companies to develop specialised digital solutions is an effective strategy for overcoming technological challenges, but the state of the IT sector varies from region to region and requires initial assessment. According to the IT VN

Research (2021) results, the Vinnytsia Region ranks 7th among all regions of Ukraine and has 5,880 IT individual entrepreneurs and 475 legal entities operating in IT-related economic activities. Such development of the IT sector significantly simplifies the implementation of digital solutions, which helps overcome technological challenges, including system compatibility issues, access to modern tools, and improves information security at the local level. After analysing strategies to overcome technological challenges, it is possible to consider the next category of challenges, namely organisational challenges.

Strategies to overcome organisational challenges are difficult to analyse at the local level due to the limited transparency of logistics companies regarding management and organisation. Therefore, these strategies will be more general and advisory in nature. Developing a long-term digitalisation strategy and establishing a digital council will create a clear plan for implementing digital technologies that take into account local specifics and resources. This plan will be coordinated by a dedicated body responsible for planning, monitoring, and controlling the implementation of digital solutions. Training and upskilling senior and middle management will promote understanding and mastery of digital tools, enabling effective process management and informed decision-making. Engaging external experts will provide logistics management with a better interpretation of the challenges and opportunities of digitalisation and the ability to develop a long-term strategy for implementing digital technologies. Training and retraining programmes, along with internal communication and staff engagement, will ensure employees are qualified in this area and reduce their resistance to change by making them aware of the advantages, disadvantages, and essence of automation. Integrating digital Key Performance Indicators (KPIs) and financial and reputational incentives can enhance the motivation of company leadership to implement digital technologies. Key performance indicators may include the number of implemented digital solutions, cost reductions due to automation, and others. As for overcoming social challenges, this process should involve the following steps: developing modern and digital training and retraining programmes for employees. Platforms like Prometheus and Udemy (We have selected..., 2023) offer opportunities to improve related professional skills or delve into the basics of another field and receive a certificate confirming acquired skills and knowledge. Establishing

partnerships with educational institutions will enable the development of programmes that meet the demands of the digital economy. Ensuring equal access to digital technologies and increasing the transparency of digitalisation processes are also crucial. The strategies mentioned above will help mitigate negative consequences and overcome obstacles, thereby enhancing the ultimate success of digitalisation for enterprises and businesses.

The issue of digital transformation across various social development phenomena and processes is widely discussed in academic literature. According to O.Y. Davydova & V.D. Kolesnikova (2022), the uneven development of digital infrastructure is one of the main challenges of digitalisation. They noted that some regions experience a lag in the development of network infrastructure, which complicates the integration of digital technologies into business processes. Their conclusions align with the results of this study, which confirm the importance of modern digital infrastructure for successful business transformation. It is noted that the problem of uneven access to digital solutions is significantly exacerbated in rural and remote areas. M.S. Shtelmashuk (2024) highlighted that one of the key problems of digitalising logistics processes is the compatibility of new technologies with existing infrastructure solutions, especially in small and medium-sized businesses. The author stated that many companies attempting to integrate digital tools face difficulties due to outdated management systems that do not support innovative solutions such as IoT, blockchain, and SCM systems. This necessitates significant additional investments in modernisation, which often poses an insurmountable financial burden for small enterprises. The findings of this study also confirmed that data format compatibility and integration between different digital platforms are critical challenges for logistics companies. An important aspect is that modern information systems across different enterprises often have varying data exchange standards, which complicates their interaction and requires the implementation of specialised software solutions or additional integration gateways. K. Verhal (2020) highlighted the social challenges of digitalisation, drawing attention to the increase in unemployment due to automation and the polarisation of the workforce based on digital skills. This study also noted that human factors, including inadequate employee training, are significant barriers to implementing digital technologies. The authors viewed on the critical importance of investing in digital education is entirely justified. This assertion can be expanded by emphasising the need for government support programmes for employee retraining.

Ye. Borodin *et al.* (2021) identified digital inequality as a key barrier to digitalisation. They noted that the lack of access to high-speed internet and the low level of digital literacy among the population significantly complicate the implementation of digital solutions. Developing regional infrastructure and promoting digital education are crucial steps to overcoming digital inequality. Furthermore, the findings of this study corroborate their arguments

but add that digital inequality also affects the accessibility of solutions for small enterprises. I.V. Kryvoviyaziuk & I.S. Sydorchuk (2022) emphasised the low level of technological readiness of enterprises, which slows down the digitalisation process. The authors focused on the partial implementation of solutions, such as cloud computing or big data analytics, which limits competitiveness. This research confirms similar findings, highlighting the particular relevance of this barrier for small and medium-sized businesses with limited resources.

L.M. Achkasova (2024) highlighted the legal and regulatory challenges of digitalising transport and logistics systems, emphasising the difficulties associated with the absence of a unified legislative framework and clear regulatory requirements for digital platforms. The author noted that these factors significantly complicate the implementation of innovative technologies and slow down the digital transformation process in the logistics sector. The lack of standardised data exchange mechanisms and clearly defined rules for electronic document management deters companies from actively implementing digital solutions. This argument can be expanded by emphasising the importance of international harmonisation of digital standards, creating legal mechanisms for the use of smart contracts in logistics, and strengthening government support for enterprises in implementing cybersecurity technologies. I.K. Pishenin (2021) and A.H. Lisna & O.V. Posilkina (2022) highlighted the cybersecurity problems that accompany digitalisation. They drew attention to the risk of unauthorised access to data and the need to develop effective solutions for its protection. The issue of cybersecurity, as noted by the authors, requires not only technical but also organisational measures, including raising security awareness among employees. M. Hryhorak *et al.* (2021) pointed to organisational barriers associated with the lack of digitalisation strategies. They emphasised that inadequate planning slows down the implementation of digital solutions. This idea is valid, as confirmed by the data obtained, with the addition that an effective digitalisation strategy should cover both technical and human resource aspects. According to S. Koliadenko *et al.* (2024), a high threshold of education and qualifications is a significant obstacle to implementing digital technologies in the agricultural sector. The authors emphasised that adapting educational programmes and training personnel to work with innovative solutions, such as IoT and drones, is crucial for overcoming this barrier. This conclusion aligns with the results obtained, which also highlight the importance of investing in digital education for employees. Furthermore, it is noted that developing regional retraining programmes could effectively contribute to mitigating this problem. O.M. Lukjanova (2023) highlighted institutional challenges in digitalisation, focusing on the low involvement of government bodies and the absence of a coordinated legislative framework. The author stated that insufficient government support significantly hinders the implementation of digital transformation strategies. The results obtained

confirm this argument, further emphasising that institutional barriers are exacerbated by the lack of government programmes to stimulate digitalisation, which negatively affects the competitiveness of small and medium-sized enterprises in the digital economy. The analysis conducted allowed for the identification and grouping of the main challenges and obstacles to logistics digitalisation at the local level and the development of strategies to overcome these challenges and obstacles.

Conclusions

The digitalisation of logistics at the local level encounters numerous challenges and obstacles that significantly slow down and complicate the implementation process. Economic challenges include the high cost of technological solutions and the need for substantial financial investments to acquire and maintain digital platforms and infrastructure. Social challenges encompass the problem of low digital literacy among employees, the increased risk of unemployment due to the automation of routine processes, and the polarisation of the workforce based on skill levels. Organisational challenges include insufficient strategic planning, the absence of clearly defined digitalisation goals, and low levels of interaction among market participants. Technological challenges are related to outdated infrastructure, the lack of access to modern solutions in some regions, and difficulties in integrating new technologies into existing business processes. Legal challenges arise from an inadequate regulatory framework and the uncertainty of data protection and cybersecurity standards.

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The results of this study have shown that the successful digitalisation of logistics requires a comprehensive approach to addressing economic, technological, social, organisational, and legal challenges. This includes active support from the state, particularly in providing financial grants and establishing retraining programmes. It is essential to develop strategic digitalisation plans at the enterprise level, which take into account the specifics of each region. It was found that in regions with developed infrastructure, digitalisation contributes to the optimisation of logistics processes, reduction of costs, and improvement of customer service. At the regional level, coordination between local authorities, businesses, and educational institutions is crucial for developing human resources and implementing innovations. This article has examined and systematised the key challenges of logistics digitalisation at the local level and developed practical recommendations for effectively overcoming these challenges, considering the specifics of the regional business environment. Further research could focus on studying and generalising the existing experience of implementing logistics strategies in Ukrainian enterprises.

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Виклики та перешкоди цифровізації логістики на локальному рівні

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Анотація. У статті висвітлено виклики та перешкоди, що обумовлені стрімким розвитком цифровізації, яка суттєво змінює бізнес-середовище, створює нові виклики для підприємств на локальному рівні. У сучасних умовах постає питання необхідності подолання цих викликів для ефективного впровадження цифрових технологій з метою підвищення конкурентоспроможності підприємств та зменшення потенційних ризиків. Метою дослідження були систематизація та аналіз ключових викликів і перешкод цифровізації логістики на локальному рівні та формування стратегії їх подолання. Дане дослідження базувалося на аналізі наукових публікацій та статистичних даних. У роботі застосовано методи порівняльного аналізу, систематизації та узагальнення. Проаналізовано основні виклики та перешкоди, які виділені в п'ять основних груп: економічні, технологічні, організаційні, юридичні та соціальні, що уповільнюють впровадження цифрових рішень. Економічні виклики пов'язані з обмеженістю фінансових ресурсів та високою вартістю технологій. Технологічні аспекти включають недостатній рівень інфраструктури та проблеми інформаційної безпеки. Організаційні виклики пов'язані з опором змінам та відсутністю стратегічного бачення, юридичні – з невідповідністю законодавства та неоднозначністю понятійного апарату цифрової економіки, а соціальні – з потребою перекваліфікації кадрів та їх нестачею. Запропоновано стратегію для подолання кожної групи викликів, серед яких створення державних програм, покращення доступу до цифрових технологій та розробка освітніх ініціатив. Практична цінність дослідження полягає у можливості використання запропонованих результативних стратегій подолання викликів та перешкод підприємствами та організаціями для вдосконалення логістичних процесів у контексті цифрової трансформації. Отримані результати можуть бути використані для розробки стратегій цифровізації логістичних процесів з урахуванням регіональних особливостей

Ключові слова: цифрова трансформація; логістичні процеси; автоматизація логістики; бізнес-моделі; цифрові інструменти; стратегії подолання; регіон