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PHILOSOPHY OF BUSINESS PROCESS RE-ENGINEERING IN THE FOOD INDUSTRY: TECHNOLOGICAL ASPECTS AND MECHANISMS OF DIGITAL TRANSFORMATION

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Summary. The article presents a study of the technological approach in the state regulation of the food industry within the context of digital transformation, covering key aspects, mechanisms, and tools for its implementation. It emphasizes the importance of implementing technologies such as automation, the Internet of Things (IoT), machine learning, and artificial intelligence, which significantly enhance the efficiency and competitiveness of enterprises. However, to ensure sustainable development, it is crucial that state support, especially for small and medium-sized enterprises, complements the adoption of digital technologies, as limited resources may lead to market inequality. The article examines two main models for implementing the technological approach: the automation of production processes and the application of digital twins and artificial intelligence. The automation model focuses on centralized management of production processes through ERP, MES, and SCADA systems, which reduce human impact and allow quality control at all stages. The other model, involving the application of digital twins and artificial intelligence, enables detailed modeling and forecasting of enterprise performance, which is important for long-term risk management. The combination of both models is noted to increase productivity, flexibility, and resilience of enterprises to changing market conditions. A significant portion of the article discusses state initiatives for developing logistics infrastructure, the use of blockchain to track supply chains, and the integration of IoT to monitor storage and transportation conditions. It highlights that a state regulatory framework is essential to ensure the transparency of production processes, reduce social risks, and maintain safety standards. The philosophical principles of business process reengineering in the food industry are substantiated, with an emphasis on a systemic approach, strategic thinking, and taking into account industry specifics in choosing digital transformation mechanisms. In conclusion, the article emphasizes the importance of state support, which should encompass financing cutting-edge technologies, developing professional competencies, and creating mechanisms for transparent control over business processes.

Keywords: technological approach, technological aspects, food industry, government regulation, robotics, blockchain, IoT, digital transformation, reengineering, business processes.

Formulation of the problem. The food industry, as one of the key components of food security and economic growth, faces an urgent need to adapt to rapid changes driven by global digitalization and technological innovations. The integration of innovative solutions such as process automation, IoT, machine learning, and artificial intelligence can significantly enhance the efficiency, productivity, and competitiveness of enterprises. However, this process is complicated by several factors: a shortage of qualified personnel, the need to comply with regulatory standards, and substantial financial investments required for implementing new technologies. Additionally, there is a risk of uneven development across the industry, as small and medium-sized enterprises, lacking access to modern digital tools, may fall behind, potentially leading to increased market concentration among large players and a reduction in competition. The absence of a comprehensive approach to implementing digital technologies may also result in a fragmented transformation process, where the lack of coordinated use of new approaches ultimately leads to missed opportunities and unrealized potential to create a modern, adaptive, and competitive food industry.

Analysis of recent research and publications. The essence, characteristics, advantages,

and disadvantages of the technological approach have been studied by the following national and foreign experts: Schumpeter J. [1], Neumann J. [2], Berger A. D. [3], Shkrabak I., Nikulchev M. [4], Kotelevets D. [5], Prots Ya.I., Danylyuk O.A., Lobur T.B. [6], Shcheglov V.R., Morozova O.I. [7], Vynnychuk R. [8], Yushchenko N.L. [9], Shkryhun Yu.O. [10]. However, the issue of defining key aspects of the technological approach, mechanisms, tools, and international experience in the context of state regulation of food industry enterprises has not been previously addressed.

The purpose of the article. Definition and analysis of the key aspects of implementing an economic approach in the state regulation of food industry enterprises. Identification of the most significant mechanisms and tools that ensure the effective functioning of food industry enterprises in the modern market, as well as the determination of regulatory instruments for their improvement. The study also focuses on analyzing the technological aspects of reengineering business processes in the food industry. It emphasizes the integration of innovative solutions and digital transformation mechanisms to enhance efficiency, competitiveness, and sustainability in the sector.

Results of the research. Digital transformation is reshaping the business landscape of the food industry, creating new conditions for effective enterprise operations and the development of innovative approaches. The implementation of technological solutions, such as process automation, intelligent management systems, and analytical platforms, enables food enterprises to adapt to dynamic market conditions and achieve higher productivity levels. However, the realization of a technological approach within digital transformation is a multifaceted and complex process that requires careful analysis of the key aspects, mechanisms, and tools that support effective technology integration across all stages of production and management. In the context of rapid technological evolution, the food industry faces the challenge of adopting innovative solutions that reduce costs, improve production quality and efficiency, and increase flexibility and adaptability to changing market conditions. Researching the key aspects of the technological approach, implementation mechanisms, and tools used in digital transformation is both relevant and essential for shaping a strategy for the food industry's development in the digital era.

Consider the essence, features, advantages and disadvantages of the technological approach in Fig. 1.

According to Fig. 1, Joseph Schumpeter's technological approach focuses on the role of innovation in economic development, represented in the concept of "creative destruction", which illustrates how technological innovations dismantle old economic structures and create new ones, forming the foundation of economic progress. Schumpeter also emphasized that entrepreneurs who implement new technologies are the primary drivers of economic growth. Schumpeter's technological

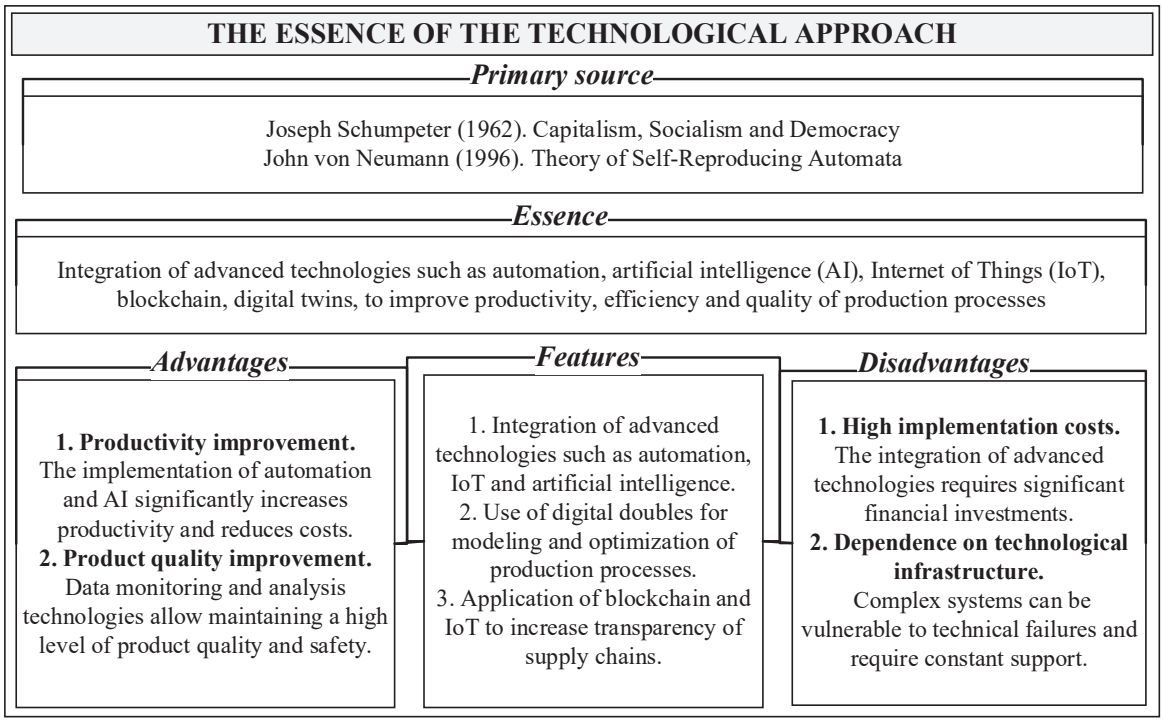

Figure 1 – The essence of the technological approach

Source: developed by the author based on [1; 2]

approach highlights the role of innovation in the dynamic development of the economy through the introduction of automated management systems, digital monitoring technologies, and new products, which are essential for ensuring the stability and growth of food industry enterprises.

The state should also support innovation development by funding research and establishing innovation clusters. In the context of digital transformation, the primary idea of the technological approach is the implementation of new technologies that not only improve the efficiency and productivity of business processes but also change the structure of business and the food industry itself. The advantages of these technologies are clear: business process automation and artificial intelligence significantly increase labor productivity while reducing production costs and enabling in-depth analysis of business processes for further optimization. Additionally, digital twins and blockchain enhance transparency and control in supply chains, improving product safety and quality. However, the technological approach comes with serious challenges, including high implementation costs, which pose a substantial barrier, especially for small and medium-sized enterprises that lack sufficient financial resources, leading to uneven development in the food industry where large companies gain significant advantages. Furthermore, these technologies require robust infrastructure and skilled personnel for maintenance, as any potential technical failures could have critical consequences for production processes.

Let's consider the key elements of the technological approach and their interaction in Fig. 2.

As shown in Fig. 2, the technological approach emphasizes the integration of advanced technologies through automation tools, including ERP, MES, and SCADA systems, which enable companies to significantly reduce human-related errors, increase the speed and accuracy of information processing, and lower costs. The implementation of digital twins and AI is directed toward modeling, optimizing, and adapting business processes to changing business environments. The integration of blockchain and IoT will ensure transparency and control over supply chains, improving quality management processes. At the business process level, the technological approach includes the stages of designing and implementing automated systems, continuous monitoring, and data analysis using IoT devices, as well as regular optimization and maintenance of these systems. On a micro-level, implementing the technological approach allows companies to optimize business processes,

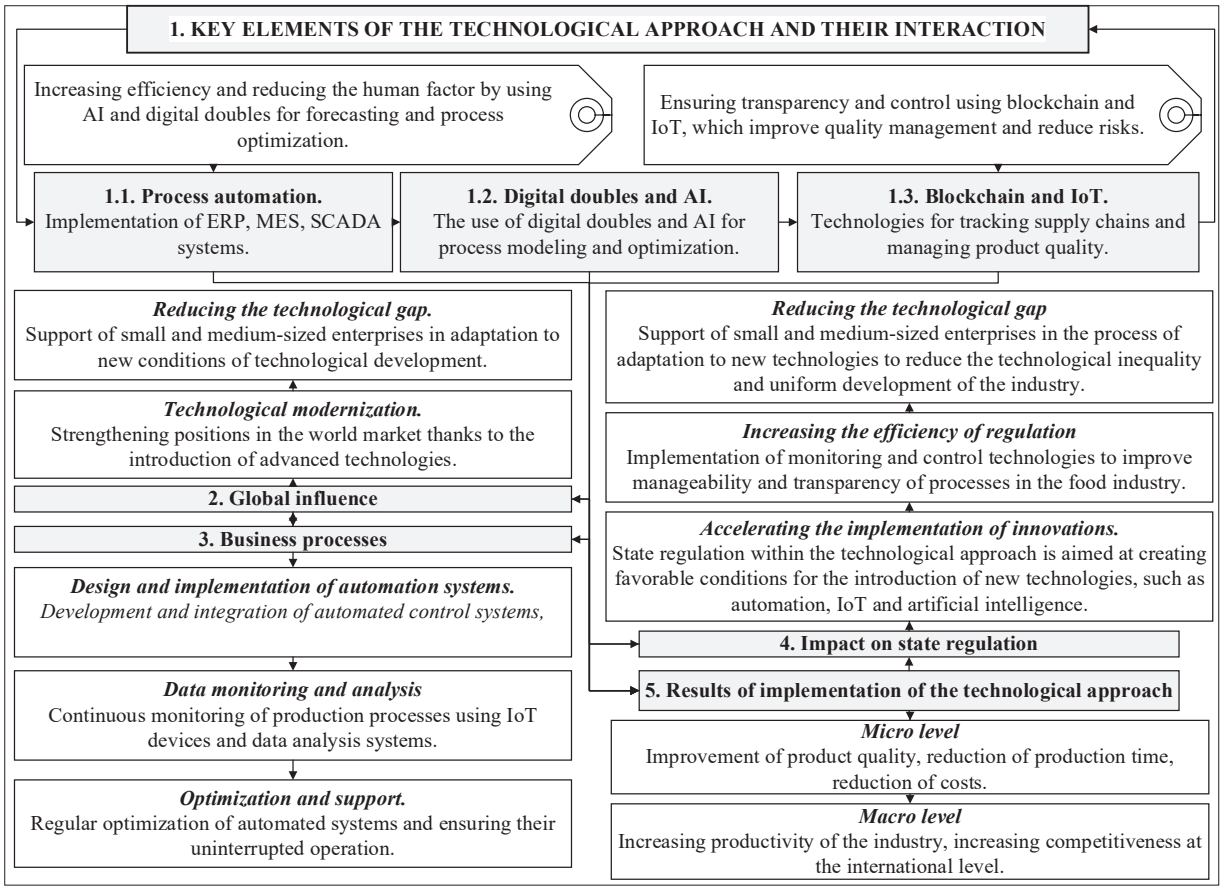

Figure 2 – Key elements of the technological approach and their interaction

Source: developed by the author based on [1; 2]

reduce costs, and enhance product quality; however, it requires significant investments in technology and personnel training, which may slow down innovation if adequate support is not available. On a macro level, the integration of advanced technologies contributes to overall economic growth and enhances a country's competitiveness in international markets. However, without sufficient government support and a systematic approach to digitalization, there is a risk of increasing technological inequality between companies of different sizes. Considering the impact on state regulation, this approach helps accelerate the implementation of innovations by creating favorable conditions for new technologies and upgrading the food industry's technological base. Moreover, the adoption of digital technologies improves the effectiveness of state regulation by ensuring transparency and control over business processes, while supporting small and medium-sized enterprises in adopting new technologies helps bridge the technology gap and promotes balanced development across the entire industry.

Let's consider the peculiarities of the implementation of the "Technological Approach" models in Fig. 3.

According to Fig. 3, the implementation of the technological approach is carried out through two key models: "Process Automation" and "Digital Twins and AI" by automating production processes and introducing digital twins using artificial intelligence (AI). The "Process Automation" model focuses on implementing ERP, MES, and SCADA management systems, along with automated production lines and equipment condition monitoring systems. ERP systems provide centralized management of key business processes and allow the integration of various data sources, ensuring efficiency at all stages of food production. The use of MES and SCADA systems allows real-time control over business processes, focusing primarily on precise, combined execution of production tasks.

Automated production lines and equipment monitoring systems are aimed at minimizing human error within enterprise processes, ensuring

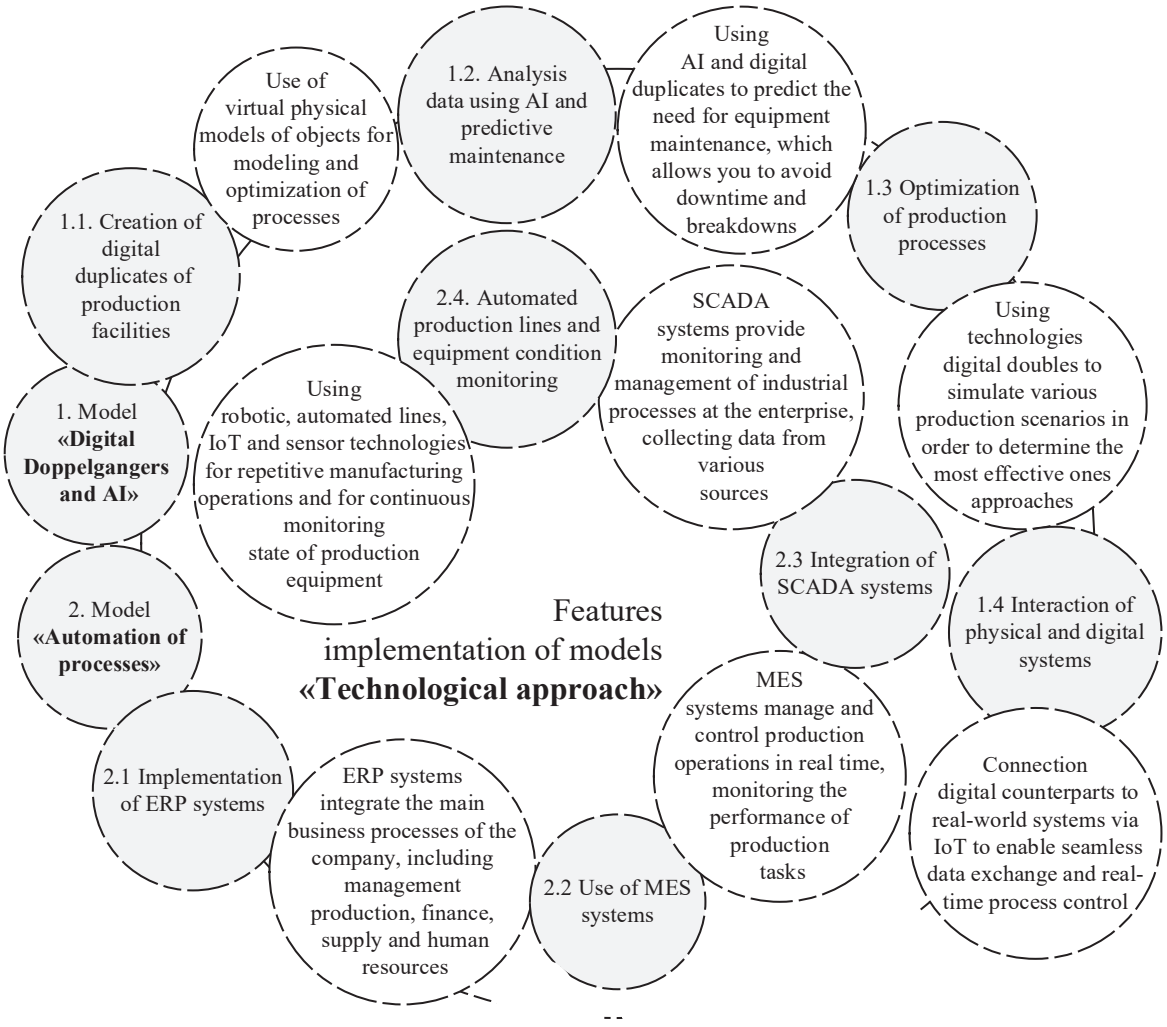

Figure 3 – Features of the implementation of the "Technological approach" models

Source: developed by the author based on [1; 2]

continuous operation. The "Process Automation" model emphasizes the importance of automation and data integration, which enhance enterprise productivity and reduce overall operational costs. However, this model primarily addresses physical production processes, requiring significant capital investments in the early stages of automation. The "Digital Twins and AI" model goes a step further by offering virtualization of production processes through advanced analytical tools. Creating digital twin models of production assets allows for pre-testing a wide range of scenarios before implementing future business processes, thereby reducing potential risks and financial costs in a realistic testing environment. Artificial intelligence further enables the analysis of large data volumes, providing forecasts to optimize production processes effectively and develop schedules for timely equipment maintenance. Therefore, the "Digital Twins and AI" model embodies flexibility and predictability by forecasting system failures or deficiencies in advance, which is especially valuable for long-term enterprise planning. The primary distinction between the two approaches is that the "Process Automation" model focuses on physical production processes, while the "Digital Twins and AI" model emphasizes forecasting and optimization.

However, the effectiveness of each model increases significantly when digital twin tools complement automated systems, while AI enhances the efficiency of ERP, MES, and SCADA systems, allowing enterprises to achieve maximum productivity and risk minimization.

Let's consider the "Technological aspect" of state regulation of food industry enterprises according to the structure of "Digitalization", in Fig. 4.

According to Fig. 4, the "Blockchain Technology" element enables a transparent supply chain tracking mechanism, which greatly enhances product trust and safety during transportation. However, the high cost and complexity of scaling this technology make it inaccessible for many food

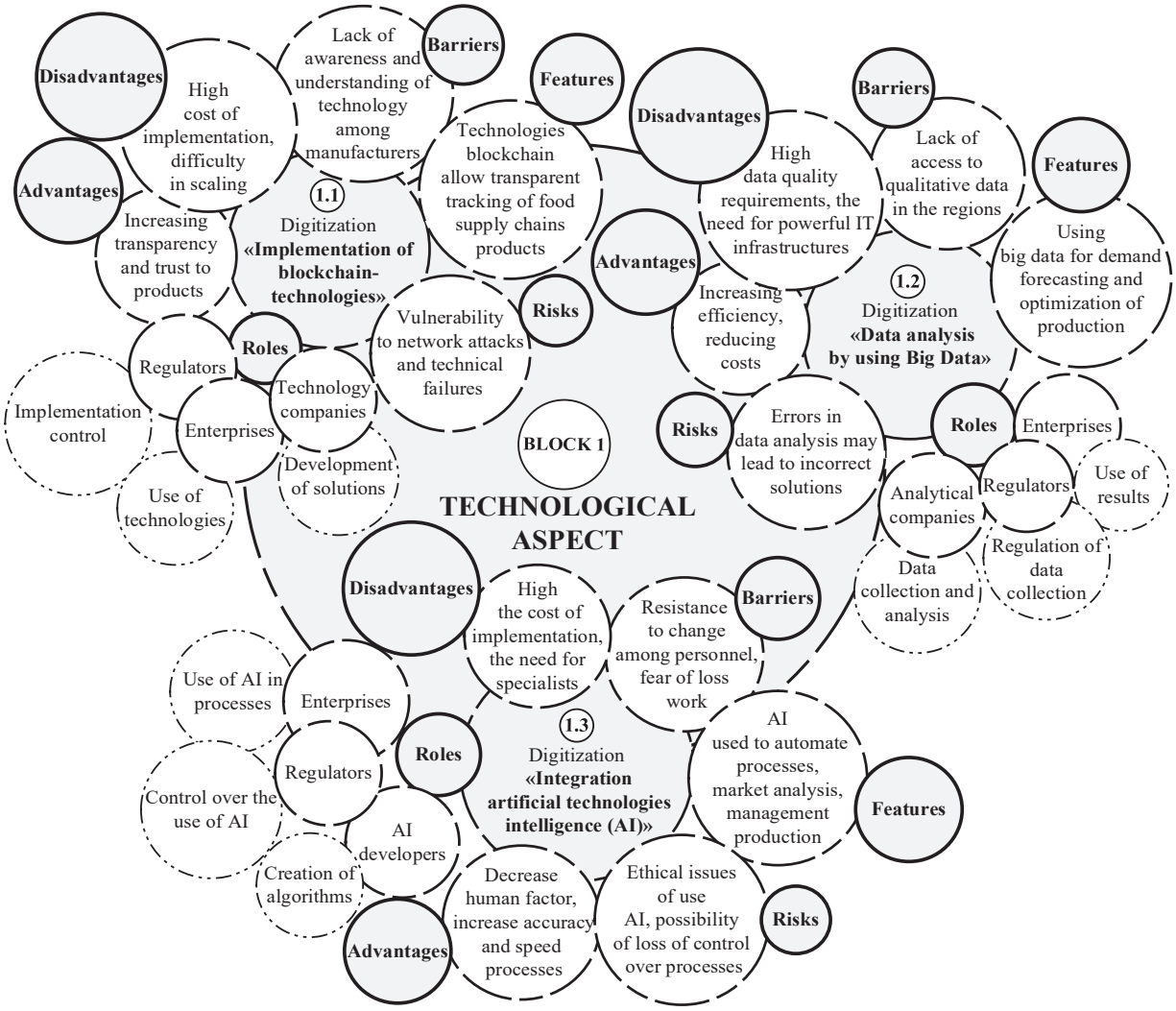

Figure 4 – "Technological aspect" of state regulation of food industry enterprises according to the structure of "Digitalization"

Source: developed by the author based on [1; 2]

industry enterprises. The "Data Analysis Using Big Data" element provides opportunities for both physical and digital production optimization and demand forecasting, but its effectiveness largely depends on the quality of data for analysis and access to modern IT infrastructure, which poses a significant challenge for many regions. The "Artificial Intelligence Integration" element radically transforms management processes, reducing or even eliminating human error, which increases the overall speed and accuracy of decision-making. However, the drawbacks associated with high integration costs, a lack of qualified specialists, and ethical risks related to automation present major barriers to the use of this technology. Thus, successful digitalization requires not only the presence of technological innovations but also systematic preparation of enterprises, investment in infrastructure, and addressing ethical and social issues associated with the implementation of new technologies.

Let's consider the "Technological aspect" of state regulation of food industry enterprises according to the "Innovative technologies" structure in Fig. 5.

As shown in Fig. 5, the "Production Process Automation" element reduces errors, optimizes costs, and increases overall productivity. However, high initial investments and dependence on skilled personnel create significant barriers to the widespread adoption of this technology. The lack of adequate financial support and limited resources complicates the implementation of automated systems, particularly for small and medium-sized enterprises.

Additionally, potential technical failures that could halt food production pose a risk to the stability of ongoing operations. The "Robotics" element is used to enhance the accuracy of operations and reduce labor costs, but the high cost of equipment and the integration of robotic systems into existing production processes require extensive preparation and infrastructure modernization. Among the

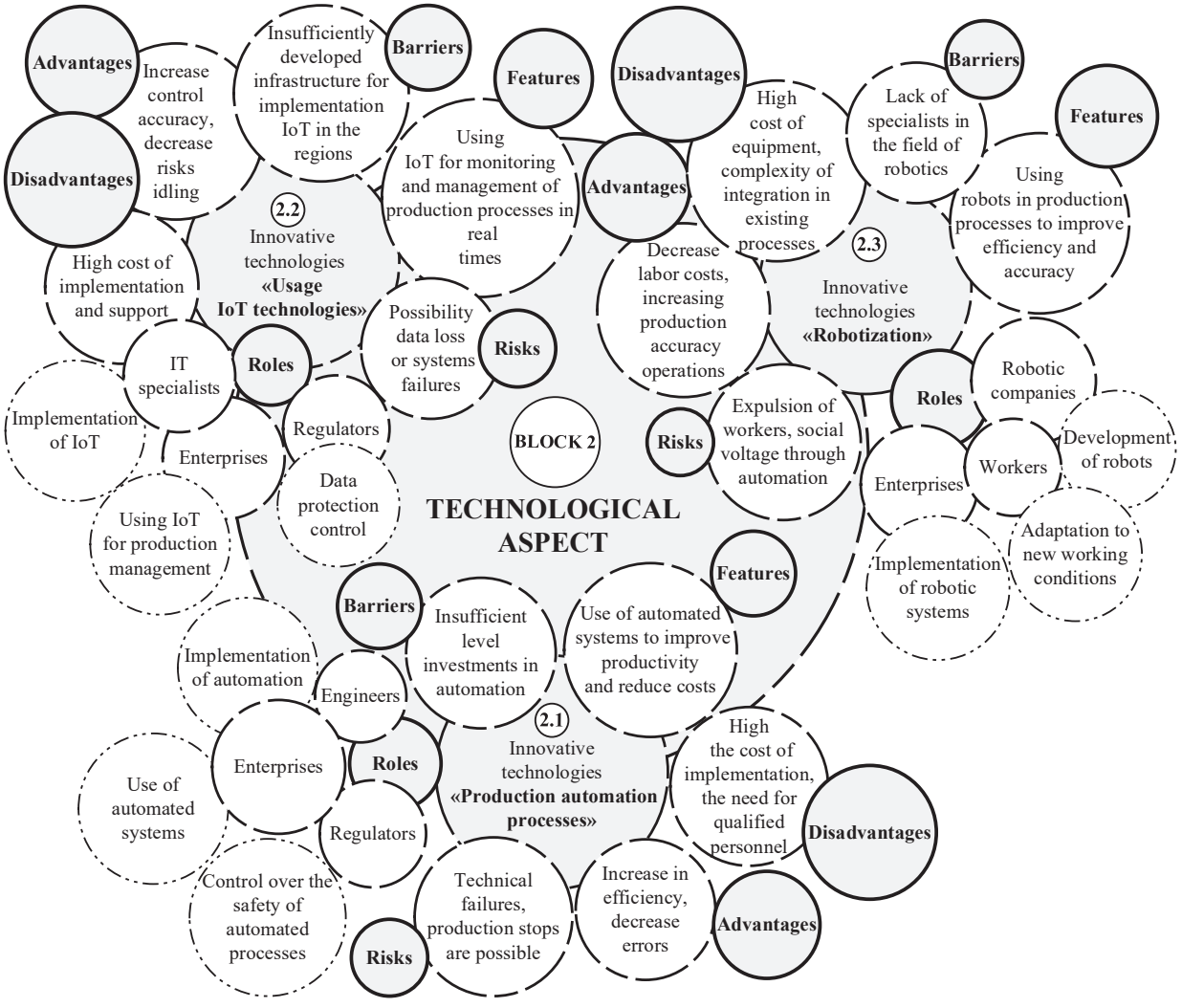

Figure 5 – "Technological aspect" of state regulation of food industry enterprises according to the "Innovative technologies" structure

Source: developed by the author based on [1; 2]

existing risks, the replacement of workers with robotic systems could lead to social tension and strikes, which calls for retraining and workforce adaptation programs to prevent such outcomes. The "Use of the Internet of Things (IoT)" element enables continuous monitoring and real-time management of production processes, reducing downtime risks and increasing overall efficiency in management processes. Key challenges include high implementation costs, the need for significant infrastructure changes, and hacker attacks.

Let's consider the regulatory tools in the category "Blockchain-based supply chain tracking platforms" and "Development of logistics infrastructure" in fig. 6.

According to the data in Fig. 6, regulatory tools for state regulation of food industry enterprises are gaining particular importance in the modern economic environment in the context of the synergy between electronic and rapid commerce. Implementing electronic product solutions and blockchain-based supply chain tracking platforms provides new opportunities for enhancing effective industry regulation and transparency in enterprise business processes. The category "Blockchain-Based Supply Chain Tracking Platform" is a crucial step in the evolution of regulatory tools. The use of blockchain technology creates an immutable and transparent record of each stage in the supply chain, ensuring better quality control. Blockchain's relevance is primarily due to the growing number of intermediaries between the producer and the end consumer. To address this challenge, attention should be given to European Union practices, which regulate product traceability through "Regulation No. 178/2002", highlighting this approach's importance for product safety. The IBM Food Trust platform further ensures full transparency and accountability for each supply chain participant. This, in turn, will help strengthen relationships between

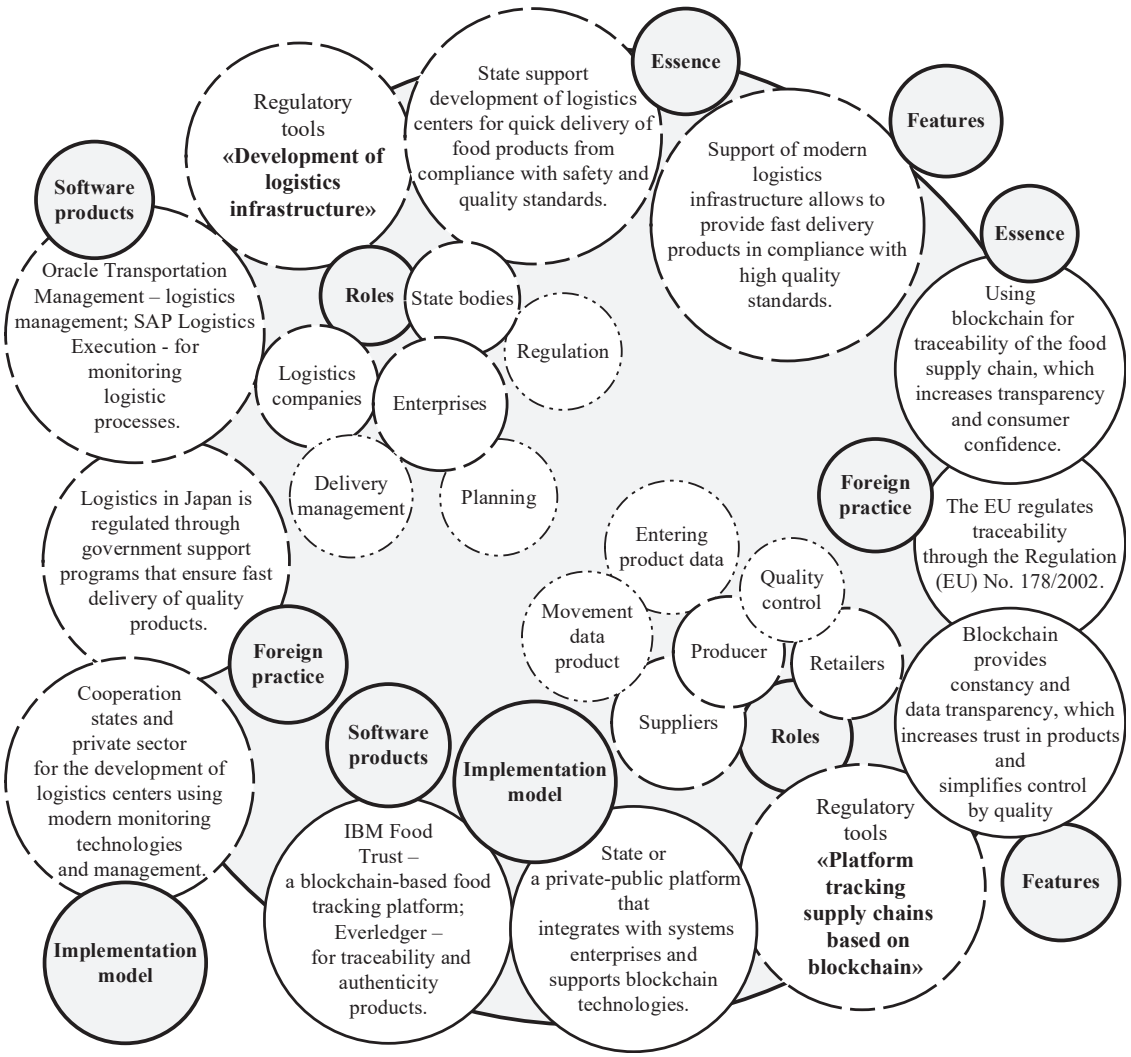

Figure 6 – Regulatory tools by category and "Blockchain-based supply chain tracking platforms"

Source: developed by the author based on [1; 2]

consumers, suppliers, and regulators, fostering a stronger trust system for products.

The "Logistics Infrastructure Development" category primarily focuses on ensuring fast and high-quality food delivery, with a particular emphasis on safety and quality standards. State support plays a critical role in this process, as creating logistics centers and implementing monitoring technologies require significant investments. The Japanese experience of state regulation of logistics highlights clear cooperation between the government and the private sector, promoting the establishment of a high-quality and efficient product delivery system. The additional use of software solutions such as Oracle Transportation Management and SAP Logistics Execution will enable effective management and control of the entire logistics process, from route planning to monitoring product quality during transportation. This approach allows for the integration of modern technologies into logistics processes, minimizing quality loss risks and improving delivery speed. The role of enterprises in this process lies in planning and managing their supply chains, while the state provides regulatory support and infrastructure development assistance.

Let's consider the mechanism of state regulation according to the structural element "Internet of Things (IoT) application technologies for monitoring storage and delivery conditions" in Fig. 7.

According to the data in Fig. 7, the application of Internet of Things (IoT) technology offers new opportunities for monitoring food storage and transportation conditions, especially in fast-paced and complex supply chains. The main elements of IoT technology are sensors responsible for tracking changes in temperature, humidity, and vibration, allowing products to be maintained in proper conditions at every stage of the logistics process. Software platforms like Sensitech and Emerson's Cargo Sensors automate processes integrated with IoT sensors and allow real-time control to detect any storage condition violations, enabling a quick response to these hazards and minimizing the risks of product quality and safety loss. However, despite the considerable potential of IoT technology in the food industry, several serious challenges are associated with the high costs of implementing these technologies, limiting the ability of small and medium-sized enterprises to benefit from them. High costs are linked not only

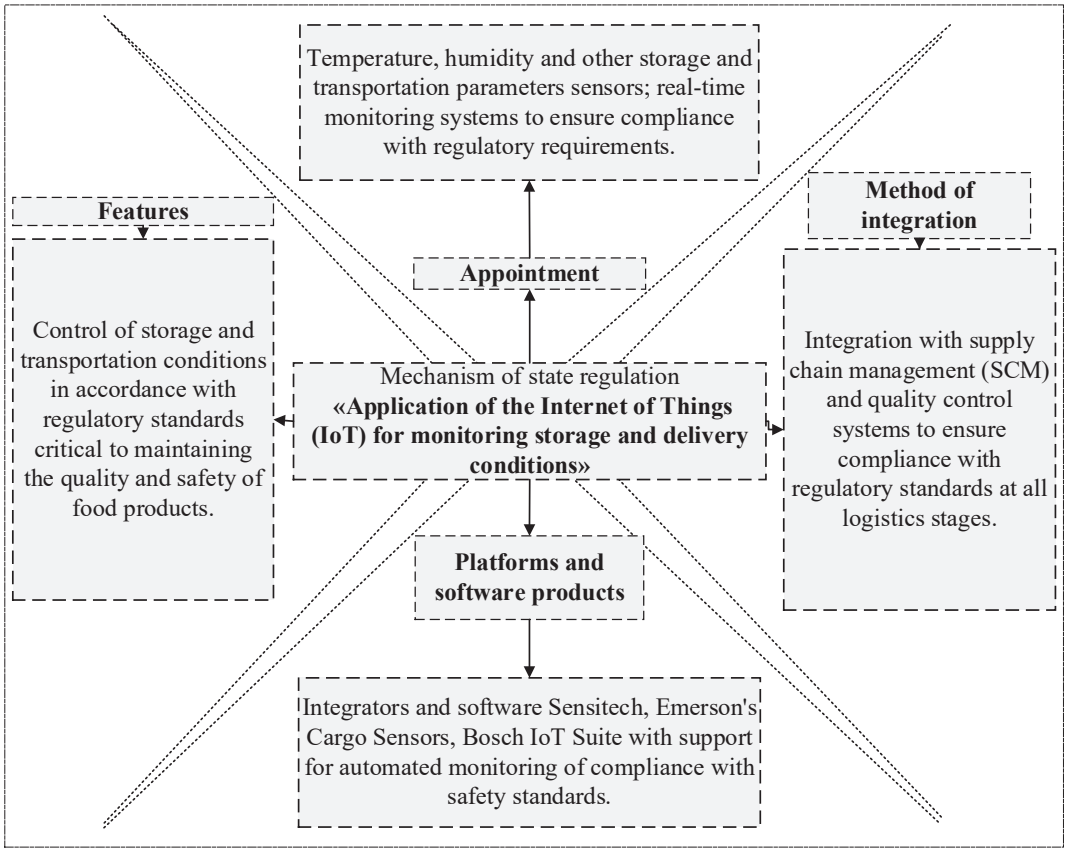

Figure 7 – Mechanism of state regulation by structural element "Internet of Things (IoT) application technologies for monitoring storage and delivery conditions"

Source: developed by the author based on [1; 2]

to equipment acquisition but also to its maintenance, which imposes a substantial financial burden on businesses. Additionally, the complexity of integrating IoT with existing management systems requires a high level of technical expertise and coordination, and without proper integration and support, these technologies could become a source of additional issues.

Among the benefits, however, are the reduction of product losses due to storage and transportation condition violations, improved efficiency in supply chain management processes, and lowered risk levels, which could become crucial factors for ensuring the long-term resilience of businesses amid increasing competition and market globalization.

Let's consider the mechanism of state regulation according to the structural element "E-commerce and logistics integration platforms" in Fig. 8.

According to the data in Fig. 8, the integration of e-commerce platforms with logistics systems has become a key success factor for companies aiming to meet the growing demands of the market. Equally important is the use of modern platforms such as Shopify Plus and Magento Commerce, which allow companies to automate order management and ensure control at each stage of the logistics chain, including delivery tracking and strict adherence to storage and transportation requirements for food products. This approach ensures high operational efficiency and full compliance with industry standards, enhancing service quality and reducing risks.

Regarding compliance with hygiene standards for food products, it is advisable to refer to European Union Regulation 852/2004, which establishes critical requirements for ensuring product safety and quality. To implement this regulation's requirements, automated Warehouse Management Systems (WMS) and Transportation Management Systems (TMS) are commonly used. These systems integrate with e-commerce platforms and allow temperature control during the transportation of perishable products. Another example of integration with national and international regulators is the Food Standards Agency (FSA) in the United Kingdom, which provides companies with the ability to automate compliance monitoring processes and avoid potential violations. Furthermore, such integrated platforms allow food industry businesses to respond more effectively to changes in demand through quick feedback from

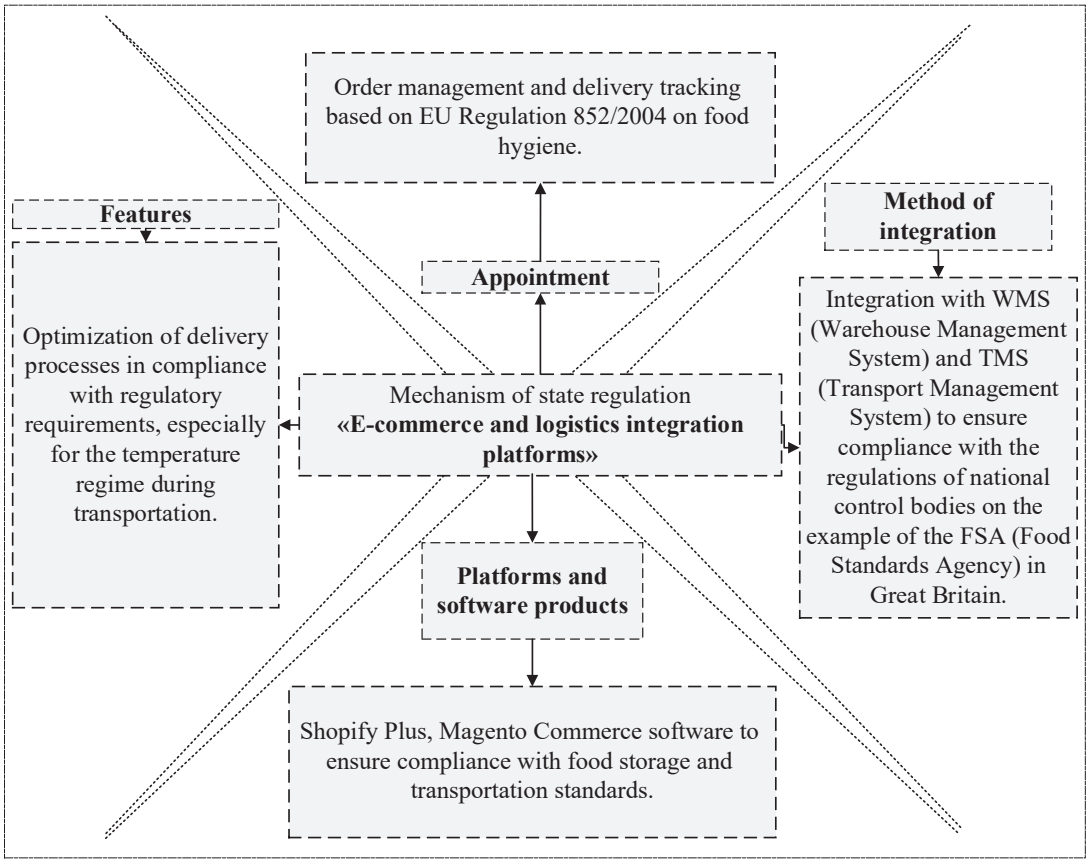

Figure 8 – Mechanism of state regulation by structural element "E-commerce and logistics integration platforms"

Source: developed by the author based on [1; 2]

consumers, fostering flexibility in order management and inventory optimization principles.

Conclusions. In summary, a technological approach is a crucial element in state regulation of the food industry amid digital transformation. Key aspects of implementing technology, automation, IoT, machine learning, and artificial intelligence have been analyzed, highlighting how they enhance business efficiency and competitiveness. At the same time, the need for government support, particularly for small and medium-sized enterprises, has been emphasized to prevent market inequality and create equal opportunities for development. The primary approaches to technological development are identified as production process automation and the use of digital twins with artificial intelligence technologies. The outlined models for implementing the technological approach focus on centralized production management, minimizing the human factor, and forecasting and optimizing production operations. Effective digital transformation of the food industry is noted to require a systemic approach, with investments in infrastructure, workforce development, and establishing a regulatory framework to ensure product transparency and quality.

References:

1. Schumpeter J. (1962). Capitalism, Socialism and Democracy. New York : Harper Perennial, p. 451.
2. Neumann J. (1996). Theory of Self-Reproducing Automata. Illinois : University of Illinois Press, pp. 388.
3. Berher A. D. (2024). Tsyfrova transformatsiia biznesu v kompaniiakh kharchovoi industrii [Digital transformation of business in food industry companies]. *Naukovi pratsi Natsionalnoho universytetu kharchovykh tekhnolohii.* Vol. 1. P. 81–90.
4. Shkrabak I., Nikulchev M. (2020). Naukovo-tekhnolohichna sfera yak obiekt derzhavnoho rehuliuvannia: terminolohichnyi i sutnisnyi analiz [Scientific and technological sphere as an object of state regulation: terminological and substantive analysis]. *Aspekty publichnoho upravlinnia.* Vol. 4. P. 64–74.
5. Kotelevets D. (2022). Suchasni aspekty derzhavnoho rehuliuvannia rozvytku tsyfrovoi ekonomiky v Ukraini [Modern aspects of state regulation of the development of the digital economy in Ukraine]. *Halytskyi ekonomichnyi visnyk.* Vol. 4. P. 13–22.
6. Prots Ya. I., Danyliuk O. A., Lobur T. B. (2008). Avtomatyzatsiia neperervnykh tekhnolohichnykh protsesiv. Navchalnyi posibnyk dlia tekhnichnykh spetsialnostei vyshchykh navchalnykh zakladiv [Automation of continuous technological processes. Textbook for technical specialties of higher educational institutions]. Ternopil: TDTU im. I. Puliuia, 239 p.
7. Shchehlov V. R., Morozova O. I. (2022). Metody ta tekhnolohii rozroblennia tsyfrovykh dviinykiv dlia harantozdatnykh system industrialnoho internetu rechei [Methods and technologies for developing digital twins for warrantable systems of the industrial Internet of Things]. S*ystemy upravlinnia, navihatsii ta zviazku.* Vol. 4 (70). P. 127–137.
8. Vynnychuk R. (2024). Shtuchnyi intelekt v kharchovii promyslovosti [Artificial intelligence in the food industry]. Grail of Science. Vol. 43. P. 335–343.
9. Iushchenko N. L. (2018). Rozvytok blokchein-tekhnolohii v Ukraini ta sviti [Development of blockchain technologies in Ukraine and the world]. *Ekonomika i suspilstvo.* Vol 19. P. 269–275.
10. Shkryhun Yu. O. (2021). Teoretychni pidkhody do vyznachennia poniattia "tsyfrova lohistyka" [Theoretical approaches to defining the concept of "digital logistics"]. *Ekonomichnyi visnyk donbasu.* Vol. 3 (65). P. 137–146.

ФІЛОСОФІЯ РЕІНЖИНІРИНГУ БІЗНЕС-ПРОЦЕСІВ У ХАРЧОВІЙ ГАЛУЗІ: ТЕХНОЛОГІЧНІ АСПЕКТИ ТА МЕХАНІЗМИ ЦИФРОВОЇ ТРАНСФОРМАЦІЇ

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Анотація. У статті представлено дослідження технологічного підходу у державному регулюванні харчової промисловості в умовах цифрової трансформації, яка охоплює ключові аспекти, механізми й інструменти його реалізації. Підкреслено важливість впровадження технологій автоматизації, інтернету речей (IoT), машинного навчання та штучного інтелекту, які значно підвищують ефективність та конкурентоспроможність підприємств. Однак для забезпечення сталого розвитку важливо, щоб державна підтримка, особливо для малих і середніх підприємств, доповнювала

впровадження цифрових технологій, оскільки обмежені ресурси можуть призвести до ринкової нерівності. У статті розглянуто два основні моделі реалізації технологічного підходу серед яких автоматизація виробничих процесів та застосування цифрових двійників і штучного інтелекту. Виділено модель автоматизації, яка спрямована на централізоване управління виробничими процесами через ERP, MES і SCADA-системи, що зменшують вплив людського фактора та дозволяють контролювати якість на всіх етапах. Інша модель впровадження цифрових двійників і штучного інтелекту надає можливість детального моделювання та прогнозування результатів діяльності підприємства, що є важливим для довгострокового управління ризиками. Зазначено, що поєднання обох моделей підвищує продуктивність, гнучкість і стійкість підприємств до змін ринкових умов. Важливе місце у статті займає обговорення державних ініціатив розвитку логістичної інфраструктури, використання блокчейну для відстеження ланцюгів постачання та інтеграції IoT для моніторингу умов зберігання і транспортування продукції. Підкреслено, що державна нормативна база є важливою для забезпечення прозорості виробничих процесів, зниження соціальних ризиків і дотримання вимог безпеки. Обґрунтовано філософські засади реінжинірингу бізнес-процесів у харчовій галузі, з акцентом на системний підхід, стратегічне мислення та врахування галузевих особливостей у виборі механізмів цифрової трансформації. У висновках зроблено акцент на значенні державної підтримки, яка має охоплювати фінансування новітніх технологій, розвиток професійних компетенцій кадрів та створення механізмів для прозорого контролю над бізнес-процесами.

Ключові слова: технологічний підхід, технологічні аспекти, харчова промисловість, державне регулювання, роботизація, блокчейн, IoT, цифрова трансформація, реінжиніринг, бізнес-процеси.

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