

Systemy Logistyczne Wojsk
Zeszyt 60 (2024)
ISSN 1508-5430, s. 181-198
DOI:

Institut Logistyki
Wydział Bezpieczeństwa, Logistyki i Zarządzania
Wojskowa Akademia Techniczna
w Warszawie

Military Logistics Systems
Volume 60 (2024)
ISSN 1508-5430, pp. 181-198
DOI:

Institute of Logistics
Faculty of Security, Logistics and Management
Military University of Technology
in Warsaw

Global or local - glocalization as a challenge for the modern supply chains management

Globalnie czy lokalnie – globalizacja jako wyzwanie dla zarządzania współczesnymi łańcuchami dostaw

Małgorzata Dymyt

malgorzata.dymyt@awl.edu.pl; ORCID: 0000-0002-8238-6917
Logistics Department, General Tadeusz Kościuszko Military University of Land Forces

Marta Bianka Wincewicz-Bosy

marta.wincewicz-bosy@awl.edu.pl; ORCID: 0000-0002-3844-2678
Logistics Department, General Tadeusz Kościuszko Military University of Land Forces

Oskar Skubisz

skar.skubisz@awl.edu.pl; ORCID: 0009-0006-1396-3625
Logistics Department, General Tadeusz Kościuszko Military University of Land Forces

Abstract. This article focuses on issues of designing supply chains in the context of the spatial scope of operation, and dilemmas related to the choice between global and local activities. The research niche of this article is the phenomenon of glocalization. The thesis statement that the authors attempted to confirm in the article is the assumption that the design and management of modern, resilient and adaptive supply chains requires combining a global approach, integrated at the international or global level, with an approach focused on the needs of local markets. The considerations are set in the pharmaceutical industry. The purpose of this paper is twofold. Firstly, identifying the challenges and directions of development of supply chain management and presenting the essence and role of glocalization, and secondly, defining the key factors for configuring supply chains in the pharmaceutical industry, especially in the context of glocalization. A qualitative research approach was used to solve the research problem, referring to the relevant literature in the field of supply chain management and the functioning of the pharmaceutical industry in Poland. The main conclusion concerns the statement that the design and management of modern, resilient and adaptive supply chains requires combining a global approach, integrated at the international or global level, with an approach focused on the needs of local markets. Glocalization in the

pharmaceutical industry emphasizes that success on the global market requires the ability to flexibly and effectively respond to diverse and changing local contexts.

Keywords: supply chain management, glocalisation, pharmaceutical supply chain, globalization, logistics system

Abstrakt. W artykule skupiono się na zagadnieniach projektowania łańcuchów dostaw w kontekście przestrzennego wymiaru działania oraz dylematach związanych z wyborem pomiędzy działaniami globalnymi i lokalnymi. Niszą badawczą niniejszego artykułu jest zjawisko globalizacji. Tezą, którą autorzy starali się potwierdzić w artykule, jest założenie, że projektowanie i zarządzanie nowoczesnymi, odpornymi i adaptacyjnymi łańcuchami dostaw wymaga połączenia podejścia globalnego, zintegrowanego na poziomie międzynarodowym lub globalnym, z podejściem skoncentrowanym na potrzebach rynku lokalne. W szczególności rozważania dotyczą przemysłu farmaceutycznego. Cel tego artykułu jest dwójaki. Po pierwsze, identyfikacja wyzwań i kierunków rozwoju zarządzania łańcuchem dostaw oraz przedstawienie istoty i roli globalizacji, a po drugie, zdefiniowanie kluczowych czynników konfiguracji łańcuchów dostaw w branży farmaceutycznej, szczególnie w kontekście globalizacji. Do rozwiązania problemu badawczego zastosowano jakościowe podejście badawcze, odwołując się do odpowiedniej literatury z zakresu zarządzania łańcuchem dostaw i funkcjonowania przemysłu farmaceutycznego w Polsce. Główny wniosek obejmuje stwierdzenie, że projektowanie i zarządzanie nowoczesnymi, odpornymi i adaptacyjnymi łańcuchami dostaw wymaga połączenia podejścia globalnego, zintegrowanego na poziomie międzynarodowym lub globalnym, z podejściem skoncentrowanym na potrzebach rynków lokalnych. Globalizacja w branży farmaceutycznej podkreśla, że sukces na rynku globalnym wymaga umiejętności elastycznego i skutecznego reagowania na różnicowane i zmieniające się konteksty lokalne.

Słowa kluczowe: zarządzanie łańcuchem dostaw, globalizacja, farmaceutyczny łańcuch dostaw, globalizacja, system logistyczny

Introduction

The dynamics of changes in the environment mean that the management of modern organizations requires openness to change, innovation, and the search for new solutions enabling survival, reconstruction and development. The pace and depth of political, social, technological and environmental changes imply the need to configure supply chains and networks that will be resistant to disruptions as well as adaptive in implementing new ways of operating. In the context of constant change, the concept of “glocalization” has gained importance. Enterprises faced the challenge of redesign supply chains to stay closer to suppliers and customers, thereby increasing resilience and responsiveness around the world.

This article focuses on issues of designing, configuring supply chains in the context of the spatial scope of operation, and dilemmas related to the choice between global and local activities. In particular, the authors focused on the phenomenon of glocalization. The considerations are set in the pharmaceutical industry, which is an interesting example of configuring the supply chain in a global or international dimension and adapting the distribution system to the specific local (national) conditions.

The thesis statement that the authors attempted to confirm in the article is the assumption that the design and management of modern, resilient and adaptive

supply chains requires combining a global approach, integrated at the international or global level, with an approach focused on the needs of local markets.

The following research questions were formulated with regard to the main issues:

What are the challenges facing the management of modern supply chains?

What is the essence and role of the concept of glocalization in configuring supply chains?

How are supply chains configured in the pharmaceutical industry? What are the key factors in configuring supply chains in the pharmaceutical industry, taking into account the case of the Polish market?

Therefore, the purpose of this paper is twofold. Firstly, identifying the challenges and directions of development of supply chain management and presenting the essence and role of glocalization, and secondly, defining the key factors for configuring supply chains in the pharmaceutical industry, especially in the context of glocalization. Moreover, the study examined the scope of use of the glocalization concept in pharmaceutical supply chains, taking into account the case of the Polish market.

The review focuses on two main conceptual aspects - the essence and dimensions of supply chain configuration (global and local) and how a glocalization approach that takes into account the combination of these dimensions can support the adaptability and resilience of supply chains. A qualitative research approach was used to solve the research problem, referring to the relevant literature in the field of supply chain management and the functioning of the pharmaceutical industry in Poland.

The structure of the article corresponds to the scope of the considerations undertaken. The first part describes the research approach and procedure. The structure of the article corresponds to the scope of the considerations undertaken. The first part describes the research approach and procedure. Then, based on a literature review, issues regarding the challenges and development directions of supply chain management were presented. Next, the focus was on the issue of glocalization and the possibility of using this concept in configuring supply chains. The next part contains a case study of configuring the supply chain in the pharmaceutical industry in Poland. The final part of the article contains the results, discussion and conclusions.

Research methodology

In order to verify the research problems, the following research methods were used: analysis and criticism of literature, analysis of documents, case study, synthesis, comparison and generalizations.

The research methodology used by the authors is a qualitative approach, subordinated to the acquisition of secondary data as part of a several-stage review of literature and documents. Based on the formulated research questions, a strategy for searching the literature and databases was developed. The search criteria included

the conceptual scope of key issues, i.e.: supply chain management, supply chain challenges, glocalization, and pharmaceutical supply chain. The selection of literature and documents was based on the analysis of full texts of publications. The research material included domestic and foreign publications, articles in magazines, reports, statistical data and legal acts.

Based on the analysis of literature and documents, the theoretical part of the article was developed regarding specific objectives, such as: identification of challenges and description of the directions of development of supply chain management, characteristics of the essence and role of globalization in configuring supply chains. In the next stage, using the case study method, a characterization of supply chains in the pharmaceutical industry was made on the example of the Polish market.

In our research, we used the case study method. This empirical research method can be exploratory, descriptive, or explanatory in nature and is used to study a contemporary phenomenon because it focuses on the dynamics of a case in its real-life context (Teegavarapu and Summers, 2008). The use of this method allowed for a deeper understanding of the functioning of the supply chain in the pharmaceutical industry, taking into account the specificity of the part of this chain that is configured at the local (national - Polish) level in terms of the distribution system. According to Creswell et al. (2007) a case study is a qualitative approach, in which the researcher examines one constrained system (case) or multiple constrained systems (cases) over a period of time, conducting detailed, in-depth data collection covering multiple sources of information and then prepares a report describing the case and its themes. Next, the data were analyzed and interpreted. The last stage of the research procedure was the synthesis and formulation of conclusions.

Challenges and trends in the development of supply chain management

The concept of supply chain management in general terms means: “the management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole” (Christopher, 2011, p. 13). As van der Vorst points out, supply chain management (SCM) is: “the integrated planning, co-ordination and control of all business processes and activities in the supply chain to deliver superior consumer value at less cost to the supply chain as a whole whilst satisfying requirements of other stakeholders in the supply chain (e.g. government and NGO’s)” (van der Vorst, 2004, p. 6). According to E. Sweeney (2007), SCM refers to the systemic and strategic coordination of traditional business functions and tactics both within individual entities, their functional units and the supply chain, aimed at improving the long-term results of individual companies and the entire supply chain. In a broad sense,

supply chain management refers to the implementation of its essence consisting in the integration of information and resource flows through a series of value added activities (Vidrova, 2020).

Managing complex multi-entity systems operating in an international environment involves many challenges. Decision-making processes related to configuring supply chains require taking into account the specificity of the environment and the situational context of the entire chain and all of its links.

Globalization and integration processes, creating inter-organizational networks in a transnational dimension, are of key importance for the functioning and development of supply chains. Particularly important factors related to the impact of globalization on supply chains include: polarization of markets in terms of their attractiveness combined with a simultaneous increase in the level of consolidation and regionalization of economic activities; competitive pressure in conditions of unstable competitive advantage; progressive concentration of population in cities and the increase in the economic importance of cities, especially metropolitan areas, and the growing number of regulations regarding waste management and environmental protection (Wincewicz-Bosy et al., 2017). It should be emphasized that the generator of logistic needs are the ongoing processes of globalization and regionalization, the emergence and development of which is facilitated by the progress of civilization, including the developing field of electronic economy (e-Business), electronic commerce (e-Commerce), electronic marketing (e-Marketing), electronic logistics (e-Logistics) (Dziurny and Stachowiak, 2022).

It is technological progress and the development of information and communication technologies that have paved the way for changes in supply chain management. As a result, a number of concepts emerged, based on the achievements of the Fourth Industrial Revolution (Industry 4.0), which significantly influenced the development potential of supply chains, including: supply chain 4.0, intelligent supply chain and smart supply chain.

Supply Chain 4.0 (SC4.0) is defined as “a series of interconnected activities concerned with coordination, planning and controlling of products and services between suppliers and consumers” (Büyüközkan and Göçer, 2017, p. 1).

The concept of an intelligent supply chain, focused on meeting customer needs, is based on issues of integration, real-time monitoring of needs, and the use of digital technologies to improve adaptability to reported demand while maintaining the lowest costs (Nowicka and Szymczak, 2020). In contrast, smart supply chains are those that include technologies that support the horizontal integration of the factory with external suppliers to improve the delivery of raw materials and final products in the supply chain (Frank et al., 2019). Thanks to technologies such as the Internet of Things (IoT), cyber-physical systems, Big Data analytics, cloud computing, artificial intelligence (AI) and 3D printing, conventional supply chains are becoming smarter, gaining properties such as intelligence, flexibility and sustainability (Oh and

Jeong, 2019). Perales-Prieto and Martin-Pena (2023) propose the five dimensions of the smart supply chain such as: instrumented (smart technologies, automation, traceability, decision-making efficiency), interconnected (integration, transparency, information symmetry), flexible (rapid response, customized product, resilience), servitized (innovation, product-service system, customer solution), and sustainable (waste reduction, cost reduction, resource consumption).

The potential of technology makes supply chains not only more digital, but also able to achieve various goals, creating value for both final consumers and all stakeholders. In this context, supply chain management is focused on achieving not only economic and market goals, but also social and environmental goals. As a consequence, the concept of a sustainable supply chain is developing. As Robinson (2023) emphasises, a key issue to resolve is the relationship between globalisation and sustainable development.

Environmental issues are emphasized within the idea of a green supply chain. The development of the concept of green supply chain management (GSCM) results from the growing need to include environmentally sound choices in research and practice in the field of supply chain management (Kazancoglu et al., 2018) and is based on the incorporation of an ecological approach - greenness in product design, selection and purchase of raw materials, production, distribution of final products and after-sales services (Plaza-Úbeda et al., 2021).

Both technological progress and social and environmental issues are the main driving forces behind the development of supply chain management. However, it should be emphasized that modern organizations operate in a “VUCA world” based on such features as: volatility, uncertainty, complexity, and ambiguity (Bennett and Lemoine, 2014). The Covid-19 pandemic, armed conflicts and climate disasters have significantly prompted companies to redefine their supply chain strategies. The reopening of the global economy, since the onset of COVID, has been hampered by massive and unprecedented supply chain disruptions that have resulted in significant increases in costs as well as an increase in the time required to move goods within and across borders (Alessandria et al., 2023).

The Covid-19 pandemic has caused disruptions in the operation of supply chains, as well as influenced the policies of companies in networks of interconnected relationships, in particular by: introducing changes in supply strategies from global to local, taking into account changes in power dynamics in supply chains, the need to build resilience and changes in inventory strategies (Raj et al., 2022). As a consequence, there is a change in the perspective on the driving forces of changes in supply chain management. The key trends transforming supply chains in 2020 and beyond include: the impact of COVID-19 and the ongoing recovery, digitization of the supply chain, the evolution of Lean Management and Just-In-Time (JIT) inventory management, risk management and building supply chain resilience, and human side of the digital supply chain (Grainger, 2021).

To sum up, it should be emphasized that managing modern supply chains is a complex decision-making process that requires constant capture of opportunities from the environment, identification of threats and constant adaptation to changes.

Glocalisation as a concept of modern supply chain management

Managing global supply chains requires consideration complexity of connections in a multi-entity, multi-national network of entities and stakeholders. Globalization has forced the need to use logistics strategies adapted to complex networks of entities covering many countries and having diversified control (Stank et al., 2014). The need to take into account the local context of operation of individual supply chain entities, as well as the specific needs of local customers, necessitates changes in designing strategies and configuring supply chains.

The Covid-19 pandemic has revealed the fragility of long supply chains and, consequently, intensified the growing trend towards localization (regionalization, local globalization) and production closer to consumption, configuring short, flexible and risk-free supply systems (Ren et al., 2021). The pandemic has revealed that global, long supply chains are extremely susceptible to disruptions on the supply side caused by lack of access to resources (raw materials, human resources) and on the demand side (quantitative and qualitative changes in consumption).

Due to the scale of disruptions caused by the pandemic, the fundamental goal of supply chains has become to ensure continuity of supplies, and therefore to adopt strategies that assume availability of key resources and possession of critical stocks. In this context, it becomes necessary to balance the „just in time” approach with the „just in case” approach, in order to ensure the possibility of redirecting components and dynamic flexibility of production in different locations to maintain production in the event of unforeseen disruptions (Bukowska-Piestryńska et al., 2022).

In this context, the location of individual links in the supply chain becomes important. Two trends can be distinguished in designing modern supply chain strategies (Maryniak and Kliber, 2023):

on the one hand, it is emphasized that companies should reduce their geographical footprint and make their supply chains less globalized, as shorter or local supply chains enable better inventory control and bring suppliers closer to buyers;

on the other hand, it is indicated that the nationalization or regionalization of supply chains may increase the risk of disruptions, which may limit the ability of companies to optimize supplier diversification and minimize risks.

As a consequence, there is an increasing tendency to shorten supply chains. Moreover, it is seen as a way to increase security and ensure continuity of supplies, especially in industries (e.g. food production, pharmaceutical industry) of strategic importance. The efficient functioning of global supply chains has become a challenge

not only for enterprises but also for countries and international institutions. The European Parliament, in its resolution of November 2020 on a New Industrial Strategy for Europe, called for action to “strengthen, shorten, make more sustainable and diversify the supply chains of European industries in order to reduce over-reliance on a few markets and increase their resilience, whereas there should also be a strategy for smart reshoring in order to redeploy industries in Europe as well as to increase production and investment and relocate industrial production in sectors of strategic importance for the Union” (European Parliament, 2020).

One of the basic activities ensuring supply chain resilience is shortening supply chains. The concept of a short supply chain is defined based on various criteria (number of intermediaries, physical distance, social relations, knowledge exchange, locality and involvement of authorities) and applies to many participants who can benefit from shortening the route of product flow to the consumer (Jarzębowski, 2018). A short supply chain involves a limited number of economic actors engaged in cooperation, bringing local economic development and characterized by close geographical and social links between producers, providers and consumers (Suchoń, 2015).

Spatial proximity means the local nature of the relationships between the links in the supply chain. As E. Staniewska (2023) emphasizes, creating relationships with partners in the supply chain and building a network of connections between enterprises based on mutual understanding of the determinants of inter-organizational relationships is the basis for effective competition on the market and developing the potential to reduce uncertainty and risk. A specific feature of local supply chains are intra-organizational (rather than inter-) business processes and interactions occurring within the same legal system, often strong, direct connections between employees and departments that go beyond a simple transactional perspective, which reduces many of the social costs associated with global supply chains (Gruner et al., 2013).

The challenge therefore becomes to seek a balance between the global and local dimensions of action. These issues are related to the concept of glocalization. The key idea of glocalization is to support social diversity, aimed at highlighting the socio-cultural differences of individual regional, national and international/global markets and adapting products and services to local, regional and national requirements (Pártlová and Váchal, 2019). Glocalization means combining global and local perspectives on the socio-economic and political impacts of phenomena affecting local and global communities, while maintaining the meaningful contributions of different communities and cultural contexts, strengthening harmonious work towards a sustainable future (Patel and Lynch, 2013).

The main features of glocalization include: using global experience or a global brand and diversifying the offer for local markets, operating on the global market and in local market niches, integration of globalism and localism, integration of quality and value in a product that is sold in large quantities, high reputation brand,

and the global nature of the product, the competitiveness of which results from taking into account local needs and preferences, with lower costs resulting from the company's global advantage (Grigorescu and Zaif, 2017).

The concept of glocalization, referred to as „decentralized” globalization, takes into account the growing importance of local communities and local conditions of operation of economic entities implementing their global strategies (Słodowa-Hełpa M., 2017). This idea indicates the simultaneity of the processes of dissemination and differentiation in contemporary social, political and economic systems, tendencies leading, on the one hand, to homogeneity and centralization, and on the other hand to heterogeneity and decentralization (Biernacka-Ligięza, 2013). Taking into account the two basic features of glocalization, i.e. accessibility and proximity, two equally important contexts of contemporary glocalization can be distinguished (Torres, 2004):

- global context of locality – global level in the local;
- local context of globalization – local level in the global one.

The implementation of the glocalization concept involves actions in the socio-economic dimension and takes into account the following aspects: elements of the global economy becoming embedded in local economic and social structures, functioning of local economies in the conditions of globalization, local economies and economic entities entering the network of global connections, transformation of local communities and value systems under the influence of globalization, making local products, symbols and cultural, ethical and moral values global (Kuciński, 2015). As Yaqoub et al. (2023) argue, the combination of global and local preferences has led to the creation of new market segments and the tailoring of products and services to local tastes and cultures.

In order to achieve benefits and build value for consumers based on the idea of glocalization, supply chains are forced to redefine strategies, reconfigure the structure of flows and design processes at the global and local levels.

The pharmaceutical supply chain - a case study of the pharmaceutical distribution system in Poland

The global supply chain in the pharmaceutical industry is complex and multistage. It encompasses a variety of entities, from active pharmaceutical ingredient (API) manufacturers, through drug manufacturers and wholesalers, to pharmacies and ultimately patients. Within the structure of the global pharmaceutical industry, five primary subsectors can be distinguished, each differing in the scope of activity and the nature of operations. Leading this classification are large international corporations with a research and development (R&D) focus, which form the economic foundation of the entire industry. Their activities are directed towards intensive

research and development of new drugs, which is crucial for progress in the field of medicine and pharmacy. These entities are characterized by extensive and complex supply chains that span globally, reflecting their international reach and the need to adapt to diverse regulatory requirements across different jurisdictions (Sousa et al. 2011).

The second category consists of generic drug manufacturers operating on the international stage. Their main task is to introduce cheaper equivalents of branded drugs after patent expiration, which constitutes an important element of the strategy to reduce healthcare costs worldwide (Simoens, 2007). The third subsector comprises local pharmaceutical companies that focus their activities on the domestic market. They can produce both generics, dietary supplements, and distribute products developed by other companies, adapting their strategies to the needs and specifics of the local market (Kaplan & Laing, 2005). The fourth group is made up of contract manufacturers who do not have their own medicinal products but specialize in offering manufacturing services to other pharmaceutical companies (Pharma IQ, 2024). The final category is represented by biotechnological companies, focused on R&D, discovering new drugs, conducting clinical trials, and securing the supply of raw materials.

In a global context, the diversity of subsectors within the pharmaceutical industry and the variety of regulations across different legal systems further complicate the task of effectively managing the supply chain. A key element for companies operating in this market is the ability to adapt and respond flexibly to changing conditions and to utilize advanced technological tools to optimize operations. The pharmaceutical market is subject to strict regulation due to the necessity of ensuring the safety, efficacy, and quality of pharmaceutical products available to patients.

The flow diagram of drugs in the pharmaceutical industry is a complex process that can be outlined in several key stages. The process begins with the synthesis of Active Pharmaceutical Ingredients (API), which are the basis of the drugs' action. The production of APIs often takes place in specialized chemical plants, which can be located in various parts of the world. API suppliers deliver key ingredients to drug manufacturers. Currently, India and China are becoming unrivalled in API production, jointly shaping the global landscape of the API market (Chandana, 2024). Subsequently, drug manufacturers process the active substances into finished drug forms, such as tablets, capsules, liquids, etc. The finished medicinal products are then subjected to certification processes by the relevant regulatory authorities: After approval, drugs are passed on to the distribution network, which includes pharmaceutical wholesalers and distributors responsible for distributing the drugs to pharmacies, hospitals, and other healthcare facilities.

Comparing the global and local supply chains in the pharmaceutical industry reveals both similarities and differences arising from the operational scope, logistical complexity, and legal regulations (Table 1). Both perspectives are crucial for

ensuring that drugs are delivered safely and effectively to the end recipients, yet they differ in terms of scale of operation, challenges, and management strategies.

Table 1. Comparison of global and local pharmaceutical supply chain

Criterion	Global Supply Chain	Local Supply Chain
Regulatory Compliance	Must navigate a complex array of international regulations, including diverse pharmaceutical standards and customs.	Primarily adheres to national regulatory standards, with a more streamlined process for compliance.
Scale of Operations	Large-scale operations with significant investments in infrastructure and logistics to manage international flows.	Smaller scale operations focused within a single country, often requiring less investment in logistics.
Supply Chain Partners	Involves a wide array of international partners, including suppliers, manufacturers, and distributors across different continents.	Typically involves local or national partners, making the network simpler and more localized.
Market Diversity	Faces diverse market demands and consumer preferences across different countries, requiring tailored strategies.	Deals with a more homogeneous market with specific local demands and consumer preferences.
Logistical Complexity	High logistical complexity due to cross-border transactions, varying transportation modes, and customs clearance.	Lower logistical complexity, with simpler distribution networks and fewer transportation hurdles.
Cost Structures	Incurs higher transportation and compliance costs, affected by international tariffs and exchange rate fluctuations.	Lower transportation costs and simpler compliance requirements, with minimal impact from tariffs and exchange rates.
Risk Management	Greater exposure to international risks, including political instability, supply chain disruptions, and regulatory changes.	Risks are more contained and predictable, primarily limited to local or national factors.
Technology and Innovation	Relies heavily on advanced technology and innovation in logistics and supply chain management to enhance efficiency and traceability.	May use less advanced technology, with a focus on meeting local needs and regulatory compliance.
Environmental Impact	Potentially larger environmental footprint due to longer transportation distances and international logistics operations.	Smaller environmental impact with shorter distribution channels and a focus on local sourcing when possible.

Source: Own study.

Table 1 highlights the main differences between global and local supply chains in the pharmaceutical industry, emphasizing the specific characteristics and challenges associated with each scale of operation. While production stages and the need for regulatory approval are common to both types of supply chains, differences begin

to emerge in the context of distribution and reaching the end customers, where factors such as logistical complexity, customs regulations, and the scale of operations play key roles.

In Poland, the key areas of activity for pharmaceutical companies are generic drugs, biological products, and over-the-counter medicines. Poland is the largest pharmaceutical market in the Central and Eastern Europe region, ranking fifth in the pharmaceutical market rankings across Europe. Among the leading players in the Polish market are both global pharmaceutical conglomerates and renowned Polish enterprises specializing in the production of biological and generic drugs. Poland is also home to 17 leading companies from the biopharmaceutical sector, indicating the dynamic development of this segment. Domestic pharmaceutical companies are significant manufacturers, with a wide product portfolio exported to over 60 countries, highlighting their international significance and competitiveness in the global pharmaceutical market (Pharmchoices, 2024). In 2024, the total number of pharmaceutical companies operating in Poland includes 84 entities (Lubelska Izba Aptekarska, 2024).

The presence of 84 pharmaceutical companies operating in Poland reflects a high level of diversification and competition in the pharmaceutical market, which has significant implications for supply chain management. Among these consequences is the complexity of management, arising from the diversity of requirements of individual companies. Increased competition encourages the search for operational efficiency, which often results in collaboration between different supply chain participants, for example, in logistics or distribution. In Poland, although many drugs are produced locally, the active pharmaceutical ingredients (APIs) for their manufacture often come from facilities located in Asia (IQVIA, 2023). This trend underscores the global division of labour in the pharmaceutical industry, where Asia stands out as a key production region due to its cost-effectiveness and operational scale. The configuration of global supply chains has significant implications for the pharmaceutical industry, especially in terms of dependence on a limited number of international suppliers of active substances.

In domestic production, the majority of active substances are synthesized in a relatively small number of factories, among which two facilities play a particularly significant role. Local capacity were identified for 19 of the 52 prioritized active substances (IQVIA, 2023).

The diversity of supply sources helps to secure the continuity of drug supplies, minimizing the risk of disruptions caused by global or local crises. As a result, the dynamic and competitive pharmaceutical market in Poland influences the shaping of the supply chain in the industry, presenting both challenges and opportunities for development and innovation.

Discussion

The modern pharmaceutical industry faces the challenge of harmoniously combining global ambitions with local realities, placing glocalization at the center of corporate strategic considerations. Glocalization in the pharmaceutical industry emphasizes that success on the global market requires not only scale and reach but also the ability to flexibly and effectively respond to diverse and changing local contexts. The trend of relocating drug production to the countries of origin of the companies points to the necessity of adapting glocalization strategies in the pharmaceutical industry. Striving for greater self-sufficiency, resilience to crises, and support for local economies becomes key in the context of the global challenges brought about by a dynamically changing world. Table 2 presents a synthetic summary of the main features of glocalization in the pharmaceutical industry.

Table 2. Main Features of Glocalization in the Pharmaceutical Industry

Feature of Glocalization	Description in the Context of the Pharmaceutical Industry
Research and technologies	Research on new substances/reference medicines is conducted at a global level, which ensures local access to the latest global technologies.
Raw materials and active pharmaceutical ingredients (APIs)	Global sourcing allows to replace one supplier with another in the case of regional disruptions, giving virtually unlimited access to desired substances delivered to a specific local market.
Universal standard of safety and quality	The global safety standard generally guarantees minimum quality requirements, while at the local level requirements can increase the level of safety.
Production Localization	Relocating or expanding the production of drugs and active pharmaceutical ingredients (APIs) in the countries of origin of pharmaceutical companies to increase control over quality, shorten supply chains, and enhance supply security.
National Self-Sufficiency	Enhancing the capability of countries to independently satisfy their pharmaceutical needs, which minimizes dependency on imports and increases drug safety in the face of global disruptions.
Adaptation to Local Conditions	Ensuring global medicine universality and manufacturing drugs taking into account the specific health needs, preferences, and regulatory requirements of a given country, which enhances therapeutic efficacy and the availability of medicinal products on the local market.
Support for the Local Economy	Investing in local pharmaceutical production supports the economic development of countries by creating jobs, developing local expertise, and building research and development infrastructure.
Resilience to Crises	Local production increases the ability of countries to quickly respond to health crises and ensure the continuity of drug supplies, reducing the risk of interruptions caused by global disruptions in supply chains.

Source: Own study

The role of glocalization in the context of effective supply chain management in the pharmaceutical industry becomes particularly important in the face of dynamically changing global market challenges. Glocalization, which combines global reach with local adaptation, allows pharmaceutical companies to more precisely tailor their products, production processes, and distribution strategies to the specific needs and conditions prevailing in different markets (Walker N., 2019).

Conclusions

The analysis carried out in the article allowed the following conclusions to be drawn:

Effective management of supply chains in the light of glocalization requires companies not only to understand global trends and challenges, but also to have deep knowledge of local legal regulations, consumer preferences and operational conditions. Such knowledge allows for process optimization, risk minimization and operational efficiency maximization. Glocalization also helps build supply chain resilience to disruptions by diversifying production and supply sources.

Supply chains in the biotechnology and pharmaceutical industries have undergone significant changes over the past few decades, becoming more global, complex, and susceptible to disruptions. This complexity leads to situations where pharmaceutical products can travel around the world several times, increasing their vulnerability to various risks. Faced with these challenges, pharmaceutical companies must intensely address supply chain risk and resilience issues.

Natural disasters, international trade tensions, cyberattacks, and pandemics can significantly disrupt their operations, and maintaining high levels of inventory is not always sufficient protection. Managing these challenges requires pharmaceutical companies to have greater visibility of their supply chains, rigorous risk management, and the implementation of new technologies.

Better understanding and control over each stage of the process - from the procurement of raw materials, through production and packaging, to the distribution of final medicinal products to recipients - also requires an understanding of the specifics of risk and building production flexibility that allows for quick relocation in case of disruptions.

Glocalization and effective supply chain management in the pharmaceutical industry thus require a comprehensive approach that combines global strategies with local adaptive actions.

The considerations carried out confirm the adopted thesis that the management of modern supply chains requires taking into account the global and local context in order to deepen adaptability, flexible and effective operation. In the pharmaceutical industry, glocalization enables the well-being of the patient to be ensured. There

is no doubt that the concept of glocalization will be implemented in supply chain management. The issues discussed in the article are an attempt to organize theoretical and practical knowledge and may constitute the basis for further research. Nevertheless, the problem of glocalization requires in-depth research. Taking into account the above conclusions, it can be concluded that further research directions should focus on identifying key conditions for shaping the strategy and structure of a supply chain capable of functioning globally and locally.

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