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DEVELOPMENT OF CONTAINER CARGO TRANSSHIPMENT IN PORTS WORLDWIDE

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РОЗВИТОК ТРАНСШИПМЕНТУ КОНТЕЙНЕРНИХ ВАНТАЖІВ В ПОРТАХ СВІТУ

In the modern context of global economic globalization, container shipping pl*ays a key role in ensuring the efficient movement of goods between countries and continents. According to data from the World Trade Organization (WTO), the volume of global merchandise trade increased by 2.6% in 2024 after declines in previous years. A further increase of 3.3% is expected in 2025. These trends indicate a gradual recovery and stable expansion of international trade. In this context, the increasing volume of shipments requires prompt and efficient cargo handling at strategically located ports, which serve as transit hubs between regional and intercontinental routes. Therefore, the purpose of this article is to highlight the features of the development of container cargo transshipment in ports around the world. As a result of the conducted research, it was established that container transshipment is a key factor determining the efficiency of logistics chains in the global trade system. Its role lies in integrating main shipping routes with regional directions, which contributes to reducing transportation costs and shortening delivery times. The analysis showed that transshipment accounts for a significant share of the total volume of global container shipments, primarily because leading world ports demonstrate dominance of transshipment operations in their activities. It has also been proven that transshipment actively develops logistics models that combine global and regional transportation. It has been demonstrated that the economic efficiency of transshipment is achieved through the transfer of containers without the need for large vessels to call at ports with lower capacity. It has been noted that the high speed of cargo handling at transshipment hubs significantly reduces overall delivery time. Thus, transshipment is a strategic tool for enhancing the competitiveness of ports and logistics networks in global trade. The prospects for further research lie in studying the impact of digitalization, automation, and changes in the global geopolitical landscape on the efficiency and development of transshipment operations in world ports.*

В умовах сучасної глобалізації світової економіки контейнерні перевезення відіграють ключову роль у забезпеченні ефективного руху

товарів між країнами та континентами. Згідно з даними Світової організації торгівлі, обсяг світової торгівлі товарами у 2024 році зріс на 2,6% після спадів у попередні роки. До кінця 2025 року очікується подальше зростання на 3,3 %. Такі тенденції свідчать про поступове відновлення та стабільне розширення міжнародної торгівлі. У зв'язку з цим висхідні обсяги перевезень потребують оперативної та ефективної обробки вантажів у стратегічно розташованих портах, які виконують функції транзитних хабів між регіональними та міжконтинентальними маршрутами. Відтак, метою статті є виділення особливостей розвитку трансшипменту контейнерних вантажів в портах світу. У результаті проведеного дослідження встановлено, що трансшипмент контейнерних вантажів є ключовим чинником, який визначає ефективність роботи логістичних ланцюгів у глобальній системі торгівлі. Його роль полягає в інтеграції магістральних судноплавних маршрутів із регіональними напрямками, що сприяє зниженню витрат на перевезення та скороченню часу доставляння. Аналіз показав, що трансшипмент займає значну частку в загальному обсязі світових контейнерних перевезень переважно тому, що провідні світові порти наразі орієнтуються саме на такі операції. Також доведено, що трансшипмент є тригером, що стимулює розвиток логістичних моделей, які поєднують глобальні та регіональні перевезення. Доведено, що економічна ефективність трансшипменту досягається завдяки перевалці контейнерів без необхідності заходу великих суден у порти з меншою пропускною здатністю. Констатовано, що висока швидкість обробки вантажів у хабах трансшипменту суттєво скорочує загальний час їх доставлення. Таким чином, трансшипмент є стратегічним інструментом підвищення конкурентоспроможності портів та логістичних мереж у світовій торгівлі. Перспективи подальших досліджень полягають у вивченні впливу цифровізації, автоматизації та змін глобальної геополітичної ситуації на ефективність і розвиток операцій трансшипменту у світових портах.

Keywords: *volume of global trade; container cargo; transshipment operations; logistics networks; cargo handling.*

Ключові слова: *обсяг світової торгівлі; контейнерні вантажі; трансшипментні операції; логістичні мережі; обробка вантажів.*

Problem statement. The relevance of this research is driven by the current conditions of globalization in the world economy, within which container shipping plays a key role in ensuring the efficient movement of goods between countries and continents. According to data from the World Trade Organization (WTO), the volume of global merchandise trade increased by 2.6% in 2024 following declines in previous years [5]. A further growth of 3.3% is expected in 2025. These trends indicate a gradual recovery and stable expansion of international trade. In this context, the increasing volume of shipments requires prompt and efficient cargo handling at strategically located ports that serve as transit hubs between regional and intercontinental routes. Such ports become key logistics centers through which a significant portion of global container traffic passes. Their advantageous geographical location—at the crossroads of major maritime trade routes—ensures effective integration of transport flows and the formation of optimal delivery routes.

Specifically, this refers to hub ports that not only accumulate large volumes of containers but also ensure their rapid transfer onto other vessels—mostly without the need to bring the cargo into the country’s customs territory. This allows for adjustments in handling time, reduces logistics costs, and enhances flexibility in planning international shipments.

In this context, the development of transshipment (or the transfer of container cargo) for further transportation takes on special significance in ports around the world. Given this importance, the major global transshipment ports are concentrated at strategically important points along key maritime routes—in Southeast Asia, the Middle East, Europe, and Latin America.

Analysis of research and publications. The main challenges in the development of container cargo transshipment in world ports have been highlighted by P. I. Pidlisna, N. O. Patkevych, Y. V. Tsvietova, V. V. Shcherbina, and A. O. Surilov.

In particular, the article by P. I. Pidlisnyi, N. O. Patkevych, and Y. V. Tsvietov emphasizes the importance of containerization of mixed cargo transportation as a factor in improving the efficiency of global trade. It also reveals the institutional barriers that hinder the development of transshipment logistics.

V. V. Shcherbina analyzes infrastructural and technical issues, specifically the insufficient development of port terminals, low cargo handling speeds, and limited transportation connectivity between main and regional routes.

A. O. Surilova examines the legal and organizational aspects of developing the transshipment institution in Ukraine, particularly the lack of a regulated legislative framework, insufficient incentives to attract investors to port infrastructure, and the need to integrate Ukrainian ports into international logistics networks.

Overall, the challenges of transshipment development encompass infrastructural, technical, regulatory, and organizational-economic aspects that require comprehensive and systematic study at the international level.

***Formulation of the article's objectives*.** Thus, this article aims to emphasize the features of container cargo transshipment development in ports globally.

***The paper main body*.** Within the scope of the study, the authors emphasize that in the modern global trade system, container cargo transshipment in world ports is a key element for the efficient functioning of international logistics chains. It provides [2; 6]:

- The integration of main shipping routes with regional directions.
- Reduction of transportation costs and minimization of delivery time.

The key role of transshipment is confirmed by the following factors [3-4; 7]:

- A high share of transshipment in the total volume of global container shipments and the dominance of this type of operation in several leading ports worldwide.
- Active development of systems connecting main and regional routes;
- Cost optimization in ports through efficient container handling without the need for vessels to call at smaller ports;
- Reduction of delivery time due to the high speed of cargo handling at transshipment hubs.

The proportion of transshipment in global container throughput is currently quite significant. According to Drewry Shipping Consultants, transshipment accounted for approximately 20% of the total volume of container shipments worldwide in 2020 [4], and by 2023, this figure had exceeded 30%. This trend highlights the growing importance of transshipment in the global logistics system, as it provides flexibility, efficiency, and economic viability for international freight transportation.

Furthermore, the high share of transshipment in certain world ports confirms the trend toward the centralization of cargo flows in major logistics hubs [2]. Such hub ports become strategic transshipment points through which the bulk of container traffic passes. In particular, in several leading ports (such as Singapore, Colon, Jebel Ali, etc.)—thanks to their specialization, advantageous location, and developed infrastructure—the share of transshipment reaches 70–85%, as evidenced by the data in Table 1.

According to the presented data, global port hubs engaged in transshipment account for a significant share of the world's container traffic.

Table 1. Development of container cargo transshipment in selected world ports, 2020

World Ports	Share of transshipment	Description of the port's operational specifics and specialization	Operational Features
Port of Singapore (Singapore)	about 80%	It is a hub for container transshipment, which significantly reduces transportation costs because large vessels do not call at smaller ports; instead, cargo is transferred onto smaller vessels for delivery to regional destinations. The hub serves vessels traveling between Asia, Europe, Australia, and North America.	Reception of large vessels (such as ULCS — Ultra Large Container Ships), which are capable of carrying thousands of containers in a single voyage. Operation of ports as hubs engaged in transshipment. Standardized container sizes (most commonly 20' and 40' in length) allow for the transportation of cargo on large container ships without the need for repackaging.
Port of Colon (Panama)	over 70%	It has become a hub that significantly reduces travel time between the oceans. The hub serves vessels traveling between the Pacific and Atlantic Oceans.	
Port of Jebel Ali (UAE)	about 60–70%	It is a hub that provides efficient container transshipment between different routes and reduces overall logistics costs. The hub serves vessels traveling to Africa, India, and South Asia.	
Port of Rotterdam (Netherlands)	about 50–60%	It is a hub that effectively connects maritime transport with inland transportation and provides transshipment of cargo for further delivery to other European ports and inland regions. The hub serves vessels traveling between Europe and other continents.	
Port of Shanghai (China)	about 30%	It is a hub actively engaged in transshipment, although its primary function is handling cargo for the domestic Chinese market. The hub serves vessels passing through Shanghai for further transportation to other Asian and international destinations.	
Port of Hong Kong (Special Administrative Region of China)	about 50%	Thanks to its strategic location and efficient infrastructure, the port is an active transshipment hub, connecting cargo between China, Southeast Asia, and other regions.	
Port of Bosphorus (Turkey)	about 40%	The hub serves as a connecting point through which significant volumes of containers pass for further transportation to Europe or other parts of the world.	

Source: compiled based on [2; 4; 7-8*]*

The integration of mainline and regional routes enables transshipment to leverage economies of scale. In particular, large container vessels serving routes

between major global hubs (e.g., Asia–Europe) do not call at smaller ports due to their insufficient depth or infrastructural limitations. Instead, containers are transshipped at major hubs and delivered by smaller vessels at the regional level (feeder service), which reduces costs and simplifies logistics. For example, large ocean-going container ships operating on the Shanghai–Rotterdam route typically do not call directly at smaller ports in the Mediterranean or the Baltic Sea, such as Gdańsk (Poland) or Koper (Slovenia). Instead, containers are transshipped at major hubs—such as Rotterdam, Antwerp, or Algeciras—and then delivered to regional ports by smaller feeder vessels. This approach avoids the additional costs associated with calling at shallow or infrastructure-limited ports and provides greater flexibility in logistics.

According to UNCTAD estimates, container shipping costs can be reduced by 15–20% when transshipment is used instead of direct calls by large vessels at smaller ports. These savings are achieved through lower fuel consumption, avoidance of high port charges in smaller ports, and optimal vessel loading. For example, at the Port of Singapore, a significant portion of containers destined for ports in Indonesia, the Philippines, or Vietnam are transshipped from ocean-going vessels onto smaller feeder ships. This helps avoid the entry of large vessels into ports with limited depth or lower infrastructural capacity, such as the Port of Surabaya (Indonesia). At the Port of Colón (Panama), containers from Asia destined for the Caribbean region or the coast of South America are often transshipped here for further delivery by smaller vessels to ports in Costa Rica, Colombia, or Haiti.

This saves time and costs associated with large vessels passing through the Panama Canal. The Port of Jebel Ali (UAE) is used as a key transshipment point for containers destined for smaller ports in East Africa (such as Dar es Salaam or Mombasa), where calls by large vessels are technically challenging and economically unfeasible. These examples illustrate the practical benefits of transshipment.

Transshipment hub ports achieve high container handling speeds due to modern infrastructure, automation, around-the-clock operations, and efficient logistical organization. This minimizes vessel and container idle times, thereby accelerating overall delivery times compared to direct calls at several smaller ports.

For example, at the Port of Singapore, the average handling time for a container ship is approximately 18–24 hours, thanks to fully automated cranes, high throughput capacity, and digital management systems. For comparison, in less developed ports of Southeast Asia, the same volume of cargo may take up to 48 hours or more to handle, which delays shipping schedules and increases carriers' costs [6-7]. Another example is the Port of Rotterdam, which boasts one of the most advanced automated container terminals in the world (such as Maasvlakte II). Here, containers are moved without human involvement using autonomous vehicles and cranes, significantly accelerating the processing of transit cargo, especially within transshipment operations.

Thus, the development of container cargo transshipment in world ports is an important part of ensuring the efficiency of international trade.

It should be noted that in recent decades, transshipment volumes have increased due to the influence of key factors such as: the growth in vessel sizes; the development of port hubs; container standardization; investments in port infrastructure; and the concurrent development of regional feeder networks and transit transport nodes.

It should be noted that large vessels are currently capable of carrying over 20,000 TEU (twenty-foot equivalent units) per voyage (see Table 2).

For example, Maersk Triple-E class ships or HMM Algeciras measure over 400 meters in length and more than 60 meters in width, allowing them to transport massive cargo volumes between major global hubs with maximum efficiency.

Table 2. Large vessels currently capable of carrying over 20,000 TEU (twenty-foot equivalent units) per voyage.

Vessel	Operator	Capacity*	Length	Width	Feature
MSC Gülsün	Mediterranean Shipping Company	23 756 TEU	400 m	61.5 m	The first vessel to surpass the 23,000 TEU mark; specially built for Asia-Europe routes.
Ever Ace	Evergreen Marine	23 992 TEU	400 m	61,5 m.	One of the largest container ships in the world by capacity, designed for Asia-Europe routes.
HMM Algeciras	Hyundai Merchant Marine	23 964 TEU	399,9 m	61,0 m	The flagship vessel of the South Korean fleet; ranked among the largest ships in the world.
CMA CGM Jacques Saadé	CMA CGM (Франція)	23 000 TEU	400 m	61 m	The first vessel of this class powered by liquefied natural gas (LNG).

Note
*TEU (Twenty-foot Equivalent Unit) — a unit of measurement for container volume, corresponding to one 20-foot container.

Source: compiled based on [2; 4]

So, ultra-large vessels significantly reduce the transportation cost per container, but they depend heavily on the availability of efficient hub ports and feeder infrastructure, which ensure the further distribution of cargo to smaller ports and final consumers.

The use of standard containers has made transportation more efficient, particularly by enabling the automation of container handling processes across different modes of transport (maritime, rail, and road [6-8]), which promotes the growth of transshipment. Previously, when cargo was transported without standardization, various sizes of boxes, bags, and pallets were used, requiring manual inspection, sorting, and handling.

According to the World Bank Logistics Performance Index, the use of standardized containers has reduced cargo dwell time in ports by 20–30% compared to non-standardized cargo. It is important to note that standardized containers have uniform dimensions, fittings, and construction, which allow for the

automation of the transfer process from one mode of transport to another. This means that [4; 8]:

- Less time is spent in ports or logistics centers.
- The transshipment process becomes continuous and efficient.

A single standardized container can make more trips per year than a non-standardized one. According to the UNCTAD Review of Maritime Transport, the average number of turns of a standard container increased from 6–7 turns per year in the 1990s to 10–12 turns per year in the 2020s, largely due to automation and transshipment.

To support the growing volumes of transshipment, global ports are actively modernizing their infrastructure, upgrading cargo terminals, installing new cranes, and automating handling processes. The main areas of port infrastructure modernization include [1]: expansion and renovation of cargo terminals; installation of modern lifting cranes; automation and digitization of processes; investments in environmental infrastructure.

A more detailed overview of the main directions and specifics of port infrastructure modernization is presented in Table 3.

These investments significantly reduce cargo handling time (thanks to automation, cargo can be transferred in minutes instead of hours as before), lower costs for carriers and logistics companies (less downtime means savings on fuel, penalties, storage, etc. [2]), increase the port’s throughput capacity (allowing it to serve more ships within the same timeframe [1; 4-5]), and enhance the port’s attractiveness as a transshipment hub (shipping companies prefer ports with the fastest and most reliable service [1]).

To support the increasing volumes of transshipment in the global logistics system, the development of regional feeder networks and transit transport hubs near major world ports is of great importance. These infrastructure elements provide the crucial "last mile" delivery of containers from large port hubs to less accessible regions and inland markets.

Table 3. Key directions and specifics of port infrastructure modernization

Directions of modernization	Modernization Specifics	Example of modernization
Expansion and renovation of cargo terminals	Construction of additional berths and container yards. Deepening of port water areas to accommodate larger vessels. Expansion of container storage areas.	The Port of Hamburg (Germany) has implemented a large-scale expansion program to accommodate vessels with a capacity of over 20,000 TEU.
Installation of modern cargo-handling cranes	Use of crawler and rail-mounted STS cranes for rapid container unloading from ships to the shore. Implementation of automated RTG cranes in container yards.	Example of modernization: The Port of Tanjung Pelepas in Malaysia installed fully automated cranes, which increased container handling productivity by 30%.
Automation and digitalization of processes	Use of terminal management systems that optimize container placement and movement. Implementation of artificial intelligence and data analytics technologies for forecasting terminal workload and planning transshipment operations. Automated gates for contactless registration of container entry and exit.	The Port of Antwerp (Belgium) uses the NAVIS TOS system, which coordinates the movement of thousands of containers daily, optimizing handling and storage times.
Investments in environmental infrastructure	Electrification of port machinery and the transition to zero-emission cranes. Installation of water collection and recycling systems, air purification, and other environmental technologies. This enables ports to comply with international environmental standards and attract more partners.	The Port of Rotterdam (Netherlands) is actively implementing eco-technologies, including electric cranes and shore power systems for vessels to reduce emissions while docked.

Note
*These cranes can operate 24/7 without breaks, with precision and speed unattainable by manual labor.

Source: compiled based on [1-2; 4-5]

Feeder networks consist of small and medium-sized container ships that transport cargo from a main port hub to smaller regional ports. Their primary functions are to provide suppliers with access to a wide coverage of coastal regions and to economically serve smaller ports that cannot accommodate ULCV-class (Ultra Large Container Vessel) ships. For example, in Europe, feeder vessels operate from Rotterdam or Antwerp to deliver containers to ports in the Baltic and North Seas, including Gdańsk, Helsinki, and Oslo. In Asia, the Port of Singapore is connected to dozens of ports in Indonesia, Malaysia, Thailand, and Vietnam.

Transit transport hubs are intermodal logistics centers that connect maritime transport with other modes of transportation such as rail, road, or inland waterways. Their primary functions include redirecting cargo deeper into the hinterland, providing supply chain flexibility, and creating “dry ports. For example, Zeebrugge and Antwerp (Belgium) have well-developed rail and barge connections nearby with Germany, France, and Switzerland. The Port of Tanjung Pelepas (Malaysia) is actively integrated with the inland logistics centers of Western Malaysia through a network of highways and railways. Jebel Ali (UAE) is connected to a network of industrial zones and a customs corridor to Dubai Airport. These elements are an essential foundation for the efficient functioning of transshipment in the global container shipping system.

Conclusions. As a result of the conducted study, it has been established that container cargo transshipment is a key factor in improving the efficiency of international logistics chains within the global trade system. Its role lies in integrating main shipping routes with regional directions, which contributes to reducing transportation costs and shortening delivery times. The analysis showed that:

- transshipment accounts for a significant share of the total volume of global container shipments, primarily because leading world ports demonstrate dominance of transshipment operations in their activities;
- logistic models combining global and regional transportation are actively developing;
- economic efficiency is achieved by transferring containers without the need for large vessels to enter ports with lower handling capacity;
- high cargo handling speed at transshipment hubs significantly reduces overall delivery time.

Thus, transshipment is a strategic tool for enhancing the competitiveness of ports and logistics networks in global trade.

Future research prospects lie in studying the impact of digitalization, automation, and changes in the global geopolitical landscape on the efficiency and development of transshipment operations in world ports.

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