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Determinants of the duration of maritime cargo transport through the Red Sea in 2023–2024

Uwarunkowania czasu realizacji transportu morskiego ładunków przez Morze Czerwone w latach 2023–2024

Abstract. The aim of the study was to identify factors influencing the duration of maritime cargo transport through the Red Sea in the years 2023–2024. The research was based on empirical data obtained from a logistics company and industry sources. The study employed comparative and statistical analysis methods, including linear regression. Particular attention was given to the impact of the geopolitical situation in the region and the characteristics of the transported cargo on the duration of transport, including physical properties, time and place of loading and unloading. The results showed that the key factor determining the length of transport was the increased level of threats to transport in the region, resulting in delivery times being extended by over 20 days compared with regular schedules. Additionally, it was demonstrated that the mass and volume of cargo did not have a significant impact on transport duration. The analysis results confirmed the dominant role of external factors in shaping the efficiency of maritime supply chains under crisis conditions.

Keywords: maritime transport, Red Sea, geopolitical crisis, transport time, supply chain

Synopsis. Celem pracy była identyfikacja czynników wpływających na czas realizacji transportu morskiego ładunków przez Morze Czerwone w latach 2023–2024. W badaniach wykorzystano dane empiryczne pochodzące z przedsiębiorstwa logistycznego oraz źródła branżowe. Do realizacji badań zastosowano metodę analizy porównawczej i statystycznej, w tym regresję liniową. Szczególną uwagę poświęcono wpływowi sytuacji geopolitycznej w regionie oraz właściwości przewożonych ładunków na czas trwania transportu, w tym cech fizycznych, czasu i miejsca załadunku oraz rozładunku. Uzyskane wyniki wykazały, że kluczowym czynnikiem determinującym długość trwania transportu było zwiększenie poziomu zagrożeń dla transportu w regionie, skutkujące wydłużeniem czasu dostaw o ponad 20 dni w stosunku do regularnego. Dodatkowo dowiedziono, że masa i objętość

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ładunku nie miały istotnego wpływu na czas przewozu. Wyniki analiz potwierdziły dominującą rolę czynników zewnętrznych w kształtowaniu efektywności morskich łańcuchów dostaw w warunkach kryzysu.

Słowa kluczowe: transport morski, Morze Czerwone, kryzys geopolityczny, czas transportu, łańcuch dostaw

JEL codes: R41, F51, L92

Introduction

Marine transport plays a key role in international trade by ensuring the efficient movement of cargo on a large scale and enabling the development of economies located along major communication routes. The Red Sea basin is of fundamental importance for global trade within maritime transport, as it contains the most significant routes linking Europe, Africa, and Asia. The functioning of these routes is hindered by recurring disruptions to maritime transport in the Red Sea, which affect the prices of raw materials and the operation of global supply chains. In geopolitical terms, the Red Sea region is an area marked by a complex political situation, which in turn influences the development of maritime transport and creates numerous challenges for it. The movement of cargo within the Red Sea is shaped by the interplay of multiple factors, including economic, political, social, and environmental ones.

In the context of 2023–2024, increasing importance was observed in various conditions affecting the duration of maritime cargo transport in this area. The significance of this topic stems not only from the role of maritime transport as a fundamental instrument of economic globalization, but also from its direct impact on the stability and development of national economies. Maritime transport through the Red Sea is crucial for maintaining the continuity of supplies of energy resources, industrial components, and consumer goods that underpin the functioning of many economic sectors. Disruptions in this region may lead to sharp increases in enterprises' operating costs, reduced availability of goods, rising inflation, and disturbances in the trade balances of many countries. In the face of a dynamically changing global geopolitical situation, the analysis of factors affecting the efficiency of maritime transport through the Red Sea becomes an essential component of strategic planning at both the operational and governmental levels.

This study identifies the significance of the Red Sea as a global transport route. It provides a description of maritime transport and the geographical location of this basin, as well as the infrastructural conditions of the region. It also presents the role of the Red Sea in international trade. The subsequent section focuses on identifying the conditions affecting maritime transport of goods from Asia to Europe in the years 2023–2024. Attention is given to transport disruptions arising from various geopolitical crises, the security threats within the Red Sea region, and the consequences of the crisis for the global economy and the economic development of the region's states. The conclusion of the study concerns the analysis of the relationships between the characteristics of transported cargo and the situation in the Red Sea.

Characteristics of maritime transport worldwide

Maritime transport in the movement of cargo and passengers has played a significant role in historical moments shaping the contemporary world. In antiquity, it enabled the development of many countries such as Egypt, Greece, the Roman Empire, and Byzantium. Owing to it, at the turn of the 15th and 16th centuries, European sailors made major geographical discoveries. Bartolomeu Dias circumnavigated the Cape of Good Hope in 1488, Christopher Columbus in 1492 discovered and later conquered America, Vasco da Gama in 1498 became the first to reach India from Europe by sea, and Ferdinand Magellan undertook the first circumnavigation of the globe in the years 1519–1522 [Zielińska 2017].

International maritime transport is one of the pillars supporting the development of the world economy and the processes of globalization occurring within it. Handling more than 80% of global trade volume, it is of fundamental importance for the growth of international commerce. Moreover, it conditions the efficiency and flexibility of supply chains and networks worldwide [Grzelakowski 2012]. Maritime transport, as part of the global transport system, is continuously evolving in response to changes occurring in the world economy [Bombińska 2017].

According to Salmonowicz, maritime transport is the most sustainable, fuel-efficient, and environmentally friendly branch of transport. The most important aspects to consider in the development of maritime transport include [Salmonowicz 2008]:

- high concern for safety and environmental protection, especially in vulnerable coastal areas,
- the environment of animals and plants growing near seaports and land-based infrastructure,
- ensuring protection against terrorist and other threats without reducing efficiency.

Ongoing technological developments are causing changes in maritime transport in terms of its capacity and reliability. The functional capabilities of vessels have increased over the years, significantly improving economies of scale, which have always been a major advantage of this mode of transport. Additionally, the construction of larger and more energy-efficient vessels and the introduction of automation have made it possible to operate ships with smaller crews while simultaneously raising safety standards. The only constraints for ships are the handling and storage capacities of ports, harbors, and the canals that serve them. Another aspect concerning changes in maritime transport is vessel speed, which has improved slightly due to the widespread use of container ships, which are faster than conventional vessels [Rodrigue 2017].

The functioning of maritime routes depends significantly on geopolitical factors, which determine both route selection and the costs of global trade. Control over strategic points such as the Strait of Hormuz, the Bab al-Mandab Strait, or the Panama and Suez Canals serves as a tool of political pressure [Nowicki 2024]. The geopolitical situation in the South China Sea and in Turkey's Bosporus and Dardanelles Straits also points to major disruptions rooted in political tensions.

In the case of the South China Sea, the strategic importance stems not only from oil and natural gas deposits but above all from the numerous trade routes running through the region. According to data from the United Nations Conference on Trade and Development, 80% of the total value of global trade is conducted via maritime transport, with

one-third of this volume passing through the South China Sea route [UNCTAD 2024]. Runde et al. [2024] report that nearly 95% of China's trade is carried out by sea, and more than 64% of these routes pass through the South China Sea. Through these waters, China exports goods worth approximately 900 billion dollars annually [Zuziak 2018].

Other global trade routes are also threatened by geopolitical instability. Around one-fifth of global oil production flows through the narrow Strait of Hormuz into the Arabian Sea, and tensions between Iran and Western economies have already led to trade restrictions. For example, in April 2024, Iran's Revolutionary Guard seized the MSC Aires, a 150,000-ton container ship [Carlomagno et al. 2025].

Another major source of disruption to global maritime routes is climate change, which became especially visible in 2023 in the Panama Canal. A significant drop in water levels caused a paralysis of maritime traffic along this corridor, resulting in delays and financial losses for the most dependent countries, including Chile, Ecuador, Peru, and the United States. In 2023, severe droughts in the Panama Canal region, which accounts for 2.5% of global maritime trade, forced operators to adjust transit capacity and reduce cargo tonnage by nearly one-third [Chambers 2023].

Geographical location and infrastructural conditions of the Red Sea

The Red Sea is an inland, intercontinental basin located between Africa and the Arabian Peninsula, approximately 2,000 km in length with a maximum width of 355 km, yielding a total surface area of more than 458,000 km² [Stewart & Rasul 2019, p. 2]. It has an elongated, spindle-shaped form and was created because of tectonic rifting of the Earth's crust. Although it is more than ten times smaller than the world's largest sea, the Philippine Sea, it has played a crucial role in global trade for decades due to its strategic location. According to the PWN Encyclopedia [Encyklopedia PWN 2024], the Red Sea – Erythraios Pontos in Greek, or the Erythraean Sea – forms a branch of the Indian Ocean, constituting a direct connection between Asia and Europe, as well as between the Indian Ocean and the Mediterranean Sea, which provides the shortest and fastest route for vessels. To the south, it connects through the Bab al-Mandab Strait and the Gulf of Aden with the Indian Ocean, and to the north through the Gulf of Suez and the Suez Canal with the Mediterranean Sea (Figure 1). Seven countries have access to it: Saudi Arabia, Egypt, Eritrea, Israel, Yemen, Jordan, and Sudan.

Figure 1. Political map of the Red Sea region

Rysunek 1. Polityczna mapa regionu Morza Czerwonego

Source: [Depositphotos 2017]

Źródło: [Depositphotos 2017]

The geographical location of the Red Sea correlates with the maritime infrastructure

established there. The implemented solutions include primarily port infrastructure and, in the case of crude oil transport, pipeline infrastructure. The passage through the Suez Canal leading from the Mediterranean Sea is complemented by the Port of Suez, which also serves as the starting point for journeys from the Indian Ocean through the Red Sea to Europe. The port was created during the construction of the canal between 1859 and 1869. It includes, among other elements, a highly important fuel depot, and it also serves as an anchorage port before or after transiting the Suez Canal. This area is an important logistical point on Egypt's transport map [Marciniak 2023].

The Bab al-Mandab Strait, forming the southern entrance to the Red Sea from the Gulf of Aden, is a critical point guarding the gateway to Europe and the Persian Gulf for crude oil and Asian manufacturers. Shared by Yemen, Eritrea, and Djibouti, the strait is about 30 km wide and divided into two channels by Perim Island. It is the reason why the Gulf of Aden has strategic importance. The gulf has traditionally faced a high level of piracy, smuggling, and illegal arms trafficking. According to the authors, international cooperation initiatives and regional regulations have not improved security despite the continued military presence of major world powers in the region, including China (in Djibouti) and the United States [Haralambides 2024].

The role of the Red Sea in the international trade

The Red Sea is a major trade and shipping route through which crude oil from the Persian Gulf is transported to Europe, meeting more than 60% of Europe's energy needs [Farid 2022, p. 8]. Al-Ahmar lies at the strategic center of the world, serving as an important shipping route also for military forces between their home countries and bases in various parts of the world. It is additionally surrounded by regional powers with their own armed forces and mutual antagonisms. As a result, the Red Sea constitutes a key area for both regional and international conflicts. There is a close relationship between the Red Sea and the Persian Gulf, which share historical, economic, and strategic ties. Events occurring within or around the Red Sea basin have long-term effects on the Gulf region, and vice versa [Farid 2022, p. 8].

The importance of the Red Sea for global trade and the risks associated with it were most visible during the six-day blockage of the Suez Canal in March 2021 by the container vessel Ever Given. This incident trapped more than 100 ships on both sides and disrupted trade flow worth an estimated USD 9.6 billion per day [Yee & Goodman 2021]. Considering that around 12% of global trade passes through the Suez Canal, the traffic disruption affected not only the global shipping industry but also countless businesses and supply chains, from manufacturers to domestic carriers, retailers, and supermarkets. The escalation of armed activity in December 2023 in key maritime regions, particularly the impact of Houthi attacks, highlighted the fragility and importance of these strategic maritime routes.

Data analysis results from 2019, published in Communications in Transportation Research, showed that nearly 23% of maritime-traded goods between non-neighboring countries pass through the Red Sea, specifically through the Bab al-Mandab Strait and the Suez Canal. Other estimates place the share of maritime cargo passing through this area as high as 30%. This percentage is significant compared with other maritime "bottlenecks" placing the Red Sea straits just behind those in the European

and Asian markets [Buchholz 2024]. The passage through Al-Bahr is also an important bottleneck for oil supplies, like the Strait of Hormuz or Malacca. In addition, according to Chatham House, before the pandemic and the Ukraine crisis, the Bab al-Mandab Strait recorded the transit of nearly 20% of global rice supplies and almost 15% of global wheat exports. This is important from the perspective of global fertilizer supply chains [Buchholz 2024].

The Houthi movement in Yemen, equipped with ballistic missiles, cruise missiles, naval mines, and drones, continued to escalate maritime attacks and block commercial transit through the Bab al-Mandab Strait in connection with the conflict between Israel and Hamas. As a result, for the first time several commercial vessels found themselves directly in the center of the conflict. Many logistics companies, such as AP Moller-Maersk – responsible for 15% of global container transport – and Hapag-Lloyd, announced that they would not transport goods through the Bab al-Mandab Strait.

The Red Sea has also gained importance in the geopolitics and economies of Saudi Arabia, the United Arab Emirates, and other Gulf Cooperation Council (GCC) states. Following the Arab Uprising and the decline in crude oil prices in the past decade, combined with the need to accelerate economic diversification, these countries began implementing ambitious visions aimed at comprehensive restructuring of their economies and redefining their role in global value chains [Narbone & Widdershoven 2021, p. 5]. The regional leader in the Red Sea area, Egypt, is seeking to restore its central role by intensifying maritime development projects and industrial zone expansion in the Suez Canal region and along the Red Sea coast. Countries outside the Persian Gulf, such as Jordan and Israel, also have strong interests in maintaining unimpeded passage through these strategic waters [Narbone & Widdershoven 2021, p. 6]. Other international actors are likewise far from passive.

China's largest state-owned shipping company, Orient Overseas Container Line (OOCL), announced during the December 2023 attacks that it was halting all transport to and from Israeli seaports. According to The Maritime Executive [2023], unlike its Western competitors, OOCL did not report suspending voyages through the Red Sea.

The impact of the Red Sea crisis extends beyond shipping companies and trade routes. Egypt, whose economy heavily depends on revenue from Suez Canal tolls, recorded a 40% decrease in income in 2021 due to vessel rerouting. Broader economic effects are also being felt across other industries, particularly those dependent on stable and efficient maritime routes.

The ongoing crisis in the Red Sea underscores the vulnerability of global trade routes to geopolitical tensions. As shipping companies adjust to the new reality, the cost structure of international trade is likely to change. Higher transport costs, increased insurance premiums, and longer transit times may become the norm, especially if conflicts in the Middle East persist. Companies will need to develop more flexible and resilient supply chains to cope with these disruptions. This may involve diversifying trade routes, increasing inventories of critical goods, or investing in new technologies that help reduce time and costs of transport. In the long term, firms will need to reassess their supply chain strategies, explore more diversified routes, and invest in green technologies to mitigate rising costs. The current disruptions highlight the susceptibility of global trade to geo-

political tensions, and shipping companies will have to adapt to a new reality of higher operational costs and increased uncertainty [Govindan 2024].

The Red Sea crisis holds significant implications for international trade and poses a major challenge for the global maritime economy. The immediate costs associated with increased transport expenses and insurance premiums have become evident, but the long-term economic consequences may prove even more profound. As global trade becomes increasingly dependent on secure and stable routes, this crisis underscores the need for international cooperation to protect key maritime arteries and ensure the uninterrupted flow of international trade. The attacks themselves are unlikely to stop soon. In addition to the conflict between Israel and Hamas, which is unlikely to end quickly, the Houthis recognize that their attacks draw international attention and divert the Yemeni population's focus from the lack of basic services, reinforcing their existing strategy.

The Red Sea region is becoming an area of global importance for security, in which economic and security issues bind together both the coastal states and international actors. As a result of these developments, geopolitical instability, rivalry, and tensions are increasing, potentially making the Red Sea a site of future confrontations. It should also be noted that this basin is exposed to environmental problems, such as rising water temperatures, which lead to coral reef decline. Although these issues do not directly affect trade, environmental pressure may in the future influence maritime transport policies and the approach of international organizations toward the protection of the marine environment.

Materials and methods

The main objective of the article was to identify the determinants of maritime cargo transport time through the Red Sea in the years 2023–2024. To fulfill this objective, aspects related to the characteristics of maritime freight transport were considered, with a focus on data concerning the transported cargo, including loading and unloading ports, as well as the duration of transport. An additional element involved the inclusion of geopolitical aspects occurring in the region during the examined period, with consideration of their impact on the decisions made by entities operating in the maritime transport sector. Two hypotheses were formulated within the study and subsequently verified during the research process:

H1: The geopolitical crisis in the Red Sea resulted in an extension of cargo transport time between ports in Asia and ports in Europe by more than 20 days compared with standard transport times.

H2: The mass and volume of cargo transported along routes between Europe and Asia in the years 2023–2024 did not have a significant impact on transport time.

The data sources used in the article include both theoretical materials and empirical data, which enabled a broad examination of the research problem. The theoretical basis consisted of subject literature, including scientific publications, monographs, and articles, which made it possible to understand the key concepts related to maritime logistics, including the characteristics of maritime transport worldwide and the significance of the Red Sea for international trade. The use of mass statistical data from publicly avail-

able databases, such as those of the United Nations Conference on Trade and Development, PortWatch, Lloyd's List, the International Transport Forum, and the World Bank, provided insights into trends and changes in shipping routes within the studied basin. An important source of data also included selected data on maritime transport originating from an international logistics company headquartered in Denmark. The company specializes in providing transport and logistics services in over 80 countries worldwide and employs more than 74,000 people. It carries out road, air, and sea freight operations and offers warehousing services as well as comprehensive supply chain management. The average annual number of cargo units transported by the company via sea routes amounts to 2.5 million TEU. In addition, industry studies published by organizations and institutions analyzing the maritime transport market were used, as they provide information on the condition and development directions of this sector.

Several complementary research methods were applied in the data analysis. The monographic method enabled a detailed characterization of conditions in the Red Sea, taking into account its specificity, significance within the global supply chain, and the impact of geopolitical factors on its functioning. Comparative analysis made it possible to contrast various cargo characteristics, considering their weight, volume, loading and unloading ports, and the duration of the entire transport process. An important element of the research was the statistical analysis of transport data, which allowed for a quantitative assessment of key factors influencing the duration of shipments. Additionally, a regression method was employed to identify relationships between variables affecting transit time, which served as the dependent variable. The independent variables included the physical characteristics of cargo in maritime transport, geopolitical threats, and the resulting delays in supply chains. These variables were selected based on their significant influence on carrier decisions and the possibility of quantitatively analyzing their effects. By combining these methods, a comprehensive picture of the mechanisms shaping maritime cargo transport time through the Red Sea in the years 2023–2024 was obtained.

Research results

Security threats to transport in the Red Sea

In 2023, the Houthi movement based in Yemen intensified its attacks on commercial vessels, significantly complicating transport operations through the Red Sea. According to data from the International Transport Forum (ITF), from mid-November until March 18, 2024, a total of 45 attacks were carried out against ships transiting the Gulf of Aden toward Al-Bahr. The ITF database includes only assaults directed specifically at commercial vessels. Consequently, it does not cover aggression against fishing vessels, warships, or attacks that were not aimed at a particular target. It also excludes interactions between the Houthi movement and commercial ships that cannot be classified as attacks – meaning situations in which no violence (or attempted violence) intended to harm a commercial vessel occurred [ITF 2024].

Data published by the ITF showed that more than 60% of the attacks were conducted using missiles, and nearly 20% involved modern forms of assault in the form of drones

(Figure 2). Only one vessel was hijacked, and this occurred at the onset of the aggression in 2023. Regarding the types of vessels exposed to danger, the distribution was relatively even: between 24% and 33% of the aggression involved the most common ship types in maritime transport-tankers, container ships, and bulk carriers (Figure 3). During the examined period, only two attacks targeted car carriers.

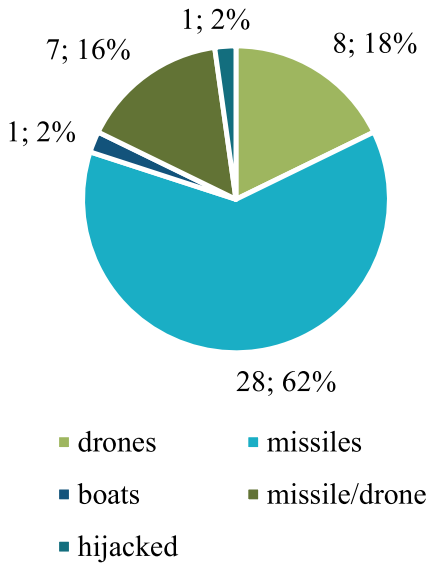

Figure 2. Number of attacks by type
Rysunek 2. Liczba ataków według ich rodzaju
Source: author's elaboration based on [ITF 2024]
Źródło: opracowanie własne na podstawie [ITF 2024]

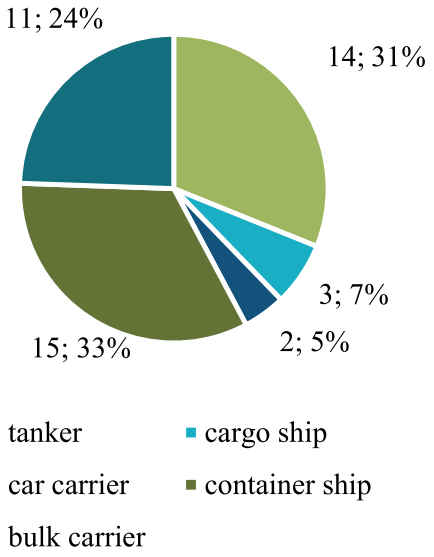

Figure 3. Number of attacks by vessel type
Rysunek 3. Liczba ataków według rodzaju statku
Source: author's elaboration based on [ITF 2024]
Źródło: opracowanie własne na podstawie [ITF 2024]

According to analysts from the Washington Institute, Houthi maritime operations in the Red Sea – particularly along its southern coast near the Bab al-Mandab Strait – demonstrate a clear evolution divided into five phases. Each of these phases is characterized by a gradual expansion of attack targets, which affects the course of global trade routes and navigational safety [Raydan & Nadimi 2024].

The number of vessels transiting the Bab al-Mandab Strait has decreased by more than 50% year-on-year. The crisis has also affected Suez Canal transits, which, according to data from Lloyd's List Intelligence, fell from approximately 2,068 in November 2023 to about 877 in October 2024. A similar trend was observed along the route through the Bab al-Mandab Strait, where the number of weekly transits significantly declined. In times of peace, this figure ranged on average between 500 and 550 transits per week, whereas from week 46 of 2024 to week 11 of 2025, it amounted to only 160–240 transits [Lloyd's List 2024]. The total number of attacks between March and November 2024 rose from 45 to 106, indicating a sustained security threat to vessels transporting goods through the Red Sea.

Considering the difficult situation in the Al-Bahr region, many shipping companies, such as Maersk, opted for the longer route around the Cape of Good Hope, which

increased operational costs and freight rates. At the same time, some companies, such as CMA CGM, continued limited operations through the Red Sea under military escort. The increased rates provided financial benefits to certain market participants, while others – seeking cost savings – relocated their operations closer to the Persian Gulf, for example to Jebel Ali in Dubai.

The Houthi maritime campaign poses a serious challenge to global trade and navigation safety. Their strategy, based on gradually expanding targets and the use of drones and other technologies, indicates the group's growing operational capabilities. An effective response requires both military and diplomatic measures from the international community and regional alliances.

In its 2025 maritime transport report, Xeneta outlined several scenarios: no return of container ships to the Red Sea, and either a partial or full return. These scenarios could result in outcomes ranging from a 3% increase to an 11% decrease in demand for cargo transport this year [Sand & Stausbøll 2025]. According to Emily Stausbøll, a senior analyst at Xeneta, "a large-scale return to the Red Sea seems unlikely for now, but a partial return may be possible at some point in 2025."

The Baltic and International Maritime Council (BIMCO), one of the largest international shipping organizations representing vessel owners, assumed that ships will continue sailing around the Cape of Good Hope throughout 2025, with conditions possibly permitting a return to regular routes only in 2026. However, if ships resume regular routes as early as 2025, demand for maritime transport is forecast to decline by 5–6% in that year, followed by growth of 3.5–4.5% in 2026 [BIMCO 2025].

Organization of maritime transport in 2023–2024

The maritime transport industry has recently undergone significant changes resulting from global economic conditions, geopolitical tensions, and the transformation of trade routes. In the years 2023–2024, the sector was marked by exceptional volatility caused by the aftereffects of the pandemic, port congestion, labor shortages, and unstable international situation. All these factors created challenging conditions for companies dependent on maritime transport, particularly for those shipping goods through the Red Sea or via the alternative route around Africa.

The data presented in Table 1 and Figure 4 originate from the E2open Ocean Shipping Index Q4 2024 report and focus on changes in the duration of maritime transport of export cargo across three main port regions: global, European, and Asian. The compilation also includes five key ports in each of these areas, which had the greatest impact on shaping the average values.

In all three regions, a significant increase in the average transport time was observed. The largest growth concerned Asian ports – from 40.6 to 57.8 days – which may indicate overloaded infrastructure, persistent port congestion, and the effects of geopolitical tensions in the Asian region. European ports recorded a smaller yet still noticeable increase in transport time in the fourth quarter of 2024 – by 11.8 days compared with the previous year. According to the analyzed data, the average extension of maritime transport time on the Asia–Europe–Asia routes amounted to 14.5 days.

Table 1. Ranking of ports with the greatest impact on the extension of export time (in days)
Tabela 1. Ranking portów mających największy wpływ na wydłużenie czasu eksportu (w dniach)

Place	Region of ports	Load port	2023 Q4	2024 Q4	Difference	Change
1	Global	Muhammad Bin Qasim, Pakistan	43	65	22	+51%
2		Hazira Port, India	42	58	16	+38%
3		Ennore, India	41	57	16	+39%
4		Aliağa, Türkiye	32	44	12	+38%
5		Jebel Ali, UAE	38	52	14	+37%
1	European	Koper, Slovenia	46	60	14	+30%
2		Bremerhaven, Germany	39	51	12	+31%
3		Gdańsk, Poland	44	57	13	+30%
4		Rotterdam, Netherlands	42	51	9	+21%
5		Gothenburg, Sweden	50	61	11	+22%
1	Asian	Mundra, India	36	53	17	+47%
2		Muhammad Bin Qasim, Pakistan	42	63	21	+50%
3		Vung Tau, Vietnam	41	58	17	+41%
4		Nhava Sheva, India	39	53	14	+36%
5		Xiamen Gaoqi Int'l Apt, China	45	62	17	+38%

Source: author's elaboration based on [E2open 2025]
Źródło: opracowanie własne na podstawie [E2open 2025]

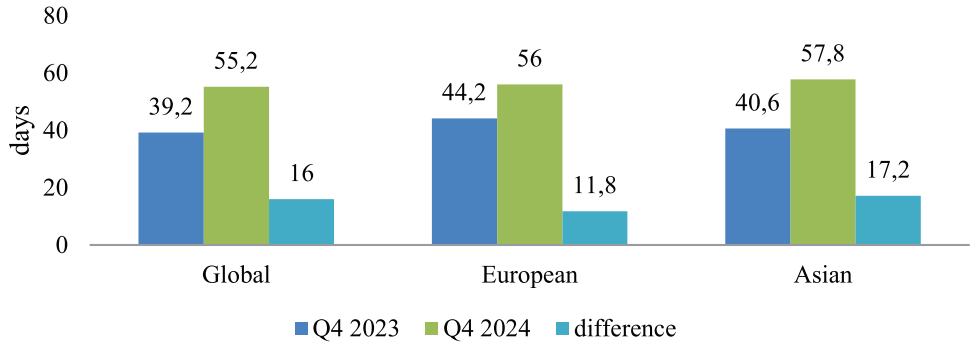

Figure 4. Average transport time (in days)
Rysunek 4. Średni czas transportu (w dniach)
Source: author's elaboration based on [E2open 2025]
Źródło: opracowanie własne na podstawie [E2open 2025]

The presented data indicate growing difficulties in maritime transport along the Asia–Europe–Asia axis, resulting from both infrastructural constraints and geopolitical instability. From a supply chain management perspective, it is necessary to account for these factors in operational and strategic planning, as well as to consider alternative routes and intermodal solutions in order to minimize the risk of delays.

In the years 2023–2024, significant changes occurred in the global configuration of maritime routes, which is clearly reflected in the data concerning the volume of transported cargo through key transit points: the Bab al-Mandab Strait, the Suez Canal, and the Cape of Good Hope (Figure 5). The data used in the analysis originate from the Port Watch platform, a joint initiative of the International Monetary Fund (IMF) and the University of Oxford. This platform monitors global maritime trade flows in real time, providing detailed information on transport volumes, delays, and route changes based on AIS systems and port data [Port Watch 2025]. The most significant decline in transport volumes was recorded on the route through the Red Sea, comprising the Bab al-Mandab Strait in the south and the Suez Canal in the north.

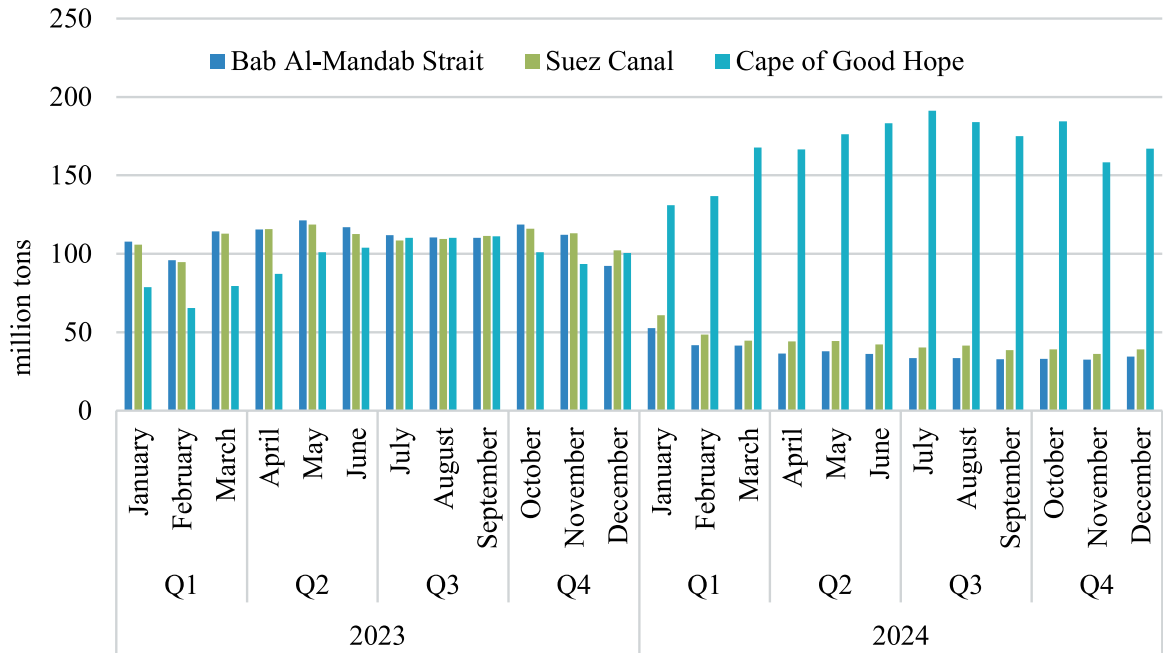

Figure 5. Number of cargoes handled at a given point in 2023–2024
Rysunek 5. Liczba ładunków obsłużonych w danym punkcie w latach 2023–2024
Source: author's elaboration based on [Port Watch 2025]
Źródło: opracowanie własne na podstawie [Port Watch 2025]

Over the course of a year, the average monthly volume of shipments through the Bab al-Mandab Strait decreased from 102.1 million tons in 2023 to 37.2 million tons in 2024, representing a decline of nearly 64% (Table 2). A similar trend occurred in the case of the Suez Canal, where the cargo volume decreased from 101.6 million tons to 43.3 million tons, i.e., by 57.4%. These declines are also reflected in the average annual transport values. For Bab al-Mandab, the decrease amounted to 66.4%, and for the Suez Canal 60.7% (Table 3). Such a substantial reduction in traffic indicates serious disruptions to navigation in this region caused by security threats in the Red Sea and Bab al-Mandab area, including armed activities, piracy, and geopolitical conflicts.

During the same period, there was a sharp increase in traffic on the alternative route around the Cape of Good Hope. In 2024, the average monthly cargo volume nearly doubled from 87.8 million tons in 2023 to 168.5 million tons the following year, representing

Table 2. Average monthly transport volumes (in tons)
Tabela 2. Średnie miesięczne wartości przewozowe (w tonach)

Period	Route via the Red Sea		Alternative route
	Bab Al-Mandab Strait	**Suez Canal**	**Cape of Good Hope**
2023–2024 (24 months)	73,891,139	76,685,732	131,820,900
2023 (12 months)	102,100,977	101,623,409	87,832,644
2024 (12 months)	37,172,887	43,279,437	168,489,768
average monthly change	**–63.6%**	**–57.4%**	191.8%

Source: author's elaboration based on [Port Watch 2025]
Źródło: opracowanie własne na podstawie [Port Watch 2025]

Table 3. Average yearly transport volumes (in tons)
Tabela 3. Średnie roczne wartości przewozowe (w tonach)

Year	Route via the Red Sea		Alternative route
	Bab Al-Mandab Strait	**Suez Canal**	**Cape of Good Hope**
2023	1,327,312,700	1,321,104,317	1,141,824,376
2024	446,074,647	519,353,246	2,021,877,216
average yearly change	**–66.4%**	**–60.7%**	**+77.1%**

Source: author's elaboration based on [Port Watch 2025]
Źródło: opracowanie własne na podstawie [Port Watch 2025]

an increase of more than 190%. Annual transport volumes likewise rose from 1.14 to 2.02 billion tons, an increase of 77%. These figures indicate a massive redirection of commercial traffic from the previously dominant Red Sea route to the southern route, despite its longer sailing time and higher operational costs.

In summary, the analyzed period saw a radical shift in shipowners' preferences regarding maritime routes. The drastic decline in the volume of cargo transported through the Red Sea and the Suez Canal was offset by a record surge in traffic around Africa. This means that, in the face of security threats in the Middle East region, the route around the Cape of Good Hope assumed the role of the main maritime artery between Asia and Europe.

Characteristics of data on transported cargo

The study was conducted based on selected maritime transport data obtained from an international logistics company headquartered in Denmark. The company specializes in providing transport and logistics services in more than 80 countries worldwide. Its average annual volume of seaborne cargo amounts to 2.5 million TEU units.

The analyzed data concerned cargo transported by sea along the Asia–Europe–Asia route in the period from January 1, 2023 to December 31, 2024, with the reservation that these were not the company's complete datasets, but only those for which permission was

granted for general research purposes. The company's full cargo volume is considerably larger; nevertheless, the obtained data enabled the study to be conducted and the research objectives to be achieved. The total number of selected cargo records amounted to 5,750, of which 80% represented goods exported from Europe, while the remaining portion concerned shipments originating from Asia.

The transport parameters included several aspects relevant to the study. Each cargo item was assigned a unique identification number, and each contained specific information on:

- cargo type (FCL or LCL)
- country of loading
- country of unloading
- estimated loading date
- actual loading date
- estimated unloading date
- actual unloading date
- mass
- volume.

The distribution of the mass and volume of the analyzed goods, divided by loading countries from Europe to Asia, is presented in Figures 6 and 7. The total mass of cargo amounted to approximately 20,505 tons, with France (19.7%), the United Kingdom (16%), and Germany (15%) accounting for the highest shares among the 14 European countries included in the dataset, while Slovenia, Finland, and Portugal each accounted for less than 1%. In terms of volume, the structure differed. Out of the total volume of 34,800 m³, Germany accounted for the largest share (25%), followed by France (16.1%) and Belgium (15.4%), while the smallest shares were the same as in the weight distribution.

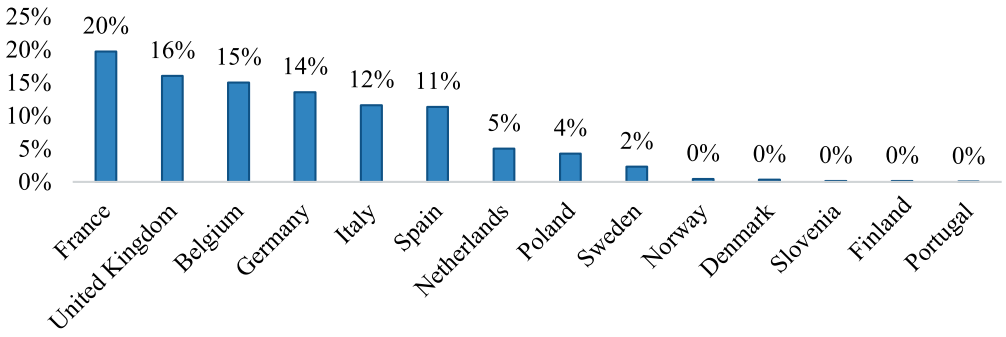

Figure 6. Structure of cargo mass by country on the Europe–Asia route
Rysunek 6. Struktura masy towarów według kraju na trasie Europa–Azja

Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

The characteristics of data for cargo transported from Asia to Europe were prepared in an analogous manner. Nine countries were taken into account, from whose ports a total of nearly 4,426 tons of goods were shipped. The most significant in terms of cargo mass were ports located in Singapore (47.8%) and China (40%), while the smallest share was

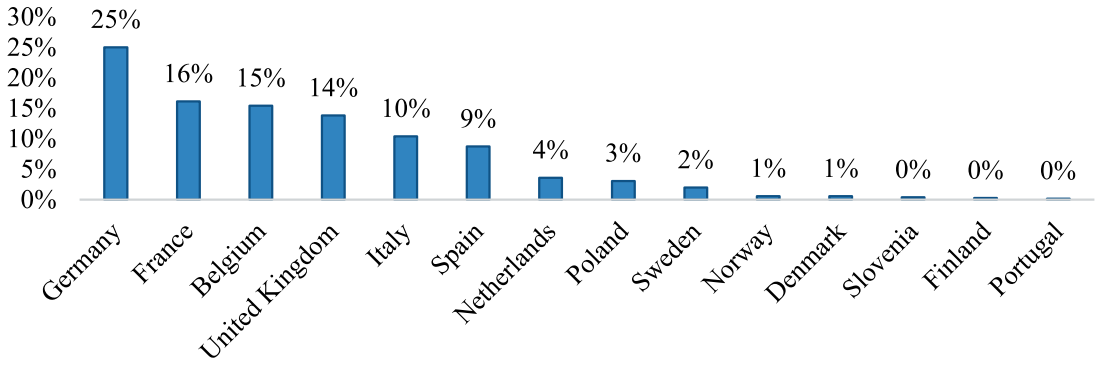

Figure 7. Structure of cargo volume by country on the Europe–Asia route
Rysunek 7. Struktura objętości towarów według kraju na trasie Europa–Azja
Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

recorded for the United Arab Emirates and South Korea, from which together less than 5 tons of cargo were dispatched (Figure 8). The volume of transported goods amounted to approximately 7,200 m³. The largest share in this category was likewise attributed to Singapore and China, which together exported 5,660 m³ (79%) of cargo, while the smallest share concerned the ports of the same countries identified as having the lowest contribution in the mass-based comparison (Figure 9).

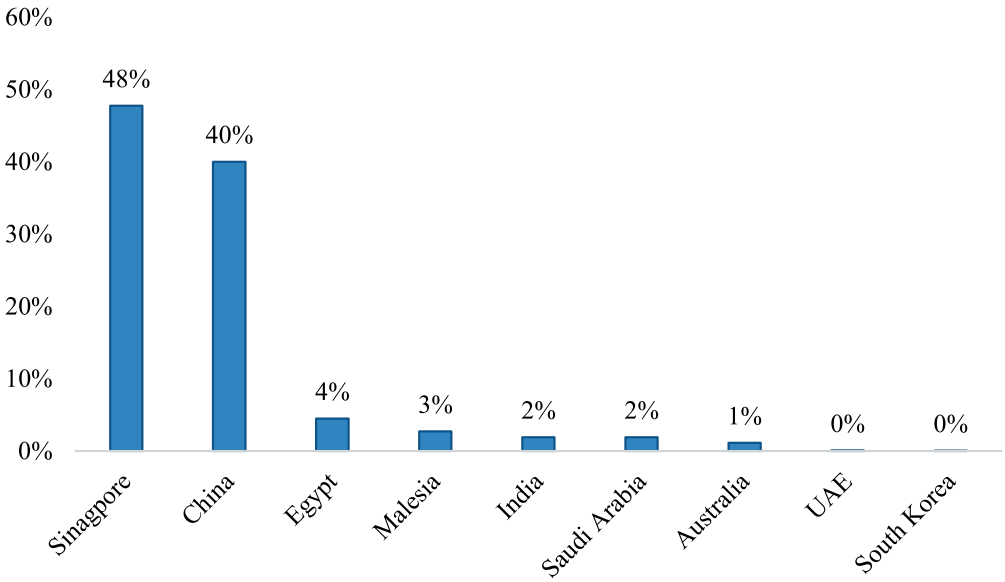

Figure 8. Structure of cargo mass by country on the Asia–Europe route
Rysunek 8. Struktura masy towarów według kraju na trasie Azja–Europa
Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

Presenting the grouped data by transport direction made it possible to conduct a comparative analysis. It should be noted that the presented data for individual countries do not represent the entirety of each country's trade flows but constitute only the share handled

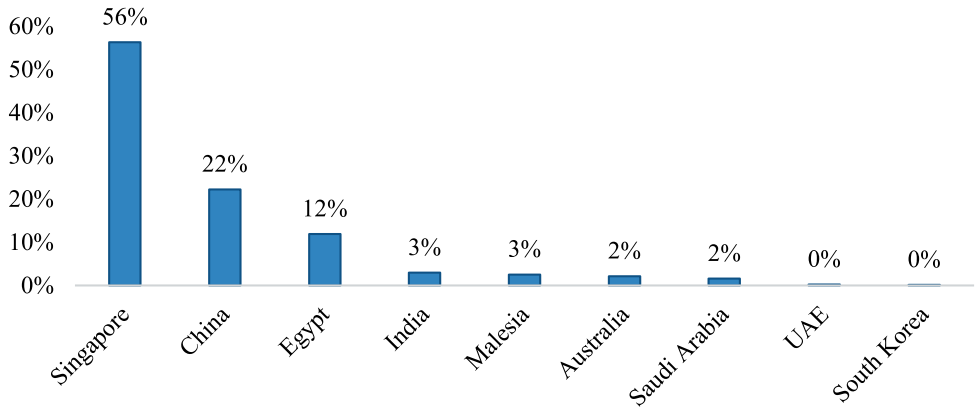

Figure 9. Structure of cargo volume by country on the Asia–Europe route
Rysunek 9. Struktura objętości towarów według kraju na trasie Azja–Europa

Source: author's elaboration based on company data

Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

by the company as part of services provided to a portion of its clients. Nonetheless, these data made it possible to verify the hypotheses and formulate conclusions.

Comparison of data before and after the onset of the Red Sea crisis in 2023

For the purpose of comparing maritime transport data for goods shipped through the Red Sea from Asia to Europe and vice versa, an estimated sailing time from each loading port to the passage through this basin was adopted. The statistical sailing time was determined based on regular voyage durations. Typical container ship routes from major seaports were assumed, under optimal conditions and with passage through the Suez Canal. All loading countries included in the analyzed cargo dataset were compiled in Table 4.

The longest sailing time to the Red Sea is from South Korea and China, while the shortest is from countries located in its immediate vicinity, namely Egypt, Saudi Arabia, and the United Arab Emirates. Among the European countries, the sailing time to the Suez Canal from Slovenia and Italy is approximately nine days [Searates 2025].

Based on the actual loading date and the estimated sailing time to the Al-Bahr basin, the estimated date of cargo passage through the Red Sea was calculated. The following formula was used:

$$\textit{actual loading date + number of days to reach the RS =}$$
$$\textit{= estimated date of passage through the RS}$$

Using these calculations, the data were grouped into two parts according to cargo transported before and after the increase in threats related to shipping goods through the Red Sea. The period preceding the onset of the Red Sea (RS) crisis was defined using the date of the first Houthi attack on a cargo vessel, which occurred on November 19, 2023. Thus, the first research period was January 1, 2023, to November 18, 2023, and the second was November 19, 2023, to December 31, 2024.

Table 4. Estimated maritime transport times from the loading country to the Red Sea passage
Tabela 4. Szacunkowe czasy transportu morskiego z kraju załadunku do przejścia przy Morzu Czerwonym

Country	Transport time to the Red Sea in days	Country	Transport time to the Red Sea in days
South Korea	**28**	Belgium	14
China	**26**	Netherlands	14
Australia	22	Germany	13
Malesia	19	Portugal	14
Singapore	18	India	12
Norway	18	France	11
Finland	18	Spain	10
Sweden	17	Italy	9
Poland	16	Slovenia	9
Denmark	16	**United Arab Emirates**	**3**
United Kingdom	15	**Saudi Arabia**	**2**

Source: author's elaboration based on [Searates 2025]
Źródło: opracowanie własne na podstawie [Searates 2025]

A total of 2,567 cargoes were assigned to the first group and 3,127 to the second (for the sake of research clarity, 56 cargoes whose estimated passage through the Red Sea would have occurred after December 31, 2024 were excluded). For both periods, the type of transported cargo was compared. Full-container-load (FCL) and less-than-container-load (LCL) cargoes were identified, along with the weight and volume of goods, the average daily number of cargoes, and the ratio of all these parameters in 2024 to the previous year. Furthermore, the average actual transport times and delays for both periods were compared by month, and the changes before and after the onset of the Red Sea crisis in November 2023 were presented.

Less-than-container-load cargoes (84%) clearly dominated full-container-load cargoes (16%) in both analyzed periods (Table 5). Due to the longer period covering the threat to transported cargo, their number increased by 28% for FCL goods and by 21% for LCL goods. The distribution of cargo across all transported goods remained similar. The difference in favor of LCL cargoes from period to period amounted to 0.8 percentage points.

Table 5. Characteristics of cargo types included in the study
Tabela 5. Charakterystyka rodzajów ładunków uwzględnionych w badaniach

Cargo type	Before the onset of crisis	After the onset of crisis	Change period to period
FCL	15.5% (399)	16.3% (511)	+28%
LCL	84.5% (2,168)	83.7% (2,616)	+21%

Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

The average daily number of maritime cargoes in a given month, as well as the year-on-year change in this value for the period from February 2023 to December 2024, is illustrated in Figure 10. In 2023, the average daily number of cargoes remained stable at approximately 8–10 units, reaching its peak in August and September. A clear decline in this indicator occurred in November 2023, which was associated with the escalation of threats in the Red Sea. An increase followed in the subsequent months. In February 2024, the year-on-year rise in the number of cargoes reached 38%, indicating a sudden redirection of maritime transport and an intensification of traffic around Africa. However, from March 2024 onwards, persistent negative year-on-year changes were observed (down to –26% in October), which may reflect prolonged transport times and the need to spread deliveries over time. Although the total cargo volume did not decrease, the duration and routing of transport changed.

Monthly changes in the mass and volume of cargo transported by sea through the Red Sea or via the alternative route around Africa in 2023–2024 are presented in Figure 11. Periodic fluctuations are visible, particularly in November 2023, when the data were divided into the periods "before" and "after" November 18, 2023, which is linked to the onset

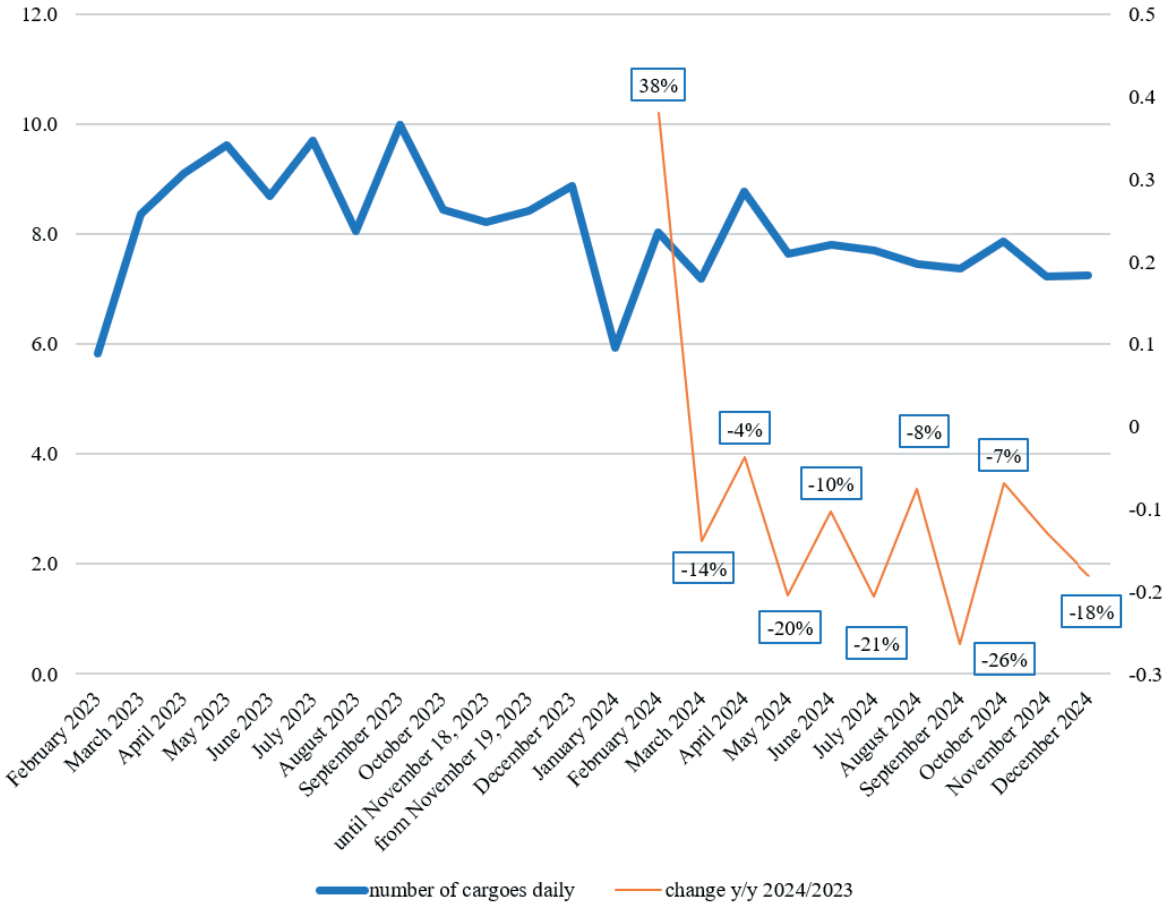

Figure 10. Average daily number of cargoes per month with year-on-year change (in days)
Rysunek 10. Średnia dzienna liczba ładunków w danym miesiącu ze zmianą rok do roku (w dniach)

Source: author's elaboration based on company data

Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

of the Red Sea crisis. The highest cargo mass values were recorded in March and December 2023 and in February 2024, when the weight exceeded 1,600 tons and the volume ranged between 2,500–2,700 m^3.

A different situation occurred in November 2023 (especially after November 18) and in January 2024, when the mass decreased to below 600 tons and the volume did not exceed 1,000 m^3. Despite these temporary declines, the subsequent months brought a rapid return to previous levels, and data from the second half of 2024 even showed increases compared with the corresponding months of 2023, indicating that maritime transport did not decrease but was redirected along another route. The results presented in the chart demonstrate flexibility in responding to geopolitical disruptions in the Red Sea region.

Monthly values of the actual transport time and transport delays for cargo moved by sea between Asia and Europe from January 2023 to December 2024 are presented in Figure 12. The data come from the monitoring system of a large logistics company and were compiled based on differences between the estimated loading and unloading dates (declared by carriers) and the actual dates of these operations.

Delays in maritime transport are a natural phenomenon, resulting, among other factors, from weather conditions, port congestion, or operational issues. However, during the analyzed period, a significant deterioration in transport punctuality was observed at the turn of 2023 and 2024. The cause of this phenomenon was the crisis in the Red Sea region, which forced many carriers to abandon the route through the Suez Canal and take the much longer route around the Cape of Good Hope.

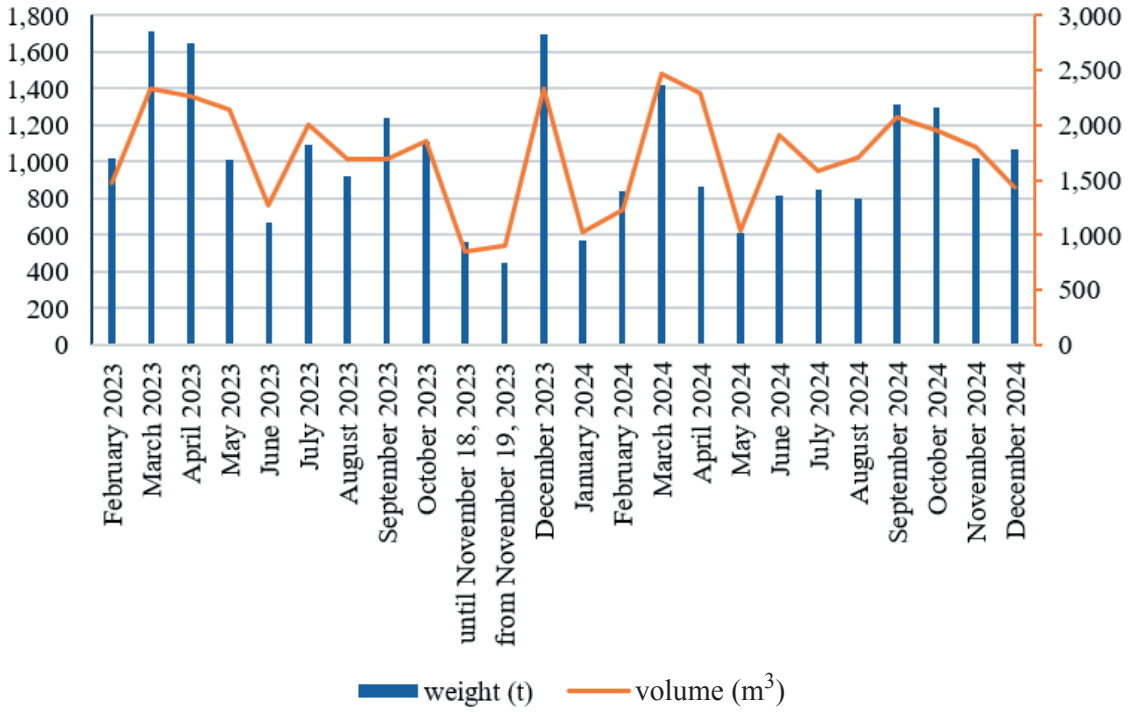

Figure 11. Comparison of monthly cargo weights and volumes in both periods
Rysunek 11. Zestawienie wag oraz objętości miesięcznych ładunków w obu okresach

Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

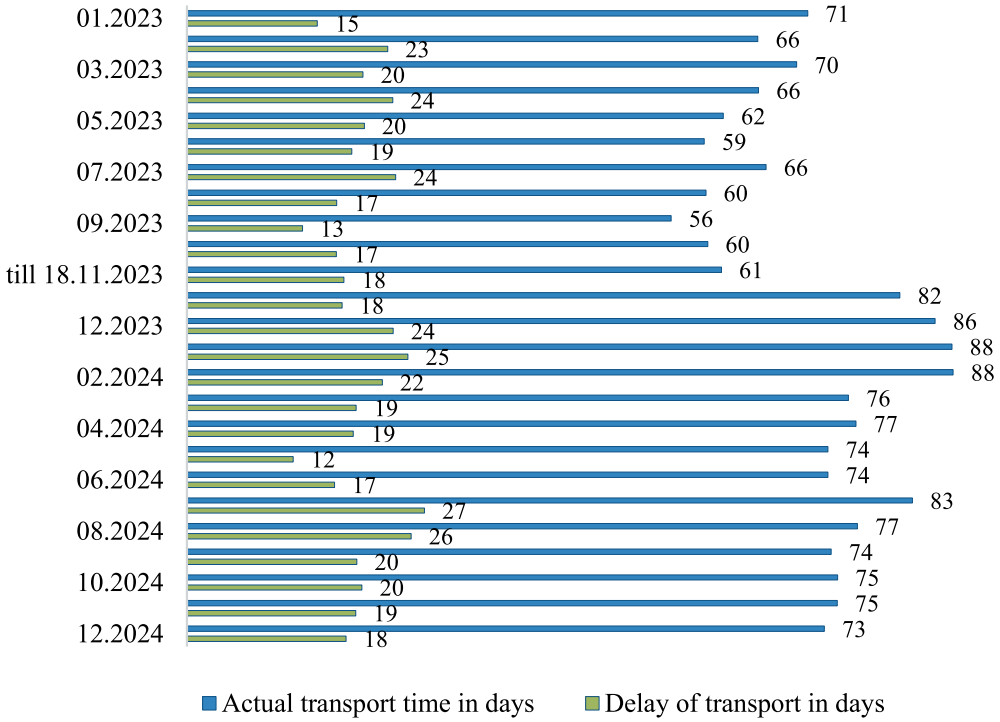

Figure 12. Actual transport time and delays in both analyzed periods

Rysunek 12. Rzeczywisty czas transportu i opóźnienia w obu badanych okresach

Source: author's elaboration based on company data

Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

As a result, a sharp extension of actual transport time occurred, from approximately 60 days in October 2023 to 88 days in January 2024. At the same time, delays increased from a typical level of around 17–20 days to 24–27 days.

In the second half of 2024, a visible improvement in transport time and a reduction in delays emerged, which may indicate a gradual return to standard routes and transport conditions. In December 2024, the average transport time amounted to 73 days, and delays fell to 18 days, a value close to the pre-crisis level.

The correlation coefficient between actual transport time and delays was 0.46, indicating a moderate positive relationship. As transport time increases, delays tend to rise as well, although this relationship is not strong. This value suggests that other factors also influence delays, and transport time is not their sole determinant.

Industry-wide data presented in the E2open Ocean Shipping Index Q4 2024 report indicated a significant deterioration in maritime transport punctuality in 2023–2024. The average transport time for cargo from Asia to Europe at ports such as Muhammad Bin Qasim in Pakistan or Mundra in India increased over the year by 22 and 17 days, respectively, reaching as much as 65 days. In the European region, noticeable extensions were also recorded; for example, in the Slovenian port of Koper, the increase amounted to 14 days. These figures align with geopolitical and structural disruptions, including port infrastructure overload during the ongoing Red Sea crisis.

According to the Port Watch platform, flows through key transit points – the Suez Canal and the Bab al-Mandab Strait – declined by 60.7% and 66.4%, respectively, after the emergence of threats, forcing operators to massively reroute voyages around the Cape of Good Hope. Consequently, the average monthly transport volume around Africa almost doubled compared with the period before the crisis.

Verification of hypothesis H1, which assumed that the geopolitical crisis in the Red Sea caused an extension of transport time by more than 20 days, was carried out by comparing data from before and after the onset of disruptions. The analysis results confirmed the validity of this hypothesis. The observed changes exceeded the assumed threshold, indicating a significant impact of geopolitics on maritime logistics. The increase in transport time was neither marginal nor short-lived but constituted a lasting consequence of route changes and the reorganization of shipping operations.

The analysis of maritime transport data before and after the beginning of the Red Sea crisis in November 2023 made it possible to formulate several conclusions. First, a significant impact of the geopolitical situation on the course of maritime routes was observed. As a result of the threat of attacks, operators abandoned the route through the Suez Canal, directing vessels around the Cape of Good Hope. This led to a marked extension of actual transport time and an increase in unloading delays. Despite the disruptions, the total cargo volume did not decline, indicating high flexibility of the logistics system and the ability of operators to adapt quickly under disturbance conditions.

The structure of shipments in terms of cargo type remained stable. The moderate correlation between actual transport time and delays suggests that, apart from route length, other operational factors such as port congestion, schedule reorganization by carriers, or weather conditions also play an important role. Data from the second half of 2024 indicate a gradual stabilization of the situation and a possible return to earlier operational parameters of maritime transport between Asia and Europe.

Relationships between cargo characteristics and changes in transport duration

To determine which additional factors influence changes in maritime transport time on the Asia–Europe–Asia route, taking into account the Red Sea crisis in 2023–2024, a linear regression analysis of the transport data was performed. The dependent variable in this model was the actual transport time measured in days, while the independent variables included the remaining available cargo parameters, namely:

- cargo type (FCL, LCL)
- loading and unloading regions coded as binary variables (Middle East, Western Europe, Northern Europe, Southern Europe)
- cargo characteristics (weight, volume)
- threat period coded as a binary variable (0 – no threat, 1 – threat present)
- estimated date of cargo passage through the Red Sea
- transport delay expressed in days.

The analyzed countries were grouped into regions in order to avoid using an excessive number of independent variables. This reduced the number of countries from 23 to 5 aggregated regions. They were classified as follows:

- Southeast Asia – China, South Korea, Malaysia, Singapore, India, Australia
- Middle East – Saudi Arabia, UAE, Egypt
- Western Europe – Germany, France, Belgium, the Netherlands
- Southern Europe – Italy, Spain, Portugal, Slovenia
- Northern Europe – Poland, Sweden, Norway, Denmark, Finland, the United Kingdom.

The constructed model, based on 5,750 observations, explained 54.2% of the variability in transport time (Table 6). This is a good result given the data's nature, which includes variables difficult to specify precisely, such as weather conditions or operators' direct decisions. To prevent the so-called "dummy variable trap," one reference category was removed – Southeast Asia. The adjusted R-squared differed only minimally, suggesting that the number of variables did not cause excessive model complexity relative to the available data, and the multiple R indicated a strong positive linear correlation between actual transport time and the variables used. The standard error of 15.24 days indicates the average deviation between actual and predicted values.

Table 6. Key results of the linear regression analysis
Tabela 6. Kluczowe wyniki analizy regresji liniowej

Indicator	**Value**
R-square	0.5418
Adjusted R^2	0.5410
Sample size	5,750
Model standard error	15.24 days
F-statistic significance	≈ 0 (highly significant model)

Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

Through the analysis of the regression coefficients, the impact of individual independent variables on maritime transport time was identified (Table 7). The model captured the significance of changes in transport duration following the emergence of threats in the Red Sea and clarified their practical implications. Among the regional variables, the strongest effect was associated with the location of the loading/unloading port in the Middle East, which increased the average transport time by approximately 10 days. Ports in Western European countries generated additional delays of about 4 days. An opposite tendency was observed for Northern and Southern Europe, where both regions recorded a reduction in transport time by approximately 5 and 6 days, respectively. During a period of disruption to the regular supply chain, a more favorable position relative to alternative routes and higher efficiency of specific ports may have contributed to these beneficial outcomes.

The second hypothesis (H2), which stated that the mass and volume of cargo transported along the Europe–Asia routes in 2023–2024 did not have a significant impact on transport duration, was confirmed. The regression analysis showed that volume was not a statistically significant explanatory variable, and although mass was statistically significant, its effect was marginal. This means that the physical characteristics of the cargo did not determine transport duration in the analyzed period; instead, delivery times depended

Table 7. Summary of the impact of variables on transport time
Tabela 7. Podsumowanie wpływu zmiennych na czas transportu

Variable	Significance	Effect
Cargo type	significant	extended time by approx. 1.7 days
Middle East	highly significant	extended time by approx. 10 days
Western Europe	highly significant	extended time by approx. 4 days
Southern Europe	highly significant	reduced time by approx. 6 days
Northern Europe	highly significant	reduced time by approx. 5 days
Weight [kg]	significant	minimal effect
Volume [m³]	not significant	no meaningful effect
Date of passage through the Red Sea	**highly significant**	**later date → shorter transport time**
Threat period	**highly significant**	**strongest effect: extended time by approx. 25 days**

Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

primarily on organizational factors and the geopolitical situation. The variable describing cargo type proved significant, though its effect was moderate. Full-container-load shipments increased transport time by an average of 1.7 days compared with less-than-container-load goods.

The most influential variables in the model were those related to the passage period (Figure 13). The estimated date of passage through the Red Sea showed a negative correlation with transport time: the later the passage date, the shorter the recorded transport duration. This may indicate a successful adaptation of the maritime transport market to the ongoing crisis. The most statistically significant variable was the "threat period," which increased transport duration by an average of 25 days, making it the most important explanatory variable in the model.

The residual plot confirms the relationship between the predicted values (transport time) generated by the regression model and the forecast errors (residuals). They were obtained by calculating the difference between the actual value and the value predicted by the model:

$$residual = y - \check{y}$$

- y – actual transport time,
- $\check{y}$ – transport time predicted by the regression model based on the variables: delay, day of the year, weight, volume, cargo type, threat period.

The points are evenly dispersed around the zero axis, which indicates that the model accurately reflects the linear relationship (Figure 14). The absence of a clear pattern in the residual distribution suggests that the assumption of constant error variance (homoscedasticity) is satisfied. No systematic deviations were observed that would indicate model misspecification. The plot confirms that the regression model has a sound statistical foundation and that its application to the analysis of cargo transport time is justified.

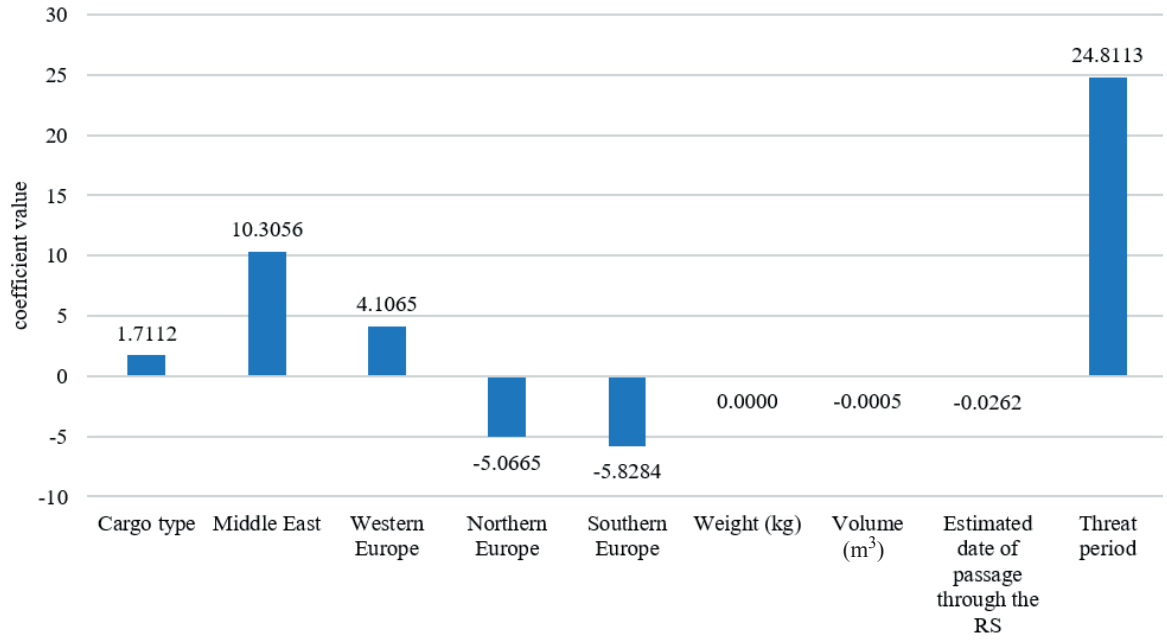

Figure 13. Coefficient values of independent variables in the regression analysis
Rysunek 13. Wartości współczynników zmiennych niezależnych analizy regresji
Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

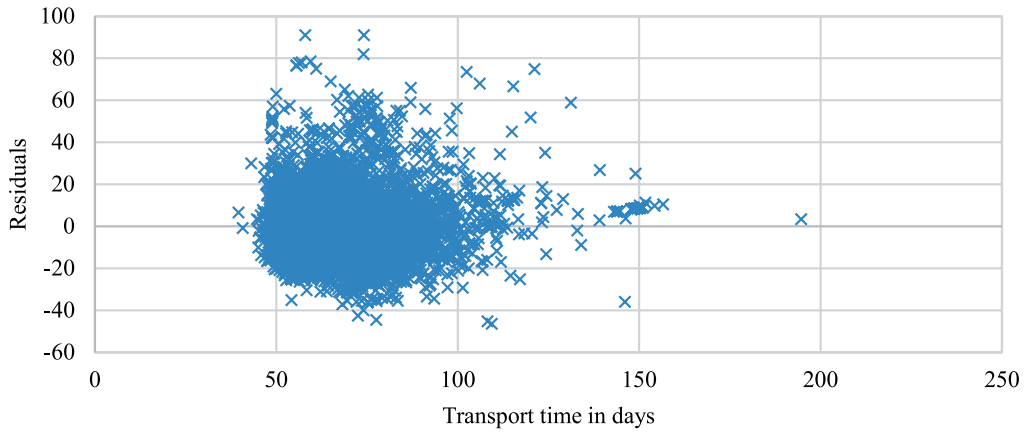

Figure 14. Relationship between the predicted values and the forecast errors
Rysunek 14. Zależność między wartościami przewidywanymi a błędami prognozy
Source: author's elaboration based on company data
Źródło: opracowanie własne na podstawie danych z przedsiębiorstwa

In summary, the conducted analysis of transport data demonstrated that the linear regression model achieved a high explanatory capacity, as more than 54% of the variability in transport time was shaped by the included variables. The most important factor contributing to the extension of transport duration was the occurrence of the threat period, linked to geopolitical instability and the uninterrupted Houthi attacks in the Red Sea region since November 2023. This threat increased delivery time by an average

of 25 days, making it the dominant variable in the model. Regional differences were also significant, as transports ending in the Middle East and Western Europe lasted longer, while deliveries to Northern and Southern Europe were characterized by shorter transport times.

Conclusions

In 2023–2024, the Red Sea region became a focal point due to disruptions in maritime transport that affected the functioning of global supply chains. Accordingly, this study focused on identifying the factors influencing the duration of maritime cargo transport through this basin during the specified period. The choice of topic was also driven by the growing importance of this area as a key transport route and by the emerging disruptions that additionally affected the economies of regional states. The core of the analysis centered on the impact of the geopolitical situation on transport duration and on the potential influence of the physical characteristics of cargo on delivery efficiency under conditions of operational instability.

The results of the study showed that geopolitical and infrastructural factors had the greatest influence on transport times. Once threats emerged in the Red Sea region, particularly in the Bab al-Mandab Strait and around the Suez Canal, operators were forced to reroute vessels around the Cape of Good Hope. This change in routing directly translated into extended transport times, with differences averaging 25–28 days compared with the pre-crisis period, which is directly confirmed by the analyzed data. Thus, the first hypothesis (H1), which stated that the geopolitical situation leads to longer transport times, was confirmed.

The second research area involved analyzing physical cargo characteristics, such as mass and volume, in terms of their impact on transport duration. The applied models showed that cargo volume had no statistically significant effect, while mass, although statistically significant, had a negligible practical impact. This means that regardless of the size of the transported cargo, the main determinants of delivery time were external conditions and operational decisions made by carriers in response to threats. The analyses therefore confirmed the second hypothesis (H2), which assumed that physical cargo properties did not play a key role in shaping maritime transport durations during the analyzed period.

An important outcome of the study was also the identification of regional variation in the impact of loading and unloading port locations on delivery times. Ports in the Middle East and Western Europe were associated with a statistically significant extension of transport duration, whereas ports in Northern and Southern Europe contributed to shorter delivery times. This may indicate greater flexibility in these regions in adapting to routing changes. Such patterns demonstrate that delivery times are shaped not only by distance and political risks but also by the adaptability and efficiency of infrastructure and operators under crisis conditions.

The findings of the study can be applied in practice primarily to enhance risk management and operational planning in maritime transport. Since it was confirmed that geopolitical factors were the main drivers of delivery times, logistics companies should develop early-warning systems for emerging threats and predictive models that incorpo-

rate political dynamics along key shipping routes. The observed differences between port regions in their impact on transport duration can also support the optimization of logistics networks. Ports demonstrating greater operational flexibility and stronger adaptive capacity may become preferred nodes during periods of instability. Moreover, transport companies can use the results to improve customer communication and ETA forecasting. If delivery times are primarily shaped by political risks rather than technical or operational parameters, forecasting models must remain adaptable and account for potential scenarios of escalation or stabilization in the Red Sea region. This enhances both the accuracy of predictions and the transparency of information shared with clients. In a broader perspective, organizations planning long-term operations can use insights about disruption mechanisms in the Red Sea to design diversified and flexible logistics structures that reduce dependency on critical chokepoints such as Bab al-Mandab or the Suez Canal. This not only mitigates current risks but also creates a competitive advantage by ensuring delivery stability under crisis conditions.

The collected material and formulated conclusions may serve as a foundation for further research on the resilience of maritime supply chains to geopolitical disruptions, as well as for developing strategies to minimize risk in international transport. The study revealed not only quantitative changes in delivery times but also demonstrated how complex and multifactorial the structure of determinants influencing global transport efficiency truly is.

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