Steel Producing and Automotive Industry Depending on Geopolitical Circumstances – A Case Study for Inland Navigation

Andrej DÁVID[1], Stanislav BLAŠKO[2], Andrea MATERNOVÁ[3], Adam TÖRÖK[4]

[1] andrej.david@uniza.sk, Department of Water Transport, Faculty of Operation and Economics of Transport and Communications, University of Zilina, Zilina, Slovakia
[2] stanislav.blasko@gmail.com, Slovak Shipping and Ports, Bratislava, Slovakia
[3] andrea.maternova@uniza.sk, Department of Water Transport, Faculty of Operation and Economics of Transport and Communications, University of Zilina, Zilina, Slovakia
[4] torok.adam@kjk.bme.hu, Department of Transport Technology and Economics, Faculty of Transport Technology and Economics, Budapest University of Technology and Economics, Budapest, Hungary

ABSTRACT

This document focuses on a logistical chain that uses multimodal transport, including rail, inland waterways, bulk transport and general freight transport. The article describes the logistics of iron ore drilling and its transport as the basic raw materials of steel production. The process also oversees the distribution of final products in the automotive industry, namely galvanised steel rods, the highest-quality and expensive products in the steel industry. The authors used statistical tools to analyse the throughput of Danube River ports and the impact of the war conflict in Ukraine on their throughput.

KEYWORDS

different modes of transport; logistics chain; iron ore; galvanised steel coils; automotive industry.

1. INTRODUCTION

Iron ore is one of the most important steel sources in the automotive industry because it produces steel coils or steel plates. Until the war in Ukraine started, most iron ore was transported to Slovakia either from Russia or Ukraine. After February 2022, Russia was replaced with overseas deliveries of iron ore (South Africa, Brazil). Ukraine is still a very important and stable partner for iron ore deliveries despite many problems caused by the war. Delivery from one important Ukrainian mine was stopped very soon after the war started (Zaporozhje mine), but other mines are still active. Slovakia, as a country, specialises in the automotive industry. Nowadays, it belongs to the leaders in the production of cars per person in the world [5], [22], [25]. Slovakia was the country with the highest number of cars produced per 1,000 inhabitants in 2022, with a value of 184 cars produced per the number of inhabitants. Czechia placed second, producing 115 cars, followed by South Korea with 72 cars and Japan with 58 cars produced per one thousand inhabitants.

In the article, we analyse a logistics solution focused on transporting fine and iron ore pellets by transport for the automotive industry. The paper aims to investigate how the port's location influences the throughput over time, as in Wu, Dong and Meng in 2025. Therefore, throughput dynamics were investigated. The author cluster analysed the investigated ports' throughput to generalise the results. Additionally, the yearly throughput was analysed using multidimensional scaling to determine if any changes had occurred in the throughput in recent years, such as those reported by Hosch et al. in 2025. Individual parts of this logistics chain will be carried out by railway, inland water and road transport. While rail and water transport are suitable for the transport of iron ore from the place of its origin to the place of its processing, road transport finds application in the transport of steel coils to the customer for its delivery in a JIT (Just in Time) system (Lambert et al. 2000, Wang, Peng, 2025).

Inland water transport is key in transporting bulk cargo (iron ore or coal) over long distances, where we have the conditions to use it, of course, with maximum safety (Rodriguez, 2023). It pushed convoys that

consisted of a pusher and barges operating on the whole stretch of the Danube. According to Hasenbichler, H-P. et al., the convoy size depends on the waterway class on which the pushed convoy operates.

2. INLAND WATER TRANSPORT

Water transport is one of the oldest types of land transport, and it has undergone remarkable transformations since its inception (Charłampowicz, Mańkowski, 2024). Currently, it is one of the most efficient types of transport, playing an essential part in transporting bulk, general and liquid cargo while having the least negative impact on the environment (Filina-Dawidowicz et al., 2022).

In water transport, respectively in inland navigation, the carrier uses different types of navigation (inland, maritime or combined) to fulfil the carrier's requirements. Means of transport of inland water transport (motor cargo ships, pushing or towing units) use inland waterways (navigable rivers, artificial canals and other inland waters) for their movement.

There is no defined boundary between inland and maritime navigation. In some cases, seagoing ships use sufficiently deep, naturally navigable rivers for navigation (e.g. the Amazon River), i.e. ships sail upstream tens to hundreds of kilometres to inland ports located deep inland (Adepoju 2024). On the other hand, under certain conditions, river ships can sail on shorter sea routes, mainly along the coast in sea bays protected from weather conditions in the open sea (Norwegian fjords). Some vessels are designed to sail in river and sea conditions (so-called river-sea ships).

As a mode of transport, inland water transport is:
— Economical, the most ecologically favourable and energy-efficient,
— Important for cargo transportation (bulk cargo, piece, liquid cargo), where transportation speed is not a decisive criterion. It also transports wheeled and tracked equipment that uses horizontal transhipment and transport technology in the Roll-on / Roll-off (Ro-Ro) system.
— Irreplaceable in the transportation of oversized or heavy shipments,
— Significant because it ensures the connection of inland and seaports using rivers.

3. INLAND WATER TRANSPORT IN SLOVAKIA

The Slovak Republic is approximately halfway between the Black and North Seas, and the Danube River plays the main and most significant role in inland navigation. Although the Danube is only 172 kilometres in the Slovak part, it is a river border (state border between Slovakia and Hungary) and the most important river in Central Europe (Bajor et al., 2024).

The river Danube's depth also allows for the navigation of bigger vessels with higher drafts, and it is not unusual to see vessels with drafts of around 3 m at good nautical conditions. In the past, there was a special type of vessel called river-sea vessels, which could pass the river Danube and enter the Black Sea.

There are three river ports situated on the Danube River (Bratislava, Komárno and Štúrovo), but considering international trade and international shipment, the Port of Bratislava and the Port of Komárno are the most important. Port of Bratislava is located on rkm 1868, and Port of Komárno is 100 rkm downstream. From the logistics point of view, approximately 1,5 – 2 million tons of cargo are handled and partly stored in the Port of Bratislava each year, which places Bratislava on the map with the most important ports on the Danube River. The Port of Komárno manipulates approximately 100,000 tons of cargo per year. Detailed analysis of water transport performance will be presented in Chapter 5.

4. DESIGNING A SUPPLY CHAIN STRATEGY FOR THE AUTOMOTIVE INDUSTRY – FROM IRON ORE TO STEEL

This chapter focuses on a specific example of goods movement through a comprehensive logistics chain. This logistics chain incorporates multiple modes of transportation, including extensive use of rail, inland waterways and road transport, and features several transhipment points throughout the journey (Šimek et al. 2021).

We will explore the movement of iron ore, a critical raw material used in steel manufacturing, and trace the subsequent distribution of the finished product: high-quality, expensive galvanised steel coils.

4.1 Mining of iron ore in Ukraine and its transportation to Slovakia

Iron ore mining starts in the Poltava region in Ukraine's centre. Wide gauge rail cars are made after transport from the Ukraine mine to the first Slovak transhipment facility. Before the war between Russia and Ukraine started at the beginning of 2023, the Poltava mining industry could support the producing market with more than 12 million tons of high-quality iron ore pellets. Production at the firm dropped from around 3.1 million tons in 2021Q4 to 0.4 million tons in 2022Q4 as the loss of electricity and other operational disruptions from the invasion rocked it. Since then, it has gradually recovered its operational capabilities and produced 3.7 million tons in 2023Q2 (Lyon, 2024).

In Cierna and Tisou, pellets are transhipped by a rotary tippler into rail cars with narrow gauge. Due to this effective technology, pellets are transhipped very fast, and rail cars are safer, considering the huge damages (Bulková et al. 2022) caused by grabs or hydraulic dredges used before. The total volume handled by the west and east transhipment complex in Cierna and Tisou is slightly less than 5 million tons of bulk cargo per year (during the year of standard steel production).

Standard gauge rail cars transport iron ore pellets or fine ore from the east of Slovakia to Bratislava. This usually takes one day. In case of heavy traffic, bad weather conditions or other technical issues, the time for transport is approximately 2 – 3 days.

4.2 Transhipment of iron ore in the Port of Bratislava

The transhipment of iron ore is primarily done in the Port of Bratislava by special cranes, such as Ganz 16 t/32 m, which are very common for transloading in the ports. The public universal Port of Bratislava has an advantageous geographical and transport location at the Danube River, at 1866 river kilometres from its source. Its proximity to Vienna and Budapest, its favourable road and railway connection to the Slovak economic and industrial background, and the Czech Republic designate the Port of Bratislava to have an essential role in goods exchange and transport to all directions. The capacity of the Port of Bratislava is 2,5 – 3 million tons per year, depending on the goods and composition. The current volume is approximately 2 – 2,5 million goods annually, including liquid cargo.

The Port of Bratislava area has two parts: the winter port (the old part) and the Palenisko basin (the new part).

Two basins (the North and South basins) were dredged in the winter port between 1897 and 1907. First, they were intended for the protection and wintering of vessels, but nowadays, they are also used for transhipment activities. From the point of view of the structure of transhipped cargo, this part of the port has a universal character. Port gantry cranes work in hook-and-grab mode at their transhipment positions. Bulk and general cargo, including iron ore from Ukraine, are handled mostly there.

Transhipment of fine ore or iron ore pellets can be direct or indirect. Indirect transhipment involves with use of a storage area and depends on the following:
— Priorities of the final recipient of cargo,
— Water conditions,
— Income and outgoing volume of the Port of Bratislava,
— Buffer stock request or long-time storage policy.

The total volume used to store iron ore is approximately 200,000 tons (Slovak Shipping and Ports, 2023). This volume also considers using smaller transhipment areas for other types of bulk cargo (e.g. slag, coal, coke).

4.3 Modality change and transport of iron ore from Bratislava to Linz by inland water transport

After the change of modality, iron ore is transported by river vessels from the Port of Bratislava to the Port of Linz (the industrial Port of Voestalpine Rohstoffbeschaffungs GmbH).

Generally, river barges have a maximum tonnage of 1,800 t at a draft of 2.8 m. Pushers push them, and each convoy on this transport route consists of 2 – 4 vessels.

Depending on the type of push boat and the water level situation, it is possible to push from 2 up to 4 units (barges) in one convoy with a total volume of 1,500 tons up to 4,400 tons.

The transport time (shipment) from Bratislava to Linz is approximately 3 days, with 16 hours of sailing time per day. However, there is also a second option – using self-propelled vessels.

There are several possibilities for transporting iron ore in river barges. The point is to find the most effective and most economical means of transport in a long-term perspective.

1) The fastest way is to use self-propelled vessels (a vessel that, using its permanent propulsion and steering, has all self-navigability characteristics). In this case, it is possible to reach the Port of Linz (port of discharging) in 1 – 1.5 days, depending on the locks. On the other hand, when using self-propelled vessels, we can talk about 800 – 2,000 t of cargo, which can be significantly less compared to using other types of river units. Because we are talking about bulk cargo with high consumption (consumption of iron ore in a mid-sized steel mill is approximately 2.5 – 5 million tons per year) and not about JIT cargo, time is not a crucial factor in the logistic chain. More important is continuous delivery within a period (month/year).

2) A more effective transport method is convoys (pusher + river barges). Even though transit time is approximately one day longer and takes 2.5 days from Bratislava to Linz, the convoy can take more cargo in one voyage than the self-propelled vessel. There are also two possibilities for using convoys:

— Pusher + 2 barges. This model is effective in low water or when using the least powerful pushers. The loading capacity of such a convoy is usually between 1,800 and 3,500 tons, and the draft of the units is between 17 dm and 27 dm.

— Pusher + 4 barges. With this model, we can easily exceed 4,000 tons in one convoy, depending only on the parameters of the pusher (also considering water level) and the maximum capacity we can reach.

Transport on the Danube River's Austrian part is more complicated than on the lower Danube. It is only 259 river kilometres from the Port of Bratislava to the Port of Linz (Bratislava rkm 1868, Linz rkm 2127), but there are seven locks on the way (Freudenau, Greifenstein, Altenworth, Melk, Ybbs, Wallsee, Abwinden).

Each lock means a partial time delay or time stop, which can be 1 – 2 hours in case of low traffic, but can also be longer, especially in summer when higher traffic is due to the higher number of passenger vessels. Thanks to the locks, the Danube River is navigable almost all the time from the Black Sea (Constantza, Izmail, Reni) up to the North Sea (Amsterdam, Rotterdam, Antwerp).

Voestalpine is one of the largest steel producers in the European Union, producing a wide range of products. Unloading iron ore from vessels takes place using grab unloaders technology, and, as in Bratislava, it can be either direct or indirect (via storage area). There is one bottleneck – the location of the factory. Voestalpine is located close to the City of Linz, and it is impossible to enlarge stock capacities to a level that is comfortable for current quantities and the disparity of incoming sources.

After discharging iron ore from the river barges, it is necessary to clean them. Bobcat removes any remaining iron ore. Sweeping is usually performed by specialised machines, which are much more efficient than the port crew. The following cargo is particularly important: if barges are used to load grain, for example, wet cleaning is necessary (using water plus chemical detergents). If barges are used to load steel (plates or coils), dry cleaning and sweeping are sufficient.

Voestalpine's production is quite broad, and a very important part of the production is steel coils for the automotive industry. These steel coils are transported from Linz to Trnava (Stellantis) by inland water and road transport. For optimisation and decarbonisation, the manufacturer switched to combined transport using river vessels (Slovak Shipping and Ports, 2023).

4.4 Inland water transport of steel coils from Linz to the Port of Bratislava

Coils are transported from the producer to the buffer stock in Bratislava on river vessels, which must be covered and protected from rain due to the sensitivity of the transported material. The transport itself takes a maximum of 2 days. The difference between upstream and downstream voyages is 0.5 – 1 day, depending on water level and traffic on the Danube (locks waiting time).

Since automotive steel is sensitive, loading spaces must be provided in ideal conditions. This means dry and clean. Especially in winter, keeping the load space dry can be a challenge. Of course, the only possibility is to use covered barges. The opening on the side of the cover was installed to keep the loading space ventilated. Conversely, openings must be protected from rain.

4.5 Discharge and warehousing of steel coils in the Port of Bratislava

In the Port of Bratislava, steel coils are unloaded at a special location in a warehouse designed for storing ferrous materials. Unloading one vessel (approximately 1,000 t) takes 4 – 5 hours. The coils are unloaded using bridge cranes into special cradles (for safety reasons). The internal steel production warehouse (Ferroservis) has a net storage area of 22,000 sq m and a floor capacity of 30 tons/sq m. The storage capacity is 60,000 tons of metal materials. The warehouse also serves as a buffer stock for producing steel coils and plates. The

consumption of steel material can differ from the production at a specific time. Therefore, it is necessary to have a minimum of 1 – 2 months of production capacity as a storage reserve.

The warehousing halls are equipped with 12 single-girder cranes with a lifting capacity from 10 tons to 32,5 tons (maximum lifting capacity). In the hall, a special device enables the turnover of steel coils from vertical to horizontal position and vice versa.

Depending on the final recipient's or the producer's requirements, storage usually takes 5 – 10 days. It can also be longer (usually during summer and general factory holidays). Before loading the steel coils onto the truck, the coils are unwrapped from the paper cover and controlled. The wrapping material must be disposed of professionally, as the rolls are oiled (sprayed on the surface with oil).

4.6 Delivery of steel coils from Bratislava to Trnava

After all processes regarding storage, control of quality and unwrapping of material are done, steel coils are waiting for the next dispositions coming from car manufacturer Stellantis Slovakia in Trnava, car producers (Peugeot and Citroen cars), and one of the largest industrial companies and employers in Slovakia. The type of coil is dedicated to the production line, and the plant must follow instructions very strictly. Since the logistics chain relies on JIT deliveries, only reliable and verified trucking companies can participate.

The bridge crane loads coils with a lifting capacity of 32.5 tons. Loading one truck with one or two coils (coil weighs between 7 and 15 tons) takes approximately 10 minutes (Slovak Shipping and Ports 2023).

Port of Bratislava (Ferroservis) is fast and takes approximately 1 hour (depending on traffic). The distance from the loading place to the discharging point is 50 km. A short distance is one of the reasons for well-working JIT deliveries.

5. IMPACT OF WAR IN UKRAINE AND RESULTANT ECONOMIC IMPACT

The year 2022 was challenging for Europe as a whole. After the war in Ukraine started, most cargo flows and standard logistics chains were changed. Unsafety led to a massive stock increase in most industrial plants across Europe. On the other hand, unprecedented increases in energy (gas, electricity, coal, coke, fuels) have led to decreased production or the complete closure of industrial plants. The authors statistically analyse the throughput of Danube River ports.

Table 1 – The throughput of major Danube ports between 2019 and 2022 (in million tons)

[million tons]	2019	2020	2021	2022
Constanta (RO)	14.5	14.5	15.8	15.4
Ismail (UA)	4.3	3.2	4.1	8.9
Reni (UA)	1.3	0.8	1.4	6.8
Smederovo (SRB)	4.0	2.6	3.2	3.0
Galati (RO)	3.1	2.8	3.3	3.0
Linz (AU)	3.3	3.4	3.5	2.9
Giurgulesti (MD)	1.3	1.2	1.8	2.1
Bratislava (SK)	1.7	1.5	1.8	1.9
Pancevo (SRB)	1.5	2.0	0.9	1.6
Regensburg (AU)	1.3	1.5	1.3	1.1
Droberta Turnu Severin (RO)	1.2	1.0	1.2	1.0
Budapest - Csepel (HU)	1.1	1.2	1.2	1.0
Prahovo (SRB)	1.1	1.2	1.0	0.9
Macin-Turcoaia (RO)	0.9	1.2	1.2	0.9
Novi Sad (SRB)	1.4	1.6	1.4	0.9
Giurgiu (RO)	0.8	0.8	1.0	0.7
Vienna (AU)	1.2	0.8	0.9	0.6

[million tons]	2019	2020	2021	2022
Calarasi-Chiciu (RO)	1.1	0.9	0.9	0.6
Enns (AU)	0.8	0.6	0.7	0.5
Tulcea (RO)	1.6	1.2	1.3	0.5
Baja (HU)	0.5	0.8	0.6	0.3
TOTAL	48.0	44.8	48.5	54.6

Source: CCNR Market Observation 2023

There is a 12,7 % increase in Danube ports in 2022 compared with 2021 (from 48.5 to 54.6 million tons). Considering all the ports, we can see a massive rise in Danube ports in Ukraine due to the closure of the Black Sea corridor. On the other hand, most of the EU's major river ports on the Danube noted a slight or more significant volume decrease (*Figure 1*).
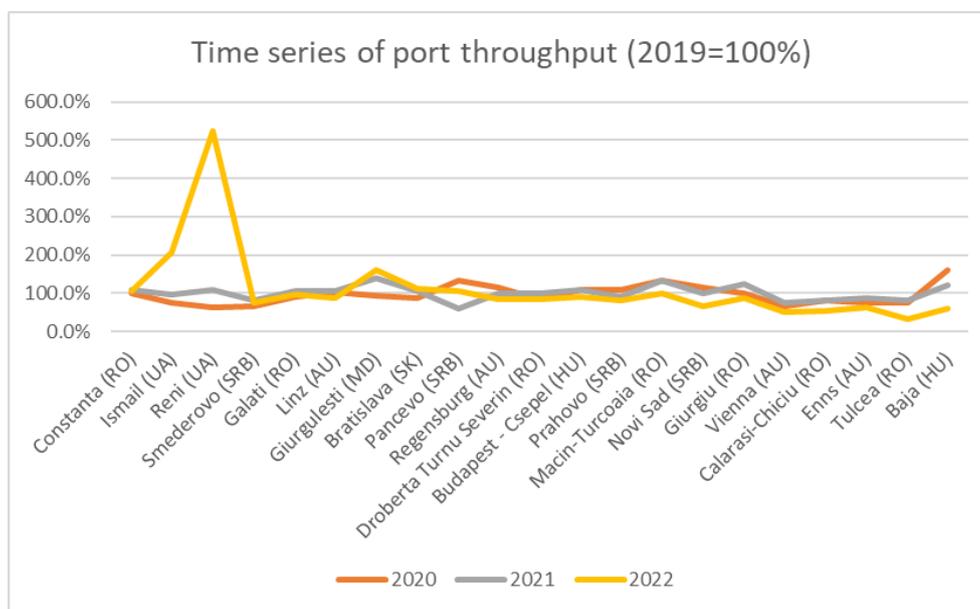

Figure 1 – Relative time series of port throughput
Source: Authors

The authors have statistically investigated the performance of ports. Statistical analysis aimed to determine similar ports by their performance. For that reason, cluster analysis was performed on the time series of different ports. The time series (port's throughput over time) was considered multidimensional (as several ports were investigated in parallel), and clusters were formed based on their throughput. Based on K-means clustering (there are other methods, but the K-means method is widely accepted and used in logistics), the results were visualised on a dendrogram (*Figure 2*). Given a set of observations (x_1, x_2, ..., x_{21}) of 4-dimensional arrays of ports throughputs, K-means clustering aims to partition the 21 observations into k (≤ 21) sets S = {S_1, S_2, ..., S_k} to minimise the within-cluster sum of squares:

$$\arg\min_{\mathbf{S}} \sum_{i=1}^{k} \sum_{\mathbf{x} \in S_i} \|\mathbf{x} - \boldsymbol{\mu}_i\|^2 = \arg\min_{\mathbf{S}} \sum_{i=1}^{k} |S_i| \operatorname{Var} S_i \tag{1}$$

where μ_i is the mean of the points in S_i.

In this case, the authors build a 4-dimensional vector-based system (the four years of investigation [2019 – 2022]) with 21 observations. This results in a partitioning of the ports' throughput data into clusters that minimise the within-cluster variances (squared Euclidean distances).
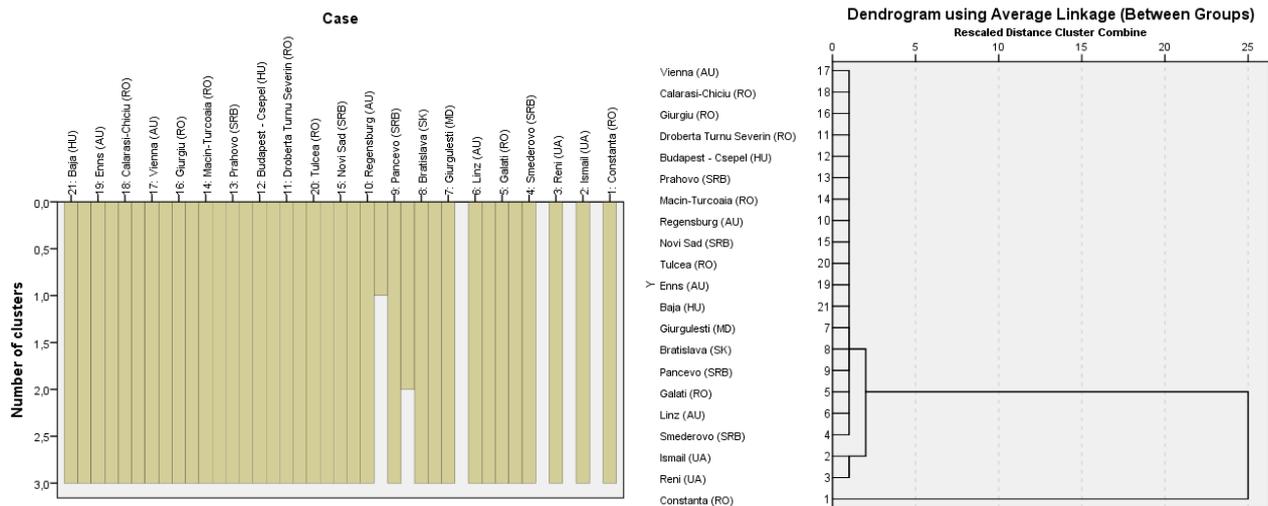
Figure 2 – Clusters and dendrogram of port throughput
Source: Authors

As the results show, Constanta (RO) plays an important role and has a unique cluster with the most significant performance. The second cluster is formed by two Ukrainian ports, Ismail and Reni, with the most significant performance development between 2019 and 2022. Finally, the third cluster is formed by the remaining ports.

A detailed focus on the Port of Bratislava helps to understand EU industrial development in 2022 – 2023, which was influenced by the war and economic fallout. Although the total number in 2022 is still high, we can see a decrease in the primary commodity (iron ore). This decrease was caused by an interruption of deliveries from one of the two total sources of iron ore in Ukraine.

The authors used multidimensional scaling to investigate the dynamics of ports' performance. Multidimensional scaling refers to related ordination techniques used in information visualisation. It is a form of non-linear dimensionality reduction. In our case, 21-dimensional data of ports' throughput (for each year, all the 21 investigated ports were considered) was reduced to two dimensions (D1, D2) to reveal if the war in Ukraine significantly affected ports' performance.

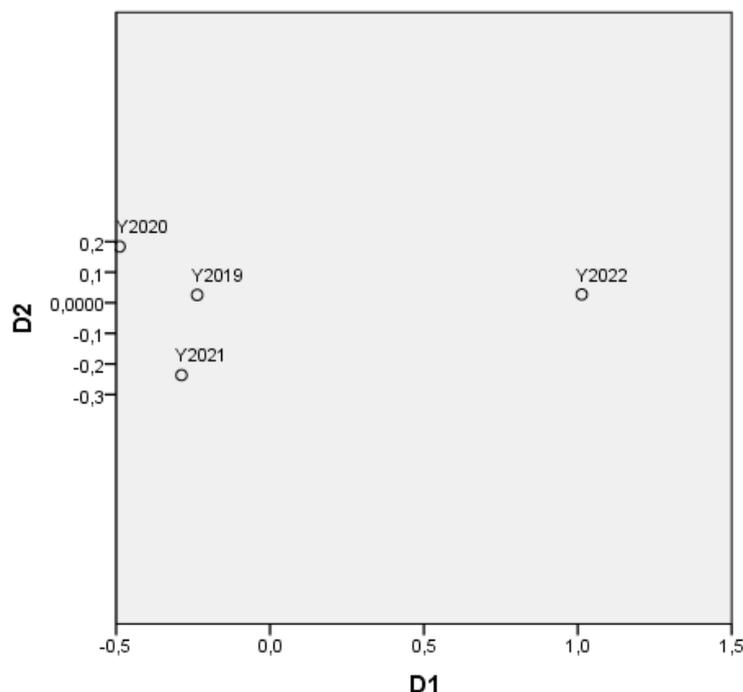This can be easily seen in multidimensional scaling based on the dynamics of port throughput (*Figure 3*).

Figure 3 – Multidimensional scaling of port throughput
Source: Authors

Figure 2 shows the effect of the war in Ukraine, as 2022 is very far away from 2019, 2020 and 2021.

Table 2 – Transhipment in Port of Bratislava in 2013 – 2023 (in tons)

Commodity	Transhipment in the Port of Bratislava (except for liquid cargo)										
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
iron ore	1 060 809	976 609	1 064 899	1 142 582	1 313 949	974 442	759 499	894 224	1 024 806	908 740	671 081
agricultural products	4 901	11 176	3 004	4 010		2 020	8 380	6 455	1 106	6 988	3 239
fertilisers	14 658	2 484	2 081		1 986	2 530	1 382				998
coke					4 000		208 228	12 930	45 124	142 405	151 028
coal	1 241			13 500	86 244	55 868	17 417	69 956	49 705	84 807	52 007
machinery	14 571	9 698	8 914	10 268	6 570	7 038	10 169	7 266	5 806	8 905	7 730
slag	28 225	33 160	30 427						26 985	23 228	127 439
ores (other)	2 955	281	205				41 242			9 312	
manganese ore	10 614	0	909	47 012	14 888		11 998	10 093	26 151		
steel scrap	8 385	14 446	1 916	1 138							
coils, plates, rails (steel)			195 499	216 248	190 474	308 558	233 516	161 649	250 013	236 491	175 714
clinker								13 437	17 612	10 502	5 000
other cargo	37 920	2 175	3 880	2 510							14 266
Total (in tons)	**1 184 281**	**1 050 029**	**1 311 734**	**1 437 268**	**1 618 110**	**1 350 456**	**1 291 829**	**1 176 008**	**1 447 308**	**1 431 378**	**1 208 504**

Source: Internal data of SPaP a.s.

In 2023, the volume of handled iron ore was significantly lower, the lowest from 2013 to 2023 in the Port of Bratislava (*Table 2*). It is also caused by the economic decrease and a decrease in the production of steel products (see the volume of steel, which was only 175 kt in 2023 compared to 250 kt in 2021). There is one commodity with a high volume in 2023: slag (127 kt in 2023). It is a new commodity in the structure of the Port of Bratislava, which started after many years, only in 2021, and the volume reached in 2023 is unexpectedly high. Without this slag volume, the Port of Bratislava's total volume in 2023 would be less than 1,1 million tons, the lowest volume in the last decade.

6. DISCUSSION

This article analyses the logistics chain of multimodal transport of iron ore and steel coils, focusing on the use of inland waterway transport in the context of geopolitical instability caused by the war in Ukraine. Our hypothesis assumes that changes in the supply environment, such as the disruption of traditional export operations, directly impact the performance and function of Danube ports.

The results confirm this hypothesis. Despite the decrease in iron ore volumes in some European inland ports (e.g. Bratislava, Linz), the Ukrainian ports of Reni and Ismail experience a sharp increase in performance. The increased load on the Romanian Port of Constanta as an alternative route for exporting Ukrainian commodities is also confirmed. These results point to the ability of some parts of the transport network to respond quickly to crises, but they also reveal the vulnerability of dependent logistics systems.

One unexpected finding was the significant volume of iron ore in the Port of Bratislava in 2023, which cannot be explained by the outage of one mining plant in Ukraine. This was also related to the overall slowdown in steel production in the European Union and, thus, increased energy costs, which led to a reduction in production and, therefore, the transportation of raw materials. This effect was not fully accounted for in the original analysis, which is represented by only limited studies.

From a methodological point of view, we relied mainly on statistical analysis of port performance, K-means clustering and multidimensional scaling. These tools provided a robust overview of port development, grouping ports according to their similarity in transport performance development. Nevertheless, some variables, such as seasonality, terminal capacity or qualitative aspects of logistics operators' decision-making, remained outside the scope of the analysis.

Our findings will contribute to a broader understanding of how geopolitical events relate to the logistics chain. The study confirms the importance of inland waterway transport as a reliable and environmentally friendly tool for stabilising raw material supplies in times of crisis. It also shows that planning infrastructure

and operational capacities can significantly reduce dependency on a single corridor or supplier in the long term.

7. CONCLUSION

Inland water transport is an essential mode of transport for bulk goods, general goods and liquids. Over the past few years, two incidents have entirely changed the flow of these modes of transport, especially in the Danube region. The first was COVID-19, which led to all restrictions on inland navigation to reduce the spread of the disease. The second was the war conflict in Ukraine, which completely interrupted the flow of transport, which focused on the transportation of bulk cargoes from Ukraine, such as iron ore, coal or grain. The Danube is the most important inland waterway in Central and Eastern Europe. It allows the transportation of goods between ports on the Danube and ports on the Rhine and its tributaries.

This article analyses the logistics chain of the transport of bulk and general goods (ferrous minerals and steel wire), which are essential to the Slovak automotive industry and are an important industry for the economy of the Slovak Republic. These materials are partly transported by inland water transport to the Danube port. Ukraine remains an important country for its extraction and exports. Our logistics chain integrates different modes of transportation to efficiently transport these materials from mines to end customers in the automotive industry, maximising the advantages of the available modes of transportation. The article also deals with how the war in Ukraine has influenced the flow of inland ports on the Danube. Two ports on the Lower Danube and one on the Black Sea coast were significantly affected by the conflict, while others did not register any changes in flow rates.

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