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Comparative Analysis of Long-Distance Transportation with the Example of Sea and Rail Transport

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Abstract: The subject of the article is a comparative long-distance transport analysis based on the relationship between central and eastern China and Poland. It provides an overview of issues related to long-haul China–Poland. The technique for order of preference by similarity to ideal solution (TOPSIS) method was proposed in the multi-criteria analysis. This method was briefly discussed, and its choice was justified. Then, the criteria adopted in the analysis were presented, i.e., time, cost, maximum number of containers, and ecology index. Multi-criteria analysis was carried out for three cases: the transport of one loading unit, 82 loading units, and 200 loading units. The geopolitical and operational situation on the transport route for the analyzed modes of transport was discussed.

Keywords: maritime transportation; railway transportation; multi-criteria analysis

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1. Introduction

The increase in trade between the economies of Poland and China determines the search for the optimal means of transport, adapted to a given order, on the customers carrying out transport along this route. The diversification of the volume, cubic capacity, and weight of transported goods create a field for the use of various means of transport, such as planes, trains, and ships. The task of the customer ordering transport on this route is to select the optimal type of transport.

The article presents the types of transport used to transport most of the goods on the Poland–China route, i.e., sea transport and rail transport [1]. The possibility of air transport was also taken into account. The method of multi-criteria analysis was selected, and the criteria, which, according to the author, are the most important when choosing a transport, were determined [2]. Examples of potential situations of the customer, whose need is to transport various quantities of containers, with a simultaneous slight change in the value of the weights of the criteria, were determined [3]. Conducting such an analysis allows the creation of a ranking that allows the best type of transport to be selected. The presented analysis results are presented in the graphs, comparative and detailed for each case, which allows for a thorough analysis of the obtained results. Later in the study, attention was drawn to the epidemiological situation in the global economy at the beginning of 2020 and affected the transport industry. An analysis of other threats occurring in both types of transport was also carried out, highlighting what a potential client must pay attention to, such as the geopolitical situation and the threat of terrorist attacks.

The presented multi-criteria analysis and additional analysis of unmeasurable situations give a general picture of the possibilities of transporting goods and the risks associated with them on the Europe–China route.

2. Overview of Issues Related to Long-Distance China–Poland Transport

Considering China's area and the variety of goods prepared for transport due to the region in which they are produced, it is difficult to indicate the main starting point for all trains operating on the routes from the Far East to Europe. In this respect, the largest industrial centers located in central China are naturally competing. The distance from ports serving ocean-going ships is significant. For this reason, an attempt was made to transport goods to Europe by rail [4,5].

The second target group for companies offering rail transport from China is companies that care about economically justified, fast export of goods. In such cases, the short distances to seaports or even their presence in the same administrative center are not considered [6].

With the simultaneous dynamic development of rail transport in China, the main and by far the leading means of transport in the export and import of goods is a ship specialized in containers' transport [7]. The developed port system provides almost unlimited possibilities for the transport of goods [8]. Chinese seaports have high transport accessibility thanks to the developed rail and road infrastructure. When choosing sea transportation to export and import goods from China, goods are delivered to the port gates, so-called door to door transportation.

The degree of economic development of this region of China and the designation of many goods for export determines the search for alternative modes of transport. As a result, customers who import goods from China have several options for transporting cargo [9]. If the goods are not oversized, the customer has three options—sea transport, rail transport, and air transport [10].

The seaport of Gdańsk is located on the southern coast of the Baltic Sea, in the Pomeranian Voivodeship. It is the northern part of Gdańsk. The port's land area is 3248 ha, and the port quays specialized for several functions are 23,700 m long. The largest seagoing ships that can sail on the Baltic Sea can be accommodated in the newest part of the Port of Gdansk, called the Northern Port [11].

There are some specialized terminals in the port area that offer to reload various types of goods.

The Northern Port bulk terminal is a terminal that handles large volumes of bulk cargo for the industrial sector [12]. It is equipped with grab cranes, stacker-loaders, and wheel loaders. It is served mainly by rail transport.

The export terminal is the base for reloading coal for export. It includes extensive facilities for the railway infrastructure, including wagon tipplers, wagon defrosting rooms, large storage areas, and belt conveyor systems. The export terminal can handle 35,000 tons a day when loading ships and 38,400 tons a day when unloading railway carriages.

The liquid fuel reloading base is equipped with five reloading stations, handling crude oil and petroleum products [13].

The liquefied petroleum gas (LPG) terminal is designed to receive, store, mix, and distribute cargo.

The newest and most dynamically developing terminal in the Northern Port is the deepwater container terminal in Gdańsk. The constantly dredged and maintained waterway leading to the terminal allows servicing the largest ocean container ships running linearly on the Europe–Far East route. Simultaneously, the terminal accepts smaller feeder vessels, thanks to which it has become the main port—a hub for countries with access to the Baltic Sea.

At the same time, the location of Gdańsk on the southern coast of the Baltic Sea offers opportunities for simultaneous activities related strictly to sea transport as well as combined sea and rail transport. Moreover, thanks to the Far East's opened rail connections, rail transport to the port and further distribution of cargo by feeder ships across the Baltic Sea or to Hamburg is possible.

DCT Gdansk terminal is constantly expanding its logistics facilities, including its railway siding and the infrastructure needed to reload containers. The expansion of the working area of the railway siding in the terminal from four to six tracks and the assembly of four new RTG cranes allow for additional use of rail transport, rather than only in the lines serving only the port's impact area.

The infrastructure connected to the Northern Port in Gdańsk is part of the TEN-T transport network, which guarantees its special supervision and quality by the State and the European Union. Investments implemented in recent years, such as the construction of a new railway bridge over the Martwa Wisła, along with the modernization of the railway line leading to the Northern Port railway station, allow for intensifying rail transport use in the port's operations.

3. Type of Multi-Criteria Analysis—TOPSIS Method

The purpose of all multi-criteria analysis methods of a decision problem is to provide the decision-maker with the tools to solve a problem in which there are simultaneously many conflicting decision criteria. Many authors divide the methods of multi-criteria decision support into multi-criteria decision making (MODM—Multi-Objective Decision Making) and multi-attribute decision making (MADM—Multi-Attribute Decision Making) [14]. Multi-criteria decision making (MODM) examines decision problems in which the set of all possible decisions is a continuous set containing an infinite number of possible variants of the solution. Multi-attribute decision making (MADM) focuses on decision problems in which the set of all acceptable decisions is a discrete set containing a finite, predetermined number of possible solution variants.

There are many methods of the multi-criteria decision—analysis, such as AHP (*Analytic Hierarchy Process*) [15], ELECTRE (fr. *ELimination Et Choix Traduisant la REalité*) [16], PROMETHEE (*Preference Ranking Organization METHod for Enrichment of Evaluations*) [17], VIKOR (sr. *VIsekriterijumska optimizacija i KOmpromisno Resenje*) [18] and TOPSIS (*Technique for Order of Preference by Similarity to Ideal Solution*) [19] can be mentioned.

The TOPSIS selects the alternative closest to the ideal solution and farthest from the negative ideal alternative. The classical TOPSIS method is based on information attributed to the decision maker, numerical data; the solution is aimed at evaluating, prioritizing and selecting and the only subjective inputs are weights.

For the analyzed issue in the thesis, the multi-criteria analysis method was chosen—the technique for order of preference by similarity to ideal solution (TOPSIS). TOPSIS is used in various fields such as IT, space, and transport [20–27]. Supporting the decision-making process in the TOPSIS method allows, among others:

- To look at the problem from a different perspective by organizing criteria and variants within a hierarchy;
- To eliminate the risk of bias or manipulation influencing the decision;
- To make a rational justification of the decision.

The TOPSIS method's assumptions consist of determining the distance of the considered objects from the ideal and opposite solution [28,29]. The result of the analysis is a synthetic index creating a ranking of the examined objects. The best object is considered to be the one that has the shortest distance from the ideal solution and, at the same time, the greatest distance from the anti-ideal solution [30].

The starting point for obtaining decision solutions is to build a decision matrix. The steps for following the procedure are [31]:

1. Calculation of the normalized decision matrix (R),

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum\limits_{k=1}^{m} x_{kj}^2}},\ i = 1,2,\ldots,m\ j = 1,2,\ldots,n \tag{1}$$

2. Calculation of a normalized decision matrix, taking into account the weights of individual criteria (W),

$$t_{ij} = r_{ij} \cdot w_j,\ i = 1,2,\ldots,m\ j = 1,2,\ldots,n$$
$$w_j = \frac{W_j}{\sum\limits_{k=1}^{n} W_k} \tag{2}$$

3. Determination of the ideal solution and the anti-ideal solution,

$$\begin{array}{l} A^{+} = \{ \langle \max(t_{ij} | i = 1, 2, \ldots, m | j \in J_{-}) \rangle, \langle \min(t_{ij} | i = 1, 2, \ldots, m | j \in J_{+}) \rangle \} \\ A^{-} = \{ \langle \min(t_{ij} | i = 1, 2, \ldots, m | j \in J_{-}) \rangle, \langle \max(t_{ij} | i = 1, 2, \ldots, m | j \in J_{+}) \rangle \} \end{array} \quad (3)$$

where

J_{+} is associated with the criteria having a positive impact
J_{-} is associated with the criteria having a positive impact

4. Calculating the value of the distance of each of the considered alternatives from the ideal solution and the anti-ideal solution,

$$\begin{array}{l} d_i^{+} = \sqrt{\sum_{j=1}^{n} \left(t_{ij} - a_j^{+} \right)^2} \\ d_i^{-} = \sqrt{\sum_{j=1}^{n} \left(t_{ij} - a_j^{-} \right)^2} \end{array} \quad (4)$$

5. Calculating the relative proximity of each alternative to the ideal solution,

$$s_i = \frac{d_i^{-}}{d_i^{-} + d_i^{+}} \quad (5)$$

6. Ranking alternatives from greatest to smallest relative proximity to the ideal solution and then selecting a specific number of the most advantageous ones.

The TOPSIS method assumes that the chosen alternative should have the "shortest distance" from the ideal solution and the "farthest distance" from the negative solution—the worst.

3.1. Criteria Adopted in the Multi-Criteria Analysis

To subject the analyzed issue, it is necessary to select criteria to obtain a ranking. In this thesis's analysis, four criteria were selected: time, cost, the maximum number of containers, and the ecology index [32]. The first two of the four conditions are standard criteria for assessing transport in preparatory or multi-criteria analyzes. The other two, i.e., the maximum number of containers and the ecology index, are the conditions that will allow the comparison of sea and rail transport in other planes, for which a common point has still been found [10,33].

The assignment of weights to criteria in the analysis depends on several factors. The first is the amount of transported cargo and its type, which depends on the weight ratio for the delivery time and the cost of delivery [34]. If the ordering party wishes to transport many non-perishable goods, the delivery time is not the most important criterion in the company's planned strategy. In the agreed deliveries, the customer pays more attention to transport costs and tries to minimize it by choosing the cheapest type of transport. Otherwise, when the ordering party orders the goods ad hoc and depends on the delivery time, the time criterion's weight should exceed the weight of the transport cost [35]. When ordering goods for medical purposes, transport must be as fast as possible, regardless of costs, as was the case during the COVID-19 pandemic in 2020 when transporting protective masks and coveralls. Air transport was then used by a transport plane—an An-225 Mrija, the world's largest transport plane [36]. However, it should be taken into account that the greatest limitation in air transport is the permissible cargo weight. There is one plane in the world, the aforementioned An-225 Mrija, that allows 250 tons, which corresponds to seven railway carriages.

An important condition is also the size of the goods. If the cargo's dimensions do not allow it to be transported by a unified unit, such as containers, then the ordering party must select the type that allows for its transport. However, it should be taken into account that there are different types of containers, allowing for the transport of different modes of transport.

In the case of rail transport, oversized transport is possible only in a few conditions.

3.1.1. Time

Time in the analysis is not taken into account in the most precise terms. With high travel times for both modes of over 24 h, days were chosen as the basic unit, which makes it easier to read the data during the comparison. Time is one of the most important criteria in many analyzes for various types of problems, starting from the analysis of project selection to the means of transport. This condition is closely related to cost. In many cases, a longer duration for a task means higher costs because the shorter the time needed to complete the task, the better the ordering party; the condition is a qualitative criterion.

Due to the necessity to choose the imposed route due to hydrographic conditions, sea transport has limited possibilities to reduce time. This is possible through the use of new solutions in shipbuilding, power plants, and the construction of the hull. As shipowners cannot replace their fleet every year, such changes do not have a dynamic characteristic. For the analysis, it was assumed that the time needed to move a ship from central and eastern China to the port of Gdansk is 45 days.

Rail transport has greater possibilities to modify the time of task completion. It is possible to set different routes for the train, which is also closely related to the cost criterion due to the different rates for using the infrastructure [37]. Rail travel time is also related to the availability of infrastructure in a given country and the degree of bureaucracy in permitting train journeys. For rail transport, the conducted analysis established that the time needed to cover central and eastern China's route to the port of Gdansk is 12 days.

3.1.2. Expense

The cost of transport, as mentioned earlier, is closely related to the time in which the operation is carried out. The relationship between these two conditions may deviate more widely when changing another condition, i.e., the maximum amount of charge. For the analyzed problem, the cost per one twenty-foot container (TEU) is presented. Similar to time, the cost is a fundamental condition in many other analyzes for a variety of topics. It is also closely related to the transport of goods and passengers—the lower the cost while maintaining adequate safety in the case of goods and safety and comfort in passenger transport, the better the offer for the final recipient [38,39]. This makes this condition costly.

In the case of rail transport, the transport cost depends largely on the fees charged by the owner of the line and point infrastructure on which the train moves and which it uses. This condition also depends on the mode of transport on which it is operated. In this case, the locomotive and its efficiency are taken into account, i.e., fuel or electricity consumption [40]. The technical condition of the platform carriages and their maximum permissible speed when fully loaded is also important. For the study, the cost of 2000 USD/TEU was assumed for the analyzed route.

In sea transport, the cost depends largely on the current fuel costs and the geopolitical situation. As in rail transport, the level of quality of the means of transport, i.e., a ship, is important. The engine room's efficiency plays a key role in the amount of fuel used and thus translates into transport costs. The study adopted the cost criterion for sea transport at the level of 850 USD/TEU.

3.1.3. Maximum Number of Containers

The possibility of transporting larger batches of containers is an important factor in transport. With long-haul transport, the maximum amount of goods plays an even greater role. In trade between China and Poland, unit orders are rare, and if they occur in retail, they are processed by air transport. The study considers the other two means of transport, which enable the transport of smaller batches at a lower cost than by plane [41]. One ordering party cannot fill the entire ship, but there is a dedicated train for one customer.

The maximum number of containers criterion is more favorable to the customer if it is larger, making it qualitative. For this condition, the quantity will determine the possibility of transporting containers per TEU.

The capacity of railway sets is limited by the individual countries' regulations through which the route runs [42]. This is due to the limitations of service by the linear infrastructure, such as the length of the so-called passing places, where trains can avoid single-track lines and the reloading capacity of terminals servicing trains on the route is complete. The maximum number of containers that can be transported on the analyzed route amounts to 82 TEU.

Thanks to the infrastructure it uses, sea transport has the greatest transport capacity of all types of transport. Shipowners who have launched their ocean services in the Far East–Europe relationship, wanting to minimize costs, order projects of ever-larger container ships from shipyards. The limitations in this regard are the maximum drafts along the route and the final transshipment terminals and the Suez Canal, which "connects" the East with the Mediterranean Sea. In the case of sea transport, the maximum number of 20-foot containers was determined based on the maximum capacity of a container ship serving lines to Gdańsk—almost 25,000 TEU.

3.1.4. Ecology Indicator

The last of the criteria selected for the analysis carried out in the literature is the ecology index. When comparing two different means of transport, they should be linked with a parameter in which we can see the fuel demand dependence per load unit. This parameter may be of critical importance when choosing a measure by the contracting authority to reduce its "carbon footprint" [43]. In recent years, all sectors of the economy, including transport, have moved more towards reducing the pollution generated during the process. To present this criterion, it was presented depending on the fuel consumption per twenty-foot container. Lower fuel consumption is more attractive to the customer, and thus the criterion is costly.

In maritime transport, the "carbon footprint" is reduced in several ways. One of them is the use of newer solutions in ship power plants, which reduce combustion. The type of fuel burned by the power plant must be considered when considering contaminants generated during a ship's movement [44]. In the largest ships, such as container ships, the fuel is fuel oil—the heaviest fuel type. Limiting its consumption, and thus reducing harmful gases for the atmosphere, is also possible through the use of the so-called "slow streaming", i.e., a speed limit. With a speed reduction of 20%, a result of 40% fewer impurities can be achieved [45]. For sea transport, the following value was adopted in the study: converting the traveled nautical miles by the engine's average fuel consumption in a container ship.

The second of the compared transports, rail, certainly has a much smaller carbon footprint than sea transport, but the number is also smaller when it comes to the volume of transported cargo. The source of pollution in a freight train is its drive unit—a freight locomotive—on the vast majority of routes with a combustion engine. In the analyzed route, using an electric locomotive is possible only in countries with developed linear infrastructure. Still, even such a locomotive needs fuel—in this case, obtained from electric traction. This type of supply increases the cost of travel due to higher infrastructure access charges. For the study, it was assumed that a diesel locomotive was used on the entire route.

4. Multi-Criteria Analysis

4.1. Multi-Criteria Analysis for the Transport of One Load Unit

For the analysis, the following tables show the weights assigned to one load unit. Table 1 shows the decision matrix for one load unit. Table 2 shows the intermediate results of the normalized matrix.

Table 1. Decision matrix for one loading unit.

Transport Type	X1	X2	X3	X4
Maritime	45.00	850.00	15000.00	240.48
Railway	12.00	2000.00	82.00	1063.15
Importance	0.40	0.40	0.10	0.10

Table 2. The normalized matrix R.

Transport Type	X1	X2	X3	X4
Maritime	0.39	0.16	0.10	0.02
Railway	0.10	0.37	0.00	0.10

Table 3 shows the ideal solution and the anti-ideal solution. Finally, Table 4 contains the resulting ranking vector.

Table 3. The best alternative A^+ and the worst alternative A^-.

	X1	X2	X3	X4
A^+	0.10	0.16	0.10	0.10
A^-	0.39	0.37	0.00	0.02

Table 4. Ranking vector.

Transport Type	Ranking Value
Maritime	0.44
Railway	0.56

In the case of transporting one container, the multi-criteria analysis showed that rail transport is more favorable. The result depends on the allocation of weights for individual criteria. However, it was established that the time and cost of delivery are equal, which corresponds to customers ordering ad hoc goods on this relation. The multi-criteria analysis is caused by a greater value ratio for the time criterion than for the cost criterion. It follows that while equating time and cost, rail transport, thanks to shorter delivery times, turns out to be more beneficial for a potential customer.

An example of the need to quickly transport a small batch of goods on this route is medical orders during the 2020 coronavirus pandemic [46]. Air transport was used, although when cargo planes are unavailable, the natural choice is the fastest transport on this route—rail transport. Reduction of travel time, which means quick delivery of goods, is an important element in many logistics processes. Rail transport turns out to be an advantageous alternative on the analyzed route in this case [47].

4.2. Multi-Criteria Analysis for the Transport of 82 Load Units

In the case of the analysis for 82 TEU containers, the number corresponding to a freight train's transport capacity was assumed. In this case, it should be taken into account that the potential customer can order a permanent service from the carrier on preferential terms. The number of 82 containers in the scale of the number of containers transported on a ship does not affect the launch of new connections. Therefore, the assumed price does not change. The analyzed case also assumes scheduled deliveries cyclically, which prompts the ordering party to look for more affordable offers. Delivery time, due to the cyclical nature of transport, is not the leading criterion.

Due to the number of containers transported corresponding to one train's capacity, new values were established for the potential price of the journey. Due to the different situations of the contracting authority, new weights were established for the following conditions. Table 5 shows the decision matrix for 82 load units and Table 6 contains the resulting ranking vector.

Table 5. Decision matrix for 82 loading units.

Transport Type	X1	X2	X3	X4
Maritime	45.00	850.00	15,000.00	240.48
Railway	12.00	1800.00	82.00	1063.15
Importance	0.20	0.60	0.10	0.10

Table 6. Ranking vector.

Transport Type	Ranking Value
Maritime	0.65
Railway	0.35

The TOPSIS analysis for 82 containers with planned and expected transport demand showed that it is more advantageous to use sea transport services from the customer's perspective. Despite the reduction in the assumed price for rail transport, the difference between the ratings is quite significant. However, it is also necessary to consider the benefit that is immeasurable in the analysis for rail transport. This is the ability to adjust delivery times ideally according to personal needs to establish a new service. This possibility, however, can be treated as an advantage by only some of the potential customers for whom the delivery of "just in time" cargo is needed in the production process.

4.3. Multi-Criteria Analysis for the Transport of 200 Load Units

The analysis for the transport of 200 loading units, i.e., 200 $\times$ TEU, reflects the order of large quantities of goods in one batch. For the work, it was assumed that this is not a cyclical and planned order by the customer, and therefore the ordering party pays more attention to the delivery time and the cost of delivery.

For the analysis, the following weights were adopted for 200 units. Table 7 shows the decision matrix for 200 load units and Table 8 contains the resulting ranking vector.

Table 7. Decision matrix for 200 loading units.

Transport Type	X1	X2	X3	X4
Maritime	45.00	800.00	15,000.00	240.48
Railway	12.00	1700.00	82.00	1063.15
Importance	0.40	0.20	0.30	0.10

Table 8. Ranking vector.

Transport Type	Ranking Value
Maritime	0.52
Railway	0.48

Assuming the transport of such a large one-time batch, which is not the planned order, the TOPSIS analysis result for both cases is similar. The ranking vector differs by 0.04 in favor of maritime transport. This is because the probability of choosing cheaper transportation or faster and more expensive transportation at the same time is up to the customer.

The approximation of the analysis results for 200 units reflects the market situation for transporting containers in this relation. Customers are only forced to choose whether the goods are needed sooner at the destination or later, but at a lower cost.

This study does not analyze other order volumes. The benefit of shipping for larger orders is obvious. It is worth noting that the largest container ships with a capacity of 24,000 TEU enter the DCT port in Gdańsk. If transporting that quantity of cargo by road, the cost would not cover the expected benefits.

4.4. Comparison of the Conducted Analyzes

Carrying out the transport analysis in the selected route for three cases, differing in the amount of cargo and expectations, allows for their comparison.

The below diagram (see Figure 1) shows the differences obtained in the multi-criteria analysis.

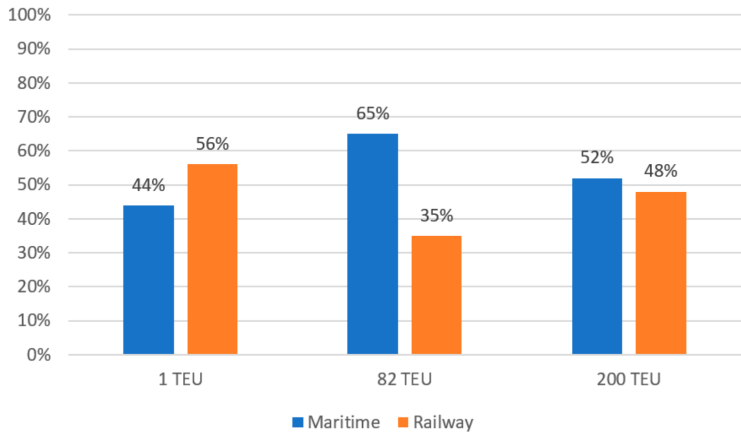

Figure 1. Comparative chart of the results of the analysis.

The difference in the final results, in the maximum deviation, is 30%, which means that in the most divergent situation, a given variant did not achieve a better offer than one third. In the case of ad-hoc ordering of a single container, rail transport turned out to be better, with a difference of 12%. The smallest difference between the two variants is the assumptions for the transport of a large batch of containers—4%—which means that factors not taken into account in this analysis may prevail for a potential customer, such as the quality of customer service at the carrier, available shipping slots and office opening hours to make contact.

5. Analysis of the Geopolitical and Operational Situation along the Transport Route

In the case of long-haul transport, which is carried out through several countries' territories with different political systems and political situations, a geopolitical analysis on this route is required. At the beginning of 2020 and the epidemiological situation that covered all transport markets, there was an additional need to analyze transport conditions in the two analyzed means of transport.

5.1. Railway Transport

During the creation of the New Silk Road—the Far East's route to Europe—by land, several fundamental geopolitical problems arose. The first is the concern of the countries through which the train is traveling about their sovereignty. This is due to the Chinese government's willingness to finance infrastructure facilities in foreign countries, which would reduce the time needed for the required reloading. Such a situation initially occurred in Poland and in Kazakhstan.

Another visible problem is the quality of cooperation in the economic field in Russia–China relations. Initially, Russia was unfavorable towards the new concept of transport advocated by Beijing because it did not like the situation wherein it is only a link between China and Europe. Investments and new economic agreements have eased the disputes. However, it is still necessary to pay attention to the political friction between those countries whose infrastructure accounts for the entire route's largest share. The estimated shares of the infrastructure length of individual countries in two different routes are presented below (see Table 9):

Table 9. The percentage share of infrastructure on the railway route for the two variants.

Country	Variant I	Variant II
China	15%	30%
Russia	60%	15%
Kazakhstan	-	30%
Belarus	15%	15%
Poland	10%	10%

The examples above show a threatening situation. Even one case of withdrawal of the country through which the offer of a given carrier passes suspends the entire logistics process. In the case of rail transport, it is problematic to quickly change the route due to the limited availability of line and point infrastructure. Despite the partial exclusion of customs and legal procedures due to the treatment of some countries as only transit territories, in the event of a geopolitical breakdown, the goods' composition may become stuck in a random territory.

Stopping a freight train in an unprepared place, as a result of the situation described above, creates another threat, which is the possibility of theft. In most cases, railway lines run through uninhabited territories, where the random stoppage of a train for a long time contributes to the theft of transported goods and the devastation of the train.

5.2. Maritime Transport

When considering potential threats on the analyzed route in sea transport, several threats other than in the case of rail transport should be taken into account [48]. Even though international conventions sanction shipping, threats remain, some of which have changed little over the centuries. In such cases, only the means used for the same obstruction of maritime transport have changed [49].

The first of such threats is the possibility of being attacked by so-called sea pirates. Contemporary sea pirates are terrorist groups that have motorized boats and are equipped with weapons including rifles and rocket launchers. The aim is mainly to intimidate the crew, quickly approach slower and less maneuverable transport ships, and illegally board. The crew is then intimidated, and a ransom is forced on the shipowner to release the ship. Over the years, modern pirates have gathered around the poorest countries' shores, which, due to limited funds, did not have organizational and military control over their coasts. As they could not contain the rebel groups attacking from their shores, other states began to organize naval control of trade routes. In recent years, the number of attacks has been significantly reduced, but there is still a real threat of an attack in Somalia's vicinity, where merchant ships from China and Europe pass.

Another of the threats limiting long-distance shipping is the so-called blockade of ports, the source of which may be the war situation near the ports or severe economic sanctions. In this case, sea transport is frozen for a long time, which prevents the transport of goods. At the moment, China is trying to maintain good diplomatic relations with its largest importers, although there is a threat of military operations with neighboring countries such as India.

Strikes in the ports where the ship calls in are another potential obstacle to long-haul shipping. Container terminals are large enterprises employing a significant number of people, which depends on the degree of port automation. By expanding its point infrastructure in the form of modern terminals, China relies on automated gantry cranes and STS cranes loading containers in the land–deck relation. On the other hand, container services call several countries where the degree of development is different. Using the example of the Gdańsk deepwater container terminal, the employment is over 1200 people, including at least 1000 people working on the square. A trade union has been established in the terminal, which uses the fear of stopping work at the terminal, negotiating better employment conditions for employees. The human factor in the decisions taken and the need to balance cooperation between trade unions and the management board creates a real risk of suspending terminal works for hours or days.

Unfavorable weather conditions are a constant threat to maritime transport. In container transport by the largest ships in the world, the risk of storms is relatively lower, although there are still other threats. The main opponent of port works at container terminals is the increased wind, which prevents containers from reloading in the main relation from land to ship and vice versa. This is dictated by the height of the STS cranes and the container's risk of tearing off the catches. There is also increased difficulty in placing the container in the designated place. Despite advances in technology and increasing the maximum wind speed for terminal operation, there are still upper limits above which operations are suspended until conditions improve.

5.3. The Threat of Transport Blockage Caused by an Epidemic

The beginning of 2020 set new challenges for many industries in the world. Transport, of all kinds, also had to adapt to the new reality. The party carrying out the transport was cut off from new orders caused by the freezing of most countries' economies around the world. Customers, on the other hand, were unable to fulfill their orders. This peculiar situation, which no one could have foreseen, stopped the world economy. In the analyzed transport relation, there were significant difficulties in the flow of goods for both approximate types of transport. In the case of rail transport, the countries' borders were closed, which significantly extended the time of the restored controls. In the case of sea transport, most container terminals performed their tasks. However, the limitations in moving within the land, which is necessary when transporting goods to the port, extended the transport process.

6. Conclusions

The article presents a multi-criteria TOPSIS analysis for transport on the Poland to central and eastern China route. Weights have been determined for three different container shipments—1 TEU, 82 TEU, and 200 TEU. Individual cases represent the different needs of potential customers and a change in the criteria' weight values.

A potential decision in choosing the type of transport in the analyzed route, as has been shown, cannot only take into account the conditions from the multi-criteria analysis, which can be approximately quantified. In addition to the standard threats associated with individual transports, in 2020, the need to analyze the epidemiological situation has also emerged. Despite the achievement of calculations for representative and different examples in the TOPSIS analysis, the potential client is still forced to rationally assess the geopolitical, economic, and epidemiological situation before entering into a contract with a given operator case of single transport and the setting of cyclical transport.

The multi-criteria analysis results allow for an accurate comparison, based on different criteria, of the two possibilities of transporting goods from the Far East. The results are presented in the form of rankings. The potential customer has a quick preview of the final result and complex charts, thanks to which it is possible to compare the results at the level of individual criteria.

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