

## IDENTIFYING AND HIERARCHIZING FACTORS THAT AFFECT THE CHOICE OF TRANSPORT ROUTES IN LAND-FERRY TRANSPORT CHAINS

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### ABSTRACT

**Motives:** The choice of a transport route has long been the subject of research because it is regarded as one of the most crucial decisions in transport organizations. However, there is a lack of studies addressing this issue in the context of land-ferry supply chains, where two transport modes have to be integrated. Therefore, analyses of multimodal transport should involve a holistic approach to account not only for seaborne transport, but also for the land leg before and after the ferry trip. This knowledge gap should be urgently addressed due to the importance of land-ferry supply chains in the transport system.

**Aim:** The aim of this study was to identify and hierarchize factors that determine the choice of a multimodal transport route combining ferry and road transport.

**Results:** The factors that determine the choice of ferry routes were identified and hierarchized according to their importance as primary, supplementary, and additional routes. The study demonstrated that the cost and time of transport are the main determinants in the decision-making process, with time being marginally more important than cost.

**Keywords:** transport systems, transport routing, ferry transport, maritime transport, transport management

### INTRODUCTION

The ferry transport market on the Baltic Sea has been developing fast (Połom, 2020; Vojdani, 2019). On the Polish market, carriers such as Stena Line, Unity Line, Polferries and TT Line provide regular services between the seaports in Świnoujście, Gdańsk and Gdynia and the Swedish ports in Karlskrona,

Ystad, Trelleborg and Nynäshamn (Stenaline; 2023; Studzieniecki & Palmowski, 2021; Polferries, 2023; Ttline; 2023; Unityline, 2023). Ferries that serve those routes are passenger and cargo vessels which in addition to the tourist function play a significant role in cargo transport and constitute key links in sea-land transport chains (Kotowska, 2016). Ferry connections from Gdynia, Gdańsk and Świnoujście play a key role

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in freight deliveries to Scandinavia. Polish sea ferry terminals handle over 500k vehicles a year, and the busiest of them is the one in Świnoujście (see Table 1).

**Table 1.** Transshipments of trucks and semi-trailers in the analysed ports in 2023

|                        | Świnoujście | Gdynia | Gdańsk |
|------------------------|-------------|--------|--------|
| trucks                 | 426,058     | 98,789 | 23,501 |
| trailers/semi-trailers | 22,790      | 63,670 | 5,516  |

Source: Transport – activity results in 2022, GUS, Warszawa, Szczecin 2023.

Given such a large disparity between the terminals (the Świnoujście ferry terminal handles over four times more vehicles than Gdynia and nearly 20 times more than Gdańsk), a question arises: which factors have an impact on the forwarders or carriers in their decision making when choosing a specific ferry connection, and consequently the particular ferry terminal. A specific feature of ferry transport via Polish seaports is the fact that a considerable part of it is made up by so called “accompanied transport”, which means that in the course of the transport process the truck drivers are on board the ferry. Consequently, this kind of transport is additionally subject to regulations covering driving time and rest period limits for drivers (Regulation (EC) 561/2006). Decision-makers must account for this when estimating the time and cost of transport, which, in consequence, affects the choice of the transport route.

The objective of this study was to identify and hierarchize factors that determine the choice of a transport route in circumstances when it is necessary to use more than one transport mode and to combine ferry and road transport (land-ferry transport chain for accompanied transport).

The simple structure of this paper serves the purpose of presenting the research results in a clear manner. The theoretical background for the research is described in Section 2. Section 3 describes the methodology. The research results and discussion are included in Section 4. The conclusions are given in Section 5.

A search of current literature on this subject has shown a lack of research studies regarding factors

that have an impact on decisions taken by forwarders or carriers when choosing ferry routes, and take into account the specific nature of accompanied transport. In this regard it is possible to assert that the presented findings fill this research gap.

## LITERATURE REVIEW

Due to its unquestionable importance for the world economy, maritime cargo transport has long been the subject of numerous research studies (Christiansen et al., 2007; Heaver, 2002). However, the studies predominantly focus on deep sea transport carried out by specialized cargo ships. In the case of short sea shipping with the use of passenger and cargo ferries, the research interests concerning passenger transport prevail over those related to cargo transport (Banerjee et al., 2020; Fomin & Lovska, 2020; Gan et al., 2017; Kizielewicz et al., 2017; Kizielewicz, 2023). The few studies regarding cargo transport by ferry focus mainly on technical (Urbanyi-Popiołek, 2014) or environmental issues (Pizzol, 2019; Kotowska, 2015). Meanwhile, ferries constitute key links in land-sea transport chains, as well as being important elements of transport systems (Urbanyi-Popiołek, 2021). It is also possible to assert that they meet the conditions for being part of combined transport that is defined as intermodal transport where the major part of the journey is by rail, Inland waterways or sea and any initial and/or final leg carried out by road is as short as possible (Directive, 2016). Combined transport involves two different modes of transport, where one (passive) means of transport is carried by the second (active) one which for this purpose uses an appropriate transport infrastructure and consumes energy (Wiśnicki, 2000). In the case of combined land-sea transport performed by the Baltic ferries, the initial and final legs are by road carriage, whereas the main part of the transport is by sea (Czermański, 2011; Frémont & Franc, 2010).

Each transport process is initiated by the planning stage including i.a. making decisions on choosing the carrier and the route (Filina-Dawidowicz et al., 2022). A number of factors influence such transport

decisions, however, there is no consensus about their hierarchizing. Cost is commonly considered to be the main determinant. As noted by Jung et al., the cargo transport cost constitutes a considerable share of the logistic costs incurred by enterprises in various industries, which consequently has a significant impact on the price of the products offered by them. Thus, a reduction in transport costs may contribute to increasing their competitiveness (Jung et al., 2019). However, researchers' opinions vary when it comes to the importance of other factors. According to Tiwari et al. (2003), in addition to the cost-effectiveness principle, entities most often follow the reliability principle when making transport decisions. Fanam & Ackerly (2019) are of a similar opinion, pointing to (in addition to the key significance of the cost factor) the importance of the carrier's service quality and their own familiarity with the service offered. Koziel (2014), in turn, names price and time as the main determinants of transport decisions, considering both of them to be of equal importance. In many sources, factors such as reliability, type of cargo, and service quality are considered significant, though not of key importance (Mangan et al., 2002; Murphy & Hall, 1995).

The issue of choosing a transport route has long been the object of research (Jiang et al., 2020). It is commonly considered to be one of the most important decisions regarding transport organization (Waller et al., 2008). However, the numerous studies on the modelling of cargo transport routes do not take into account the specific nature of ferry transport and the need to integrate two transport modes (Andersson & Ivehammar, 2017; Keshkamat et al., 2009; Weisbrod & Lawson, 2003). Thus, there is a lack of studies relating in this context directly to combined transport, in particular land-ferry transport. Coordination of both transport modes is of key importance and requires in-depth research to address this specific nature. When making decisions on choosing a transport route and a concrete ferry connection, carriers engaged in combined transport must also account for the human factor – the presence of HGV drivers on board the ferry (Hanssen et al., 2020).

When travelling on a ferry, drivers are not performing transport activities, nevertheless, they are taking part in the transport process and are subject to the provisions of Regulation 561/2006. When travelling on a ferry, drivers use their "resting time". If the ferry travel time is significantly longer or shorter than the prescribed 9 hours of the daily rest period, this may have a significant impact on transport decisions. In this case, it is necessary to take a holistic approach to account not only for the seaborne transport itself, but also the land leg that needs to be carried out prior to and after the ferry trip (taking into account both the total transport cost and the total transport time, including the required breaks for the driver).

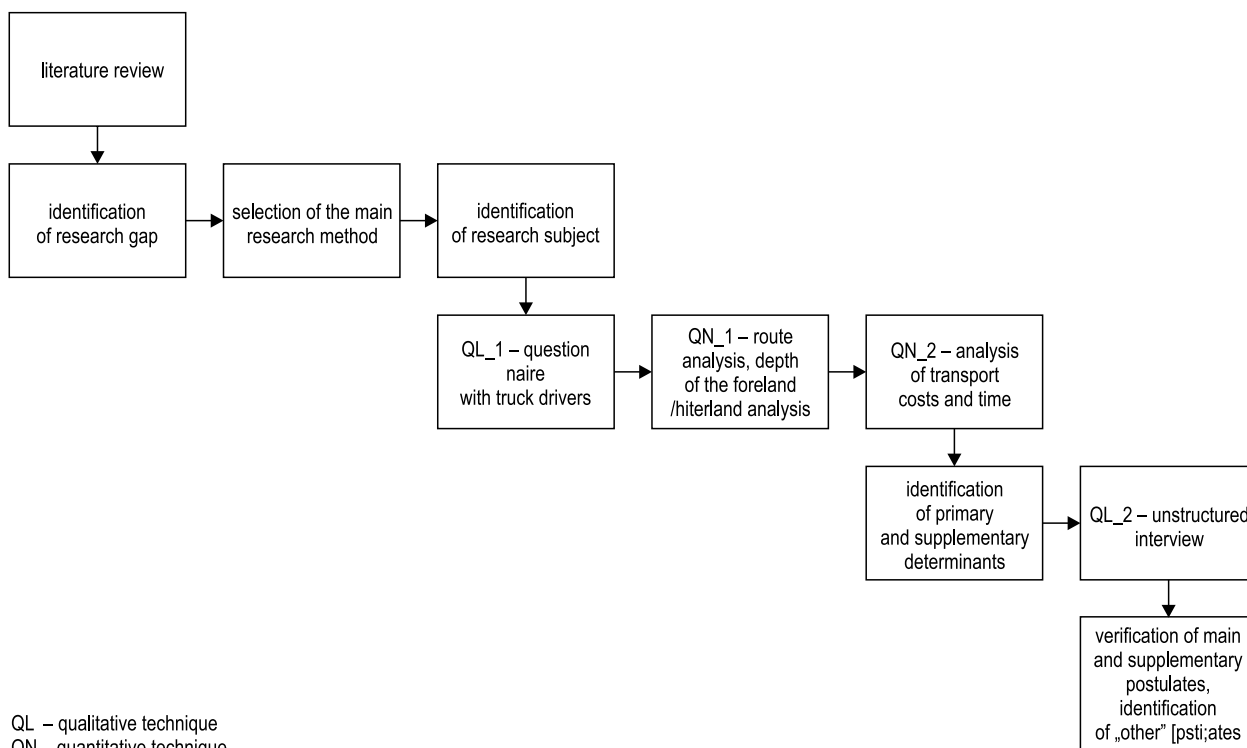
## METHODS

An analysis of the existing research literature has shown that the main determinants in choosing transport routes include cost and time. However, as desk research has demonstrated, most sources did not take into account the situations where transport is carried out using more than one transport mode, and, in addition to seaborne transport, also comprises the road leg. The objective of this study was to fill the research gap by identifying and hierarchizing the factors that determine the choice of a transport route when it is necessary to use more than one transport mode and to combine ferry and road transport (land-ferry transport chain for accompanied transport).

To attain this objective, the Multi Case Study (MCS) method was applied (Yin, 2018), as well as qualitative and quantitative research techniques (Fig. 1).

The next step in designing the MCS method was defining the unit of analysis. The research study was based on the analysis of carriage taking place via three Polish ferry terminals: in Świnoujście, Gdynia, and Gdańsk.

The largest of these three is the ferry terminal in Świnoujście, comprising five berths. It serves ferries going to two Swedish ports: Ystad and Trelleborg. From 7 to 11 ferry connections are served daily. There are three carriers operating at the terminal: Polska Żegluga Bałtycka (PŻB), Unity Line, and TT Line.



**Fig 1.** Research method and techniques  
 Source: Own elaboration based on the conducted research.

In 2021, the ferry terminal handled 6.5m tonnes of ferry cargoes (Eurostat Database).

The ferry terminal in Gdynia serves the connection to Karlskrona in Sweden. There are three connections per day, operated by Stena Line. In 2021, the terminal handled 1.5 m tonnes of ferry cargo.

The third and the smallest of the analysed terminals is the ferry terminal in Gdańsk. It serves one connection per day to Nynashamn in Sweden – the port located nearest to Stockholm. The service is operated by PŻB. The terminal locations are shown in Fig. 2.

In accordance with the MCS method principles, at the first stage of the study the following research questions were formulated:

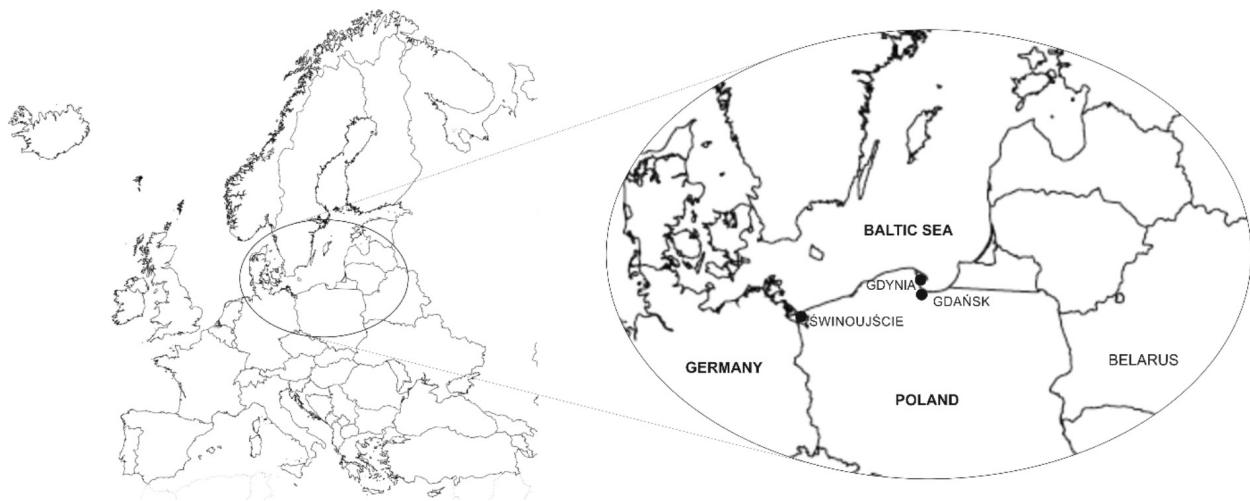
1. Which routes are chosen by shippers of cargo carried by road accompanied transport (where do the cargoes come from and where are they headed) via Polish ferry terminals?
2. Which factors are decisive in choosing a given ferry connection?

In order to answer Question 1, the study applied the survey research technique.

The main goal of the survey was to collect the primary research material to be the basis for specifying the length of the road link in land-sea transport chains. The research was completed using the personal survey technique (PAPI – Paper and Pencil Interviewing) in September 2022 at the three ferry terminals in Świnoujście, Gdynia, and Gdańsk. The study used one of the non-random sampling methods – the targeted sampling. As a result, a total of 245 drivers were surveyed. The analysis covered responses obtained from 115 drivers from the ferry terminal in Świnoujście, 104 drivers from the ferry terminal in Gdynia, and 26 drivers from the ferry terminal in Gdańsk. As the surveys were held among drivers waiting to board a ferry, they pertained only to the routes headed for Scandinavia.

The drivers answered two questions:

1. Where did you pick up the cargo?
2. Where are you carrying your cargo to?



**Fig. 2.** Locations of the analysed ferry terminals  
*Source:* Own elaboration.

The data were gathered with accuracy to the following spatial aggregation levels:

1. Regarding the place of cargo origin:
  - a. for cargoes coming from Poland – the voivodeship (16);
  - b. in other cases – the country (9 countries of cargo origin were identified; Belarus, Bulgaria, Czech Republic, Holland, Germany, Slovakia, Ukraine, Hungary, and Italy).
2. Regarding the place of cargo destination:
  - a. (D) Denmark;
  - b. (N1) South Norway;
  - c. (N2) North Norway;
  - d. (S1) South Sweden;
  - e. (S2) Central Sweden;
  - f. (S3) North Sweden;
  - g. (F) Finland.

The drivers' responses were then grouped by route. For each route  $T(x, y, z)$ ; where  $x$  – place of cargo origin,  $y$  – ferry connection used in the cargo carriage,  $z$  – place of cargo destination), a number of identified trips was determined.

In order to answer the second research question, at the first stage of the study two primary determinants of choosing a transport route were identified, based on the literature as well as the expertise and experience of the research group:

- a. Total transport time;
  - b. Total transport cost.
- Then, as supplementary determinants:
- a. shorter transport time in hinterland and foreland;
  - b. lower transport cost in hinterland and foreland;
  - c. shorter transport time by ferry;
  - d. lower transport cost by ferry.

Next, a database was developed. For each route  $T(x, y, z)$  the following values were specified:

- a. number of trucks carried on the given route (identified based on the surveys);
- b. carriage distance in the hinterland – the distance between i) the capital city of the voivodeship of the place of cargo origin and the ferry terminal (for cargoes from Poland) or ii) the distance between the capital city of the country and the ferry terminal (for cargoes from outside Poland);
- c. carriage distance in the foreland – the distance between the ferry terminal and the central point of a given region;
- d. total carriage distance as the sum of the distances specified in items b and c;
- e. mean ferry travel time specified on the basis of the ferry service timetables. Values adopted in the study: 7 h for the Świnoujście – Ystad/Trelleborg route, 10.5 h for the Gdynia–Karlskrona route, and 18 h for the Gdańsk–Nynashamn route;

- f. pre- and on-carriage time – the transport time in the hinterland and foreland, assuming a mean speed of 60 km/h, and the daily rest period required by Regulation EC 561/2006;
- g. total carriage time, taking into account: pre- and on-carriage time, mean time of waiting for the ferry, equalling half of the time between ferry departures, but no less than 2 hours (vehicles are required to arrive 2 hours before ferry departure time), ferry travel time;
- h. ferry transport cost was specified based on mean rates offered to surveyed road carriers;
- i. cost of pre- and on-carriage was established as EUR 1.00 per km;
- j. total cost was calculated using the mean cost of 1 km and the offer price for ferry transport (data obtained from direct interviews with road carriers).

The total of 525 hypothetical routes were identified.

For each cargo transport  $P_i$  identified in the survey and following route  $T(x,y,z)$ , it was established whether it met the condition of the lowest total cost or the shortest total transport time in comparison with the other two routes starting at the same pick-up place ( $x$ ) to the same place of destination ( $z$ ) via the other two ferry terminals ( $y$ ), assigning respectively the value of 1 – if the condition was met and 0 if it was not met.

At the second stage of the study, with regard to the cargo transports that did not meet any of the primary determinants, with the use of the same method it was established whether they met the supplementary determinants of choosing the transport route. The research results are presented in a graphic form.

In order to validate the quantitative research results and to specify additional determinants that could not be identified on the basis of the quantitative research, unstructured interviews were held with five experts – representatives of carriers and forwarders from Poland, who specialized in organizing and carrying out transport to and from Scandinavia. The research was carried out in two transport enterprises and three forwarding companies. The selected entities specialize in organizing transport

to and from Scandinavia. It should be noted that there are few entities with such experience on the Scandinavian transport market. Most entities did not consent to participating in the research study. The respondents were decision-makers in executive positions, selected for the study on the basis of their business experience of at least fifteen years in the transport industry. In the forwarding companies, the study involved managers of international road transport forwarding departments, whereas in the transport enterprises the interviews were held with managers of international transport departments. In one of the enterprises, there was a department dealing with transport to Scandinavia. All the interviewees participating in the study were asked questions regarding the major factors which they considered crucial when deciding which ferry to use.

## RESULTS AND DISCUSSION

The locations of ferry terminals in Poland determine their geographical hinterland. The ferry terminal in Świnoujście is situated in the west of Poland next to the German border. Its geographical hinterland covers the western part of Poland (voivodeships: Zachodniopomorskie, Lubuskie, Wielkopolskie, Dolnośląskie, Opolskie) and West European countries. Gdynia and Gdańsk are located in the central-northern part of Poland. Their geographical hinterland covers 2/3 of Poland's territory (the central and eastern part) as well as the countries of Central and Eastern Europe. However, the survey showed that cargoes gravitate to the Świnoujście terminal much more extensively and from greater distances. As many as 30% (35 of 115) trucks carried cargoes from outside Poland, from countries such as Slovakia, Hungary, Bulgaria, Ukraine and Belarus, for which the closer ferry terminal is the one in Gdynia or Gdańsk (Appendix 1a). A similar situation was observed for the domestic hinterland. As many as 33 of 80 cargo transports coming from the domestic hinterland and served in Świnoujście came from the voivodeships in central and eastern Poland (Table 1, Appendix 1b). A different picture is presented by the ferry terminals in Gdynia

and Gdańsk, where Polish foreign trade accounts for as much as 95% of the traffic (Appendix 2a). Only 6 out of 130 identified cargo transports were transits from other countries (i.e. Czech Republic, Slovakia and Hungary). Most of the transports related to Polish foreign trade were the ones from central and eastern Poland. Only 15 out of 124 transports came from western Poland (Appendix 2b). It is worth noting that as many as 26 surveyed drivers picked up their cargoes in central and eastern Poland and in the countries of Central and Eastern Europe (Slovakia, Hungary, Ukraine, Belarus, Bulgaria) that were destined for Central and North Sweden, Norway and Finland, and used the ferry service from Świnoujście (Appendix 3). In geographical terms, such transport is unreasonable, those cargoes should gravitate to the ports in Gdynia and Gdańsk (Appendix 4).

The second stage of the research made it possible to identify the most frequently found determinants in choosing a transport route. As many as 158 (65%) of 245 cargo transports met one of the two primary determinants. Out of that 71 (29%) met both determinants: the lowest cost and the shortest time, 49 (20%) met only the shortest time determinant, and 38 (16%) – only the lowest cost determinant (Fig. 3).

It is therefore possible to assert that the received findings are convergent with the results of the studies completed by Jung, Tiwari et al., Fanam & Ackerly & Koziel (Fanam & Ackerly, 2019; Jung et al., 2019; Koziel, 2014; Tiwari et al., 2003). Nevertheless, our study showed a slight preference for time over cost. This is due to the fact that it is most often the cargo carrier rather than shipper that decides about choosing the route. For road carriers, transport time has a significant impact on total costs, due to the considerable fixed costs of running their business activity (i.e. costs of depreciation of the means of transport, insurance, vehicle maintenance, repair and inspections, administration and drivers' wages), whereas it has no impact on the price of the service offered (offers for cargo shippers depend on the transport distance rather than its duration). Many road carriers are ready to incur a slightly higher cost of transport to shorten the transport time. The saved time may be used to perform another transport order.

However, particular attention should be paid to the transports that did not meet any of the specified primary determinants. There were 87 such transports, accounting for as much as 36% of their total number. In Fig. 3, they are represented by the "Other" category.

**Table 2.** Distribution of journeys via the examined ferry terminals

| Place of cargo destination | Place of cargo pick-up                           |                   |   |                   |
|----------------------------|--|-------------------|---|-------------------|
|                            | Western Poland and Western Europe <sup>a,b</sup> |                   | Central and eastern Poland, Central and Eastern Europe <sup>c,d</sup> |                   |
|                            | Via Świnoujście                                  | Via Gdynia/Gdańsk | Via Świnoujście   | Via Gdynia/Gdańsk |
| (D) Denmark                | 1  | 0                 | 1   | 0                 |
| (F) Finland                | 1  | 0                 | 0   | 0                 |
| (N1) South Norway          | 7  | 4                 | 1   | 16                |
| (N2) North Norway          | 1  | 2                 | 3   | 14                |
| (S1) South Sweden          | 18   | 2                 | 19  | 24                |
| (S2) Central Sweden        | 33   | 9                 | 15  | 35                |
| (S3) North Sweden          | 9  | 2                 | 6   | 22                |
| Total                      | 70   | 19                | 45  | 111               |

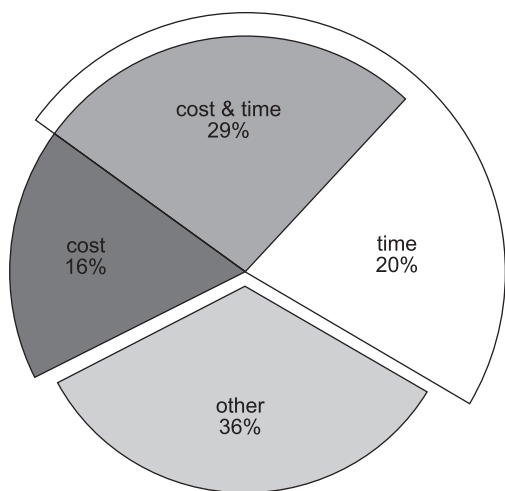
a. Dolnośląskie, Lubuskie, Opolskie, Wielkopolskie, Zachodniopomorskie

b. Czech Republic, Holland, Germany, Italy

c. Kujawsko-Pomorskie, Lubelskie, Łódzkie, Małopolskie, Mazowieckie, Podkarpackie, Pomorskie, Śląskie, Warmińsko-Mazurskie, Podlaskie, Świętokrzyskie

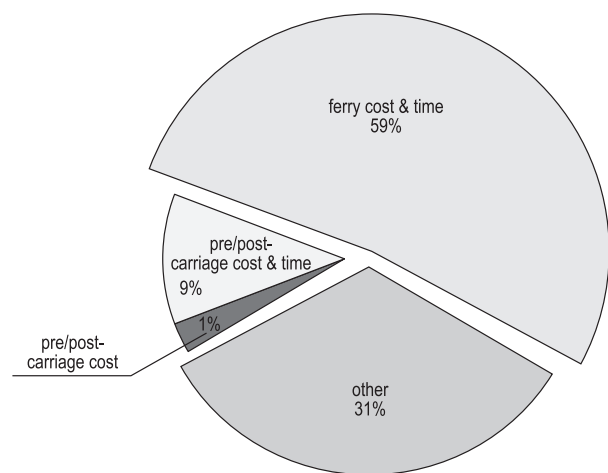
d. Belarus, Bulgaria, Slovakia, Ukraine, Hungary

Source: Own study based on the conducted research.



**Fig. 3.** Percentages of meeting the primary determinants in the whole research sample  
 Source: Own elaboration based on the conducted research.

With respect to this group, it was checked whether they met the supplementary determinants (Fig. 4). The findings were quite unambiguous. As many as 51 (59%) met the shortest time of ferry transport determinant, 8 (9%) transports met the two determinants of pre- and on-carriage time & cost, and 1 of the pre- and on-carriage cost. 27 transports (i.e. 31%) did not meet any of the identified supplementary determinants. In Fig. 4, these are represented as “Other”.



**Fig. 4.** Percentages of meeting the supplementary determinants within the group that did not meet the primary determinants  
 Source: Own elaboration based on the conducted research.

The considerable predominance of ferry travel time over the other determinants of choosing the transport route can be attributed to several factors:

- in the analysed case of sea passages starting in Polish seaports only the shortest ferry connection Świnoujście – Ystad/Trelleborg taking 7 hours did not exceed the drivers’ shortened daily rest period regulated by Regulation EC 561/2006. The other ferry connections starting in the seaports of Gdynia and Gdańsk did not meet the requirement;
- out of all the analyzed ferry terminals, only the seaport of Świnoujście offers so many loading opportunities. In Świnoujście, up to 11 ferries are served on a daily basis, whereas in Gdynia there are only 2 or 3, and in Gdańsk – just one. As a result, in normal conditions, drivers do not have to wait to board the ferry longer than the required 2 hours, regardless of the time they reach the terminal. The other ferry terminals do not offer such possibilities.

As a result, only the Świnoujście-Ystad/Trelleborg connection ensures the optimum use of the driver’s daily rest period during the mandatory sea passage.

However, the completed quantitative research did not explain the carriers’ motivations in the case of the 27 cargo transports (over 10% of all the identified transports) which did not meet any of the determinants, either primary or supplementary. In view of the above, an interview with the experts was conducted, which made it possible to explicitly specify the obtained findings. All the respondents agreed that time is an important factor, even though the points of reference shown by the forwarders and carriers were diverse. From the point of view of the forwarders, the transport time was the most crucial, but it did not matter whether the land transport time or sea passage time was shorter. According to the carrier, both factors were equally important due to the need to reach the place of destination at a specified point in time. Additionally, the carriers definitely pointed out the possibility of using the driver’s rest period during the sea passage. It was also important for them that the waiting time for the ferry should be as short as possible. The carriers also pointed out that an important determinant of choosing a transport route was the need to arrive “on time”. This is due



to the working time of warehouses/terminals and the designated time slots in which trucks may be handled at the terminal. If a vehicle arrives at the point of destination outside the designated time window, it will not be handled and will have to wait for another available time slot. As for transport costs, the forwarding companies decided that the total cost is the most important, without breaking it down into the ferry crossing cost and the road carriage cost. The carrier, in turn, found the cost of ferry passage more important. The ferry crossing cost depends on the received offer and contract concluded with the ferry operator. This often determines the choice of a specific ferry by the road carrier, even if this is not the first outgoing ferry upon the truck's arrival at the ferry terminal.

The interviewees also indicated that choosing a ferry as a means of transport is most often connected with the nature of the cargo being moved, e.g. in the case of perishable goods the ferry cost is not a significant factor, similarly as in the case of valuable cargoes. On the other hand, the ferry cost will be an issue in the case of low-value cargoes such as e.g. recycled paper bales, where each additional

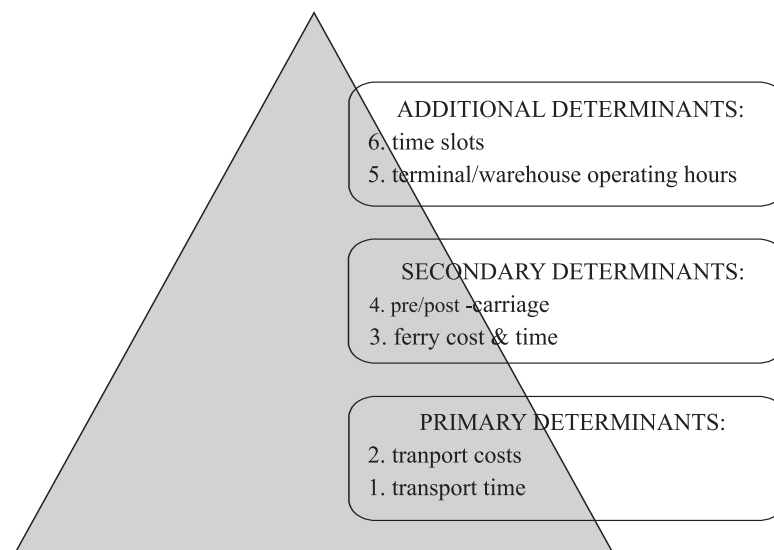
cost factor has a significant impact on the final price of the product.

Having analyzed the obtained responses it is possible to conclude that choosing the way the transport is organized is a question of transport optimization, where time and cost factors are considered to be primary determinants, at the same time taking secondary factors into account.

## CONCLUSIONS

The research study aimed to identify and hierarchize factors that determine the choice of a transport route when it is necessary to use more than one transport mode and to combine ferry and road transport (land-ferry transport chain for accompanied transport). The study focused on the Polish market, which has seen significant developments in ferry transportation over recent years.

The research objective has been achieved, and the research process provided an answer to the posed research questions. The research findings have shown that in the case of land-ferry transport there is no geographically assigned hinterland, and the distance



**Fig. 5.** Hierarchizing the determinants of choosing transport routes in land-ferry transport chains

Source: Own elaboration based on the conducted research.

to a ferry terminal is not a determinant of choosing a transport route.

The research results made it possible to identify and hierarchize the determinants of choosing a given ferry connection. The determinants were hierarchized according to their importance as primary, supplementary, and additional. The main determinants identified at the first stage of the research are cost and time of transport, with a slight prevalence of time over cost. Thus, the obtained results generally confirm the results of desk research regarding maritime transport in its broad sense. However, the in-depth quantitative research made it possible to identify the supplementary determinants: ferry cost, ferry time, pre- and on-carriage cost, pre- and on-carriage time. The qualitative research, in turn, verified the quantitative research and made it possible to identify additional determinants: terminal/ warehouse working time and designated time slots (Fig. 5).

These factors are characteristic for land-ferry transport chains and have not been identified before. The desk research has shown there are few studies focusing on freight transportation via ferries, especially in the context of combined transport. Most existing studies concentrate on long-distance maritime shipping, while short-distance maritime transportation on ferries has received less attention. In this respect, it is possible to assert that this article fills the theoretical research gap.

By identifying and hierarchizing the factors determining the choice of transport route, the study provides valuable insights for shippers, transport operators, and policymakers involved in planning and optimizing land-sea transport chains. The results of the research can support decision-making processes by helping stakeholders prioritize the factors that have the most significant impact on route selection.

#### Conflict of interest

None.

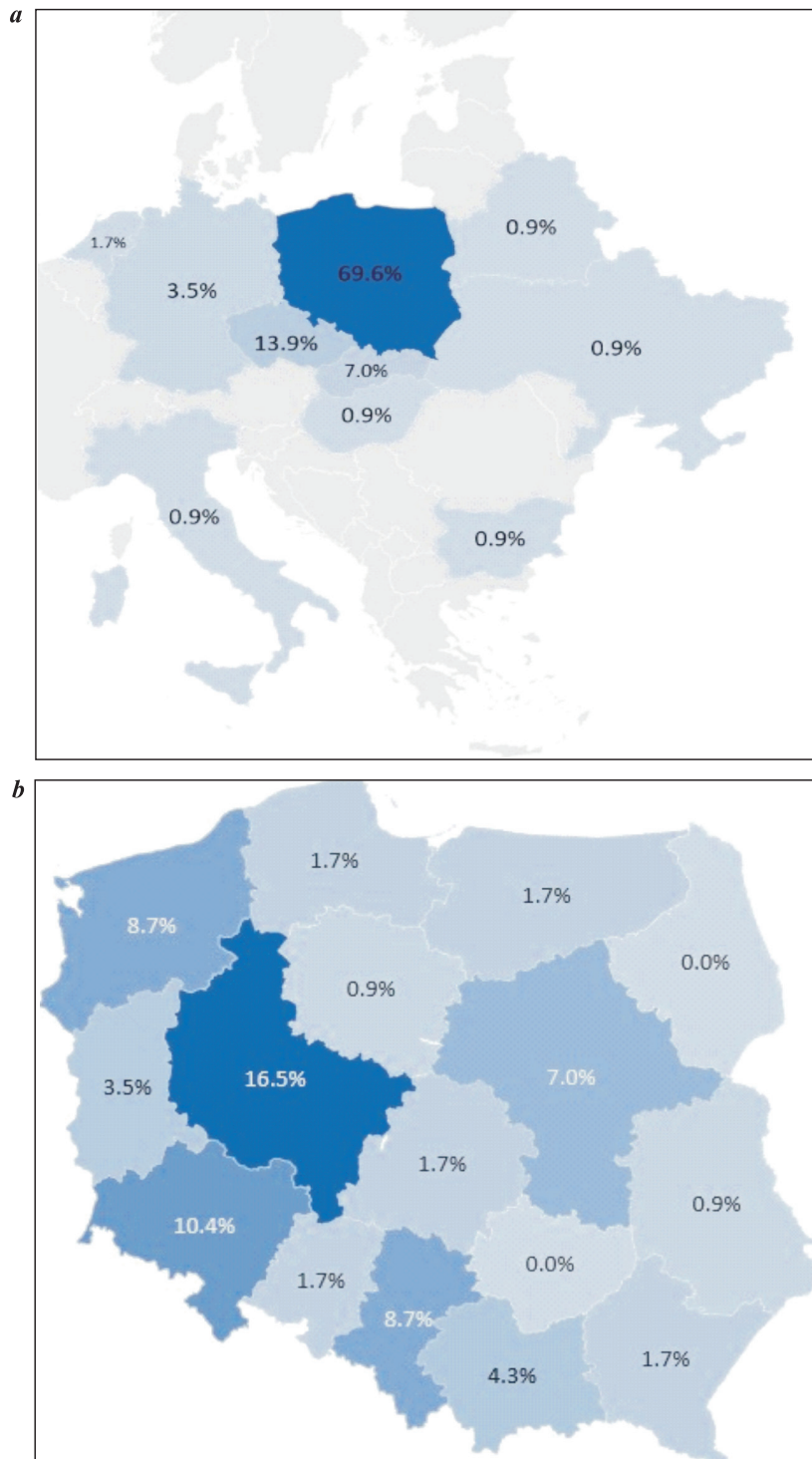
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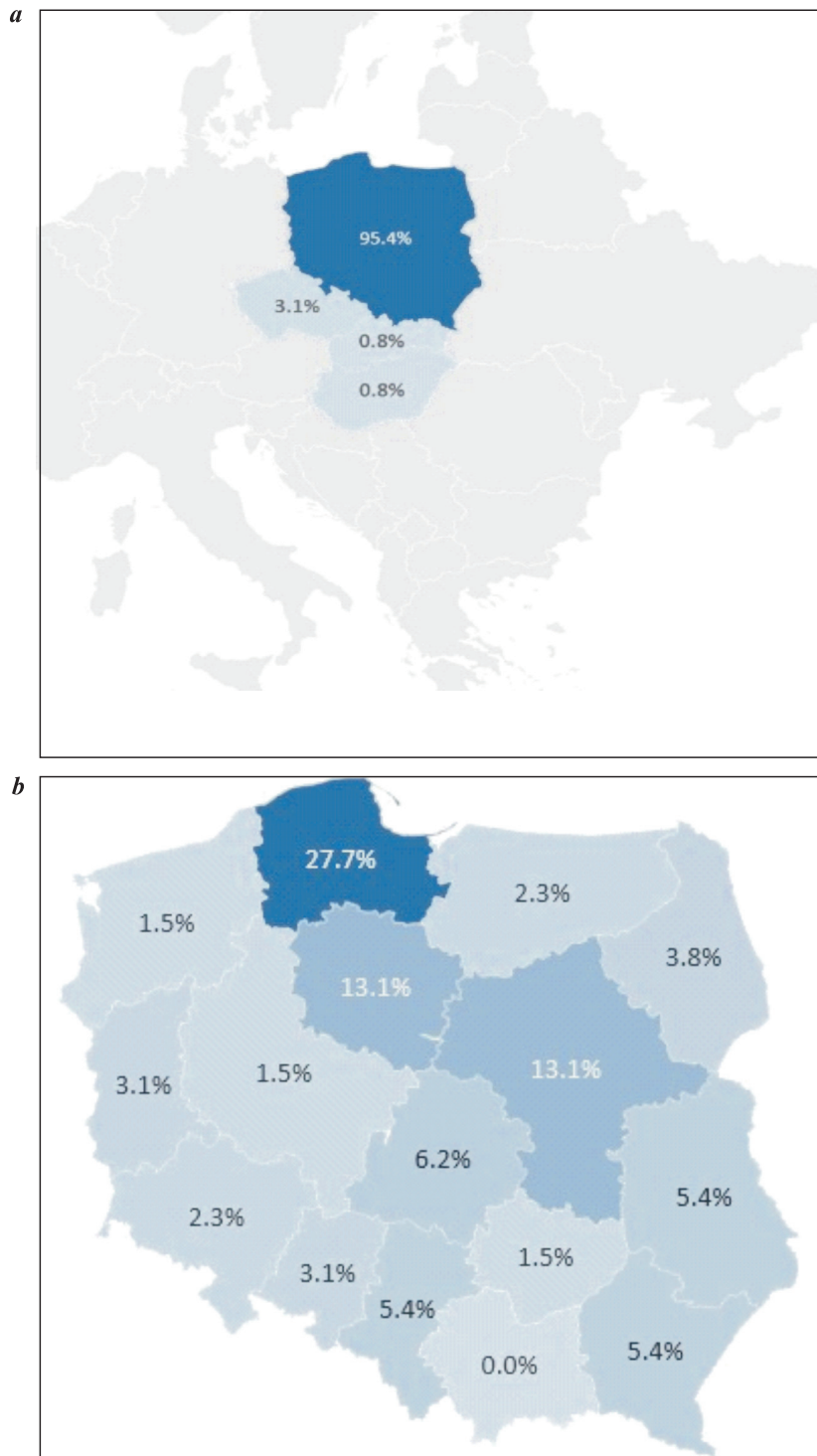
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Appendix 1



Foreign and domestic hinterland distribution of Świnoujście ferry terminal  
Source: own study.

Appendix 2



Foreign and domestic hinterland distribution of Gdynia and Gdańsk ferry terminals  
Source: own study.

### Appendix 3



Foreland distribution of cargo originated from Western Poland and transported via Gdynia and Gdańsk ferry terminals  
*Source: own study.*

#### Appendix 4



Foreland distribution of the cargo originated from Eastern Poland and transported via Świnoujście ferry terminal  
Source: own study.