FUTURE SHIFTS IN THE COMPETITIVENESS OF FREIGHT TRANSPORT: A DELPHI METHOD-BASED STUDY

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Abstract

The modality of freight transport undergoes changes influenced by various factors, including transportation regulations (such as emission restrictions), technological advancements across different modes of transportation, and the inherent dynamics of multimodal logistic chains. This study examines the evolving competitiveness of three key transport modes – road, rail, and maritime transport – over the next three decades. This study involves input from an international panel of transportation experts and utilizes the Delphi technique to analyse significant influencing factors shaping the future of these transportation modes. Based on these factors, we aim to predict the potential dynamics of two primary parameters of transportation service: speed of operation over distance and transportation cost. Through comparing these forecasts and situating them within a broader context, we draw conclusions regarding the probable shifts in transportation modalities.

Keywords: freight transport, modal shift, rail freight, maritime cargo transport, road freight transport, transport costs, multimodal transport chains, competitiveness, long-term changes in logistics, expert opinions, Delphi method.

JEL code: L1.9., F47.

1. Introduction. Research tasks and the importance of the subject

In this article, we aim to introduce readers to the results of a study regarding the future competitiveness of various modes of transportation conducted with the help of an expert panel. This involves highlighting the central arguments considered by the experts, commenting on the results reached by expert panel and drawing some broader conclusions.

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The study's time horizon was the year 2050, with a particular focus on developments within the European Union's economic space.

To work with the topic of future of freight transportation we set ourselves two methodological tasks. Firstly, to define, through which categories and logics to address the long-term development of the transportation system and the modal shifts occurring within it. Secondly, to establish an appropriate procedure for organizing the work with experts when dealing with complex tasks characterized by varying understandings among experts regarding the impact of the influencing factors on the process whose potential future we are considering.

The Delphi method, which has been central to our foresight work, has a long history of use. However, the traditional form of this method (conventional Delphi) performs relatively poorly when dealing with complex and not well-structured tasks. Therefore, it was necessary to develop a version of the methodology tailored to the specificity of our task.

We think that there is some scientific novelty in both, in our approach to factors influencing transport modal shifts and in our version of using Delphi technique and interpretation of the role of experts. The latter can be applicable in a wide range of life domains.

The determination of the appropriate mode of transportation for specific freight types and distances used to be a question with clear answers among specialists in the past. However, this certainty has diminished over time. The dominance areas of transportation modes have begun to overlap and shift, raising questions about the extent of this transformation. These modal shifts are propelled by several factors, including advancements in transportation technology, such as the widespread adoption of cargo containers facilitating multimodal solutions. Additionally, the development of international transport corridors and the emergence of green policies with new transportation requirements contribute to these shifts. Moreover, the utilization of information technology and digitalization presents new opportunities in the transportation sector.

Changes in transportation modality have been increasingly recognized as a topic and not only of academic interest; it is a strategically important question. Investments in transportation infrastructure, such as expanding ports, building tunnels, bridges, or railways, entail significant costs but can lead to substantial economic and social returns if successful. When making such decisions, it is crucial to adequately envision how, by what means of transportation, cargo could be moving even decades into the future. However, such foresight is important for everyone whose decisions are related to regional development in any way. Changes in logistics of goods movement directly impact regional development patterns, raising or lowering development prospects for certain locations.

For foreign companies, particularly larger entities that could potentially invest in our industry or utilize our ports and railways, making significant investments and rapidly altering existing logistical schemes is typically a complex and time-consuming decision. To incentivize them to do so, we must carefully market our logistical potential. This entails considering nuances such as the types of freight, the optimal mode of transport, and the associated costs for transporting or transiting through our facilities. Additionally, we need to assess whether our existing advantages can be sustained over the long term.

2. Challenges facing transportation modes

Generalizing materials on the future of freight transport published over the last 10 years, it becomes evident that the majority of keywords associated with the ability of different transport modes to develop themselves and increase their competitiveness can be divided into three groups (The Future of Rail, 2023; Bin Aslam, 2023; Md Zaharul Islam et al., 2016; Girardet et al., 2014; The Wall Street Journal, 2020; Dianori et al., 2015; Oliver Wyman, 2017; Anspal et al., 2020; Eriksen, 2019; The Maritime Executive, 2017). It can be argued that all transport modes are engaged in the same struggle, albeit somewhat differently and with different advantages and weaknesses in this struggle.

The first cluster of keywords encompasses key terms like decarbonisation, emissions reduction, green mobility, and transport electrification, which includes the utilization of green energy sources. In essence, it revolves around addressing the fuel issue in a manner that is less environmentally damaging. From the perspective of this cluster, rail transport holds a favourable position compared to other modes of transportation. Rail has achieved a high level of electrification, drawing electricity from power lines without the need for an onboard energy source. In contrast, electric cars face significant challenges with batteries and charging infrastructure, which are even more pronounced for freight trucks. Nonetheless, there is optimism that electric trucks will become more prevalent in the future as advancements in battery technology and charging infrastructure make electric vehicles (EVs) more feasible for long-haul transportation. Given the increasing emphasis on "green" themes, rail transport stands to garner support from both countries and the European Union, both presently and in the future. However, the competition for rail transport is not without challenges; other modes of transportation are also striving to transition to less polluting fuels and engines with lower fuel consumption.

The second cluster of keywords includes terms such as digitization, automation, new data processing technology, big data, machine learning, IoT, and AI. Representatives from the road freight industry are particularly optimistic about the adoption of IoT devices. They suggest that within less than a decade, widespread adoption of IoT devices and connectivity solutions in trucks and trailers will occur. These IoT-enabled devices will provide real-time data on various aspects such as fuel efficiency, vehicle health, and driver behaviour, enabling more informed decision-making and proactive maintenance. However, many of the opportunities mentioned in this cluster apply to all modes of transport. Customers across different industries are increasingly interested in obtaining greater clarity on the progress of their shipments and feeling empowered to intervene in the event of delays or deviations, regardless of the mode of transport. IoT devices and connectivity solutions are transforming industries across the board.

A significant issue facing the freight transport industry is the potential transition to autonomous vehicles, particularly driverless trucks. Some experts believe that autonomous vehicle technology could substantially reduce the cost of trucking within a decade or two, potentially posing a significant challenge to railroad markets. However, the widespread adoption of driverless trucks will not occur quickly; it necessitates complex preparations in transportation infrastructure and legislation, as outlined in an overview by Noussia & Channon (2023). While fully autonomous trucks may take time to materialize, platooning – where one driver controls several following trucks – is already being tested in multiple locations and is becoming a commercial reality. Autonomous vehicle

technology is theoretically possible for other modes of transport as well, with rail and maritime transport potentially facing fewer complications due to safety concerns. However, the potential cost savings from labour reduction are smaller in these sectors compared to trucking. Moreover, the introduction of autonomous trucks could address one of the central challenges facing the trucking industry: the shortage of professional truck drivers. The long-haul nature of truck driving often results in difficulties for drivers to stay overnight at home, leading to fewer individuals willing to work in this profession. In the European Union, the shortage of truck drivers was projected to rise from less than half a million in the early 2020s to over 2 million due to retirements and a lack of popularity among younger generations. In Estonia alone, it is estimated that around 5600 truck drivers will need to be replaced within the next decade (Lassur & Viia, 2024).

When it comes to rail transport, it is acknowledged that the industry has been relatively slow to adapt to technological advancements. This can be attributed to the highly regulated environment and the long lifetime of rail assets. However, there has been an observed acceleration in activity within the sector in recent times. Railways present significant opportunities and potential for increasing efficiency through mechanization and digitization. Some of these opportunities include implementation of a digital rail network with full transparency of all processes for planning and monitoring rail freight traffic, digitalization and automation of the marshalling of trains, utilization of innovative coupling and braking technology, or implementation of a computerized maintenance-management system (with a clear picture of the current condition of their fleet and infrastructure, operators can better plan maintenance and repairs, proactively order spare parts, and avoid costly derailments and breakdowns).

The third cluster of keywords is associated with terms such as redesign of the supply chain, improving connections with terminals and logistic platforms, and interoperability. Calls for action are primarily directed towards maritime and railway transport sectors. Maritime transport is urged to undergo radical reorganization, encompassing ships, ports, and the links between them. A high-quality connection between ports and railways in the hinterland is deemed essential. Similarly, railways are encouraged to integrate into supply logistics, modernize infrastructure, and mutualize resources, especially feeder lines and local freight terminals. Ensuring fast transfers to final clients who require last-mile delivery is paramount. However, the last-mile delivery topic is also crucial for road transport. To address the challenges of congested urban areas and reduce emissions, adopting more last-mile innovations such as electric cargo bikes, drones, and robotic delivery vehicles is necessary.

On one hand, there is a clear desire in relevant literature to promote the creation of comprehensive multi-modal infrastructure, enabling different modes of transportation to cooperate towards common goals (Carboni & Della Chiara, 2018). However, many calls can also be interpreted as encouragement for the expansion of railway transport. It is emphasized that growing along the supply chain might be the ultimate competitive edge for railways. There is a consensus that railways must focus on international traffic and strive to win it from trucks and other competitors.

In the past, trucks and trains have traditionally served quite different types of freight. Rail freight transportation has historically focused on hauling bulky, heavy commodities that are typically less valuable on a per-ton basis. However, with the increasing containerization of cargo, opportunities for rail transportation have expanded, positioning it as

a suitable mode of transportation for covering longer distances in intermodal transportation chains, bridging the gap between maritime and road transport. It is widely recognized that the central question regarding freight transport modalities is the balance between road and rail transport. For a long time, state-owned railway companies have been hesitant to venture beyond their comfort zone, primarily handling bulk cargo, thereby ceding market share to more aggressive and faster-acting road hauliers. However, the situation appears to be changing, with the rise of ecological criteria being a primary driver. Given that road freight transport emits over five times more greenhouse gases per ton/kilometre of freight transported than rail transport (according to data from the European Environment Agency in 2021), there is a growing favouritism towards rail in the European Union's transport policy.

Furthermore, the issue of road congestion exacerbates the need for rail transport solutions. The EU has set a goal to increase the share of rail transport in freight transportation from the current level of under 20% to 30% by 2030, with a projected increase to 50% by 2050 (The Future of Rail, 2023). However, the expansion of railway transport to capture international freight is hindered by the territorial fragmentation of European railways. Unlike road transport, which can be considered a free market for such services across the entire EU, the same cannot be said for rail freight transport. Rail operators contend that beyond each national border, a different world with different rules, both administrative and technical, begins. As a result, the European Union has declared railway harmonization as one of the key prerequisites to eliminate such fragmentation, necessary for achieving its ambitious goals.

The preceding brief summary highlights that all transport modes possess significant opportunities to enhance or retain their market share, but they also encounter significant barriers. Predicting how they will seize these opportunities and how the market for transport services might be divided among different modes in the coming decades is essential but exceedingly complex.

3. About the research project and what was forecasted within its scope

This article is based on research commissioned by the Estonian Ministry of Economic Affairs and Communications and financed by the European Commission. The aim was to provide a broader understanding of the competitive landscape that may emerge with the launch of the new Rail Baltica international railway. However, the study was not narrowly focused on Rail Baltica alone. Instead, it sought to examine the development prospects of three modes of freight transport – road transport, railway transport, and maritime transport – in the economic and geographical context of the EU. The goal was to draw conclusions about the changes in their competitiveness. The time horizon considered for this analysis was the year 2050.

The main part of the study, involving work with the panel of experts, was conducted in 2019, with discussions on interpreting the results held in 2020. Given that several years have passed since the forecasts were made, we deemed it relevant to briefly comment on some developments that occurred after the completion of the study in the conclusion of this article.

When designing the study, we proceeded with the understanding that the forecast period is sufficiently long to assume that during this time, the requirements placed on the transportation process will change significantly and that new technologies will alter the situation. However, considering the relatively slow pace of innovation processes in the transportation sector, there is reason to believe that most of the factors that will become 'game-changers' in a few decades are already present, at least in an embryonic form, today. Many change processes have already been initiated. There are a number of changes in the air that we believe will come, but we do not know when or how strong their impact could be.

From this perspective, the idea emerged that it might be appropriate to rely on a **panel of experts** for such a task. This involved assuming that experienced, yet open-minded individuals with a broad understanding of various fields could, based on their knowledge, experience, and intuition, foresee significant changes and perceive crucial connections in a changing environment. Therefore, we decided to establish an international panel of transport experts for the study. The formation of the panel and the process of working with it using the Delphi method will be described in subsequent sections of the article. Here, we briefly touch on some questions related to the treatment of the transportation process and its evaluation criteria.

Before commencing the study, it was necessary to take positions on the following questions:

- Defining **the distance of the transport** to be used as a basis for comparison. When assessing the competitive advantage of one transport mode over another, it is essential to clarify the length of the distance being considered. For shorter distances, the advantages of trucks are more pronounced, while for longer distances, the advantages of freight trains become more significant. We posed our questions to experts regarding freight distances ranging from 400 to 1000 kilometres because the most intense competition between different modes of transportation occurs within this range.
- The selection of **transport service parameters** for which we sought prognostic assessments from experts: Several criteria could be considered; however, we focused on the two most important ones: transport cost and speed. Regarding the ecological pressure exerted by a particular mode of transport, we assumed that carriers must inevitably adapt to tightening ecological requirements. Experts are capable of assessing the extent of cost increases, for example, resulting from switching fuels to more environmentally friendly options.

Several questions arose regarding the consideration of **speed**. We decided to base it on the average speed (km/h) over the distance, including necessary stops, speed reductions in traffic, etc. This may not always align with the speed valued by the consumer interested in the delivery of goods because besides speed over distance, the time spent on receiving/accepting and loading/unloading goods is also significant.

Under the term '**transport cost**', we did not mean the direct expenses related to the transportation of goods (such as driver wages, fuel costs, vehicle depreciation, etc.), but rather the total costs incurred by the carrier associated with delivering the goods from point A to point B, including the infrastructure usage fee applied to them. We assumed that with sufficient competition among carriers, this would correlate quite strongly with

the price that the party interested in forwarding the goods must pay, as under normal competition, the carrier's profit margin cannot be very high.

When comparing transport costs in 2050 with those at the time of the assessment, the only feasible approach was to use comparable prices. This meant estimating how much arranging a particular transport would become more expensive or cheaper without considering the change in the general inflationary background. When making conclusions based on speed forecasts regarding their impact on competitiveness, it is necessary to consider that in the case of railway and maritime transport, the transit time of the transport means relatively little if the train or ship connection is not **regular and frequent**. While this remains significant for ocean freight, for short-sea shipping, it is more important how the ship's route is designed and how frequently it visits the port. With a larger cargo flow, one can expect both higher visitation frequency and lower freight rates.

Forecasts regarding freight costs and speed are indeed fundamental in predicting changes in competitiveness. However, competitiveness does not solely stem from these two indicators as straightforwardly as it might seem at first glance. Changes in the structure of goods requiring transportation can also be significant. The composition of potential goods flow may be quite different in the future due to shifts in people's lifestyles, technological advancements in goods production, changes in international trade conditions, or other reasons. For certain goods, one combination of transport cost and speed may be preferred, while for others, it may differ. As a result, some goods are more 'rail-friendly' than others, depending on their specific transportation needs. However, we addressed this topic not so much in the work of expert panels but within the framework of workshops following expertise.

4. The Delphi method: its advantage and limitations

The method chosen for our study, the Delphi method, is one of the longest-used expert-based techniques used in forecasting and various other assessment-related exercises aimed at reaching a consensus among experts or at least significant convergence of their opinions (Bell, 1997; Kuusi, 2017; Lang, 2019). This method allows expert opinions to serve as a decision-making basis for practitioners through rational discourse and information exchange. The uniqueness of the Delphi method lies in its ability to circumvent "follow the leader" tendencies and other problems often encountered in regular group discussions of experts. To prevent group pressure, Delphi experts work separately, in isolation from each other. Typically, an expert involved in the process does not know who the other experts are. The exchange of information between experts occurs only through the facilitation of the expertise coordinator. Experts are individually asked a series of questions, which are progressively specified and detailed over several rounds. The results are then compared to determine the extent to which the answers of individual experts differ from the panel average. Experts whose opinions differ most are asked to explain their estimations, and their arguments are communicated to the other panel members, who then decide whether to include them in their assessments. This procedure allows for gradually refining the investigated problem, working through new arguments, and getting closer to a well-founded result. However, there are downsides to the Delphi method. The process, when conducted correctly, can be labour-intensive and time-

consuming. Additionally, it may be unclear how to proceed in situations where the process "gets stuck," if experts with different opinions stubbornly adhere to their views and refuse to consider counterarguments from other experts.

The traditional use of the Delphi method assumes that the vast majority of questions are well-structured. This includes providing numerical estimates, ranking given answer options, selecting certain options deemed more significant, and using correct assessment scales. These structured questions allow for easy comparison of estimations and quick identification of differences in opinions, facilitating the process of detailing and refining the assessments.

Expert-based methods are naturally susceptible to criticism regarding their scientific rigor, and forecasts obtained through these methods may not necessarily be considered "correct." However, it can be argued in response that predicting the behaviour of complex social systems over a long period is not possible in a strictly scientific manner because their future is open and multifaceted. The ability to predict the future behaviour of social systems based solely on their past behaviour is limited, and it is challenging to create strictly scientific theories and models about their behaviour in the future. Nevertheless, the insufficient capability of scientific models or their absence cannot serve as reasons for giving up attempts by people to organize and combine existing knowledge and experience through structured communication. This process allows for the exploration of relevant information for the future and aids in attempting to foresee future developments. While the forecasts obtained through expert-based methods may not be infallible, they can still provide valuable insights and guidance for decision-making in uncertain environments.

Publications on traditional prognostics often classify the Delphi technique as a qualitative method because it relies on expert opinions rather than hard data and quantitative modelling (Makridakis & Wheelwright, 1989). However, practitioners of qualitative methods may not readily accept the Delphi method as their own. They may shy away from its perceived strictness and focus on numbers, as the Delphi method utilizes an inductive and reductionist approach (Saritas & Oner, 2004). Participants in the Delphi process come from different experiences and viewpoints, and consensus-building may be overly mechanistic due to the limited opportunities for qualitative discussion. Convergence of positions in the Delphi procedure occurs through providing unambiguous answers, preferably in quantified form, to narrowly formulated sub-tasks. Participants substantiate or oppose these answers without the opportunity to explain their holistic vision. If participants cannot convince each other during the iterative convergence of positions, the traditional Delphi method uses the average of different estimates as a group judgment in the final round, which may lack substantive depth (Mitroff and Linstone, 2011). According to Mitroff and Linstone (2011), the Delphi technique is suitable only for well-structured or structurable tasks where events or sub-tasks can be treated separately and reduced to numbers. In other words, they suggest that the utility of the method is limited to a narrow class of problems (Linstone & Turoff, 2011).

The Delphi method is considered advantageous because it allows for integrating the experience, intuition, and viewpoints of a large number of people, tapping into the potential of scattered inductive understanding. It is primarily viewed as a method for leveraging experts – individuals from whom in-depth knowledge is expected. Some authors argue that it enables the combination of expertise with the "wisdom of the crowd" (Tetlock &

Gardner, 2015). Information technology facilitates the involvement of a large number of people in the Delphi procedure, but this presents a significant disadvantage compared to the traditional method. In the traditional Delphi method, where the number of experts is relatively limited, respondents are usually more motivated to adjust their assessments during the process according to the opinions of other respondents.

There have been attempts to modify the conventional Delphi method to expand its sphere of use. For example, some modifications abandon the requirement for consensus among experts and instead focus on identifying a wider range of expert assessments or forming several patterns of assessments with clear reasons for the differences. Others combine the strict Delphi procedure with discussions between experts, allowing for more qualitative debate, though this raises concerns about ensuring experts' mutual anonymity and avoiding excessive orientation to more eloquent participants. Different situations arise when the Delphi technique is used not only for prognostication but also for developing solutions acceptable to organizations or wider groups of stakeholders (organizational Delphi or decision Delphi). In such cases, participants, regardless of their knowledge of the field, may no longer be considered independent experts but rather stakeholders or actors. In this context, retaining anonymity during the Delphi process may be more theoretical than practical.

Some radical attempts have been made to modify the Delphi method, such as the "roundless" or almost real-time Delphi proposed by Gordon and Pease (2006, pp. 321–333).

Whether the latter cases can still be considered as the Delphi method is subject to debate. Osmo Kuusi, one of the most recognized experts on this method, attempts to find a compromise in this regard (Kuusi, 2017). He outlines the three most significant attributes of the Delphi method as: anonymity, controlled feedback and consensus seeking. Kuusi suggests that the Delphi method can be considered as such if at least two of these three attributes are present. In the case of the traditional Delphi, all three attributes are typically present. Controlled feedback appears to be a crucial attribute for the method, as attempts to abandon it are rare. However, concessions have been made regarding the requirements of anonymity and consensus as the primary goal.

5. Adapting and implementing the Delphi procedure in the given study

Taking into account reflections on the conventional Delphi procedure, both positive and negative, as well as attempts at method modernization, and considering the peculiarities of our research task and situation, we formulated the main choices when using the Delphi method in our study as follows:

- Should the experts' work be organized as a separate process, or should some form of discussions be organized involving not only panel members (independent experts) but also stakeholders, such as individuals from the Estonian public sector and transportation companies, to make predictions together and create joint visions?
- Should we adhere to the classical principles of the Delphi procedure, where experts work in isolation from each other, and the process consists of a series of rounds where problem perceptions and solutions gradually refine based on

feedback received from others? Or should we abandon such a time and labour-intensive round system?

- How "automatic" and "self-operating" should the process become? One extreme involves highly formalized participant communication, where the process moves forward based on computer calculations elucidating the dominant position after soliciting divergent opinions from experts. The organizer of the expertise, the panel curator, does not communicate with individual experts in this case. In the second variant, efforts are made to ensure that participants understand the categories or arguments used in the expertise in the same way. The panel curator can help prevent confusion and misunderstandings among experts in the work process, providing explanatory answers to confused experts or initiating panel discussions to reformulate categories or questions.
- Should the process aim to reach a consensus position at the end of the process at all costs, even if it requires organizing a large number of clarification rounds? Or should the attitude be that multiple forecast variants, all based on clearly presented logic, are completely acceptable outcomes?

In the classical interpretation of the Delphi method, these opposing pairs start from the first understandings mentioned. However, regarding alternative pairs no. 3 and no. 4, they may come into conflict, especially in complex tasks. Ensuring a common position regarding the final solution is difficult when proceeding quickly and mechanically through intermediate stages. In this case, regarding alternative pairs 1 and 2, we opted for a logic characteristic of conventional Delphi. Regarding alternative pairs no. 3 and 4, however, we leaned towards the non-conventional. The decisive factor for the first choice was that we considered obtaining assessments from an independent panel of experts as having intrinsic value. We found that precisely this type of expertise process output, which cannot be suspected of being in any way biased, can be a very good input for stakeholder discussions. If the obtained result differs from what stakeholders would have assumed, it even has an additional stimulating effect on their subsequent discussions.

Regarding the third pair of alternatives, the solution mentioned first might have been usable perhaps at the stage of work where forecasting of speeds and transportation costs was already underway. However, since we planned to work on impact factors in the early stages of the expertise, such a mechanical approach did not seem relevant here. Impact factors represent categories created with a quite high degree of abstraction, and the hope that their formulations would be completely understood in the same way by all participants did not seem very plausible. Also, the actual course of the process showed that some of them had to be discussed with experts and some even reformulated. This imposed a fairly heavy workload and responsibility on the panel curators but was probably justified.

Since we planned to further discuss and work with the results of the expert panel with stakeholder groups, there was no reason to try to force experts towards a consensus view. Different logics and results regarding the forecasting of transport costs and truck speeds began to become clear already after the second round of refinements. Since the range of dispersion of final positions for different forecasts was not very large, it even seemed better that stakeholders received somewhat different results along with different justifications. Considering the distant time horizon and the high degree of uncertainty

regarding several factors, attempting to present the obtained forecasts as the only valid ones would have seemed very artificial.

For the study, we assembled a group of 35 independent transportation experts (referred to as the Delphi expert panel), comprising 19 experts from abroad and 16 from Estonia. Experts were selected based on the mode of transportation (road transport, maritime transport, railway transport), including practitioners, consultants, as well as researchers working in universities and other higher education institutions. In each subpanel, there were at least 10 experts. Experts from different transportation sectors mainly dealt with issues concerning the future of their respective sub-sectors during the expert consultation, so essentially, we can talk about the work of three separate sub-panels. Communication with the experts took place via email. Each sub-panel was coordinated by one member of the expertise organizing team (the sub-panel curator). They were authorized to present additional or clarifying questions to the participants after each round of the procedure, if deemed necessary.

We believe that methodologically, the most interesting aspect of our study was the inclusion of impact factors related analyses into the research process. We proceeded from the understanding that the task of comparing future states to which different phenomena under observation (in this case, modes of transport) may arrive after long-term development, and where the comparison itself must be based on the synthesis of several criteria (various aspects of competitiveness), cannot be solved in one fell swoop. Therefore, we designed the study as a three-stage process.

In the first stage, each mode of transport was examined to clarify the impact factors: formulating and categorizing the main factors with positive and negative impacts into groups based on their expected strength of impact. **The second stage** involved forecasting changes in freight speeds and freight costs using the vision obtained in the previous stage. **The third stage** consisted of drawing conclusions about the likely trends in the comparable competitiveness of modes of transport till the year 2050, based on the forecasts obtained from the expert panel and on some considerations about geopolitical and geo-economic trends. This stage took place in collaboration with working groups representing the Estonian public sector and the transportation-related business community. Given that the launch of the Rail Baltica railway line in Estonia was scheduled to take place no later than by the year 2030, the discussions naturally focused on trends related to the competitiveness of the railway.

After the summaries of the work of expert panels, including forecasts and comments describing how they reached their conclusions, were handed over to the third-stage working groups, communication with individual panel members continued to gather comments and clarifications. Let's delve deeper into what occurred at different stages of the project. When engaging with impact factors, all subpanels selected the most important factors from the initial list provided by the organizers. They adjusted the wording if necessary and proposed one or two additional factors not included in the initial list. On average, each subpanel selected about 8–10 factors for further analysis from the initial list of about twenty, with a few initial formulations corrected. After presenting arguments, debating, or agreeing with them, the subpanels reached a relative consensus on the strength of the key impact factors, which were visually represented. This visual depiction depicted forces positively and negatively affecting the development of the subsector, represented by arrows whose length corresponded to their expected strength in

shaping the future compared to other influencing forces (see Appendix 1). It took the subpanels 3–4 rounds of communication to obtain such a picture, with several email exchanges between experts and the subpanel curator to clarify questions that remained unclear.

In the next task of forecasting changes in freight service parameters (cost of transportation and real speed of transport vehicles over a distance), experts could use this picture of impact forces as a general mental model. However, they were not obligated to rely solely on the factors depicted in the picture of factors. The forecasts they proposed regarding changes in transportation costs and speeds were holistic assessments, contingent on their individual understandings. However, discussions held over the preceding picture of influence were instrumental in ensuring that the dispersion of forecasts of individual experts wasn't excessively high. Furthermore, the subsequent discussion about the differences in forecasts also unfolded relatively smoothly.

During the second stage, the procedure followed the standard Delphi method rules. Experts submitted their forecasts, selecting a percentage range on a given scale. The received forecasts were compared with each other, and those deviating significantly were asked to justify their assessments. This process of clarification was repeated two or three times depending on the transportation sector. The outputs of the second stage were presented in a format convenient for use in subsequent discussions regarding the likely dynamics of comparative competitiveness in the transportation sectors. This involved not only presenting the final results of the forecasts but also describing the logic behind reaching such conclusions. It was considered valuable to present the results of panellists whose forecasts did not align with mainstream assessments, if there was a clear logical rationale behind the divergent results.

6. Results of the expertise by modes of freight transportation

6.1. Road freight transportation

In publications dedicated to the future of road freight transportation the dominating topic is usually the transition to autonomous trucks. In our expertise, the emphases of specialists dealing with the future of road freight were different.

Factors with negative impact to future competitiveness. The most critical among them was considered to be the increase in road usage taxes for trucks. It was assumed that the policy based on the idea of external cost internalization would continue, with the addition of specific taxation related to the emission pressure of the respective transport mode. It was found that this altogether increases the cost of road freight transportation significantly. There was further debate over the increase in costs due to switching fuel types. All assumed that there would be a transition away from traditional diesel fuel to other fuels for environmental policy reasons, although there were disagreements on which fuels exactly. Consequently, the impact of abandoning diesel fuel on fuel price increase was assessed differently. Some experts, especially those from Estonia, predicted a predominant shift towards gas. It was assumed to be relatively easily achievable and shouldn't necessarily raise fuel costs. Other experts, particularly those not from Estonia, emphasized that since natural gas is also a fossil fuel, there will come a time when it needs to be abandoned in favour of renewable options such as hydrogen, biogas, or

(green) electricity. This would inevitably lead to a significant increase in fuel costs. The construction of new service infrastructure related to new fuels (including gas stations) requires investment, and it's unrealistic to expect that this wouldn't increase fuel prices. Increased traffic density on roads was considered a significant negative factor, leading to lower speeds and thereby increasing the cost of transportation.

Factors with positive impact to future competitiveness. The most important of these were considered to be the improvement of cooperation among operators in consolidating freight volumes (ultimately considered the most important positive factor) and increasing the load capacity of trucks. Closely following were utilizing opportunities in electronic optimization of traffic flow and freight and making engines more economical. Some experts, albeit a minority, expressed hope that the EU would manage to reduce protectionist policies, such as those achieved through changes in drivers' working and resting regimes. Making the work of carriers from other countries less inconvenient and less costly would enhance the efficiency of road haulage. To the surprise of the organizers, experts did not include the introduction of autonomous vehicles, i.e., driverless cars, among the significantly positive factors during the period. It wasn't disputed that this would eventually happen, but it was thought that replacing the truck fleet and establishing necessary infrastructure (including legislation) would take time, and the overall situation wouldn't change significantly before 2040 at least. There were also concerns that any decrease in labour costs due to a decrease in the number of drivers could be offset by growing technology costs unless the state undertakes all the necessary costs for innovation. However, it was believed that electronic lock-controlled platooning trucks, where only one driver is in one of the vehicles, would start influencing the competitive situation earlier. This is especially true for longer hauls on major highways. Managing such platoons on major highways is easier, and having one driver instead of several for overnight long-haul transportation provides significant savings.

Estimations about transport costs and speed. It was almost unanimously concluded that freight costs per ton/kilometre in comparable prices (i.e., without considering general inflation) would increase by approximately 20% by 2040. During the expert analysis, when considering distances close to 500 kilometres, the cost per ton/kilometre was slightly below one euro, i.e., for an average load of 20 tons, the cost was 18 euros per kilometre. However, towards the end of the period under consideration, such loads would incur costs of 21–22 euros per kilometre (in comparable prices). Most experts were not optimistic about the increase in the speed of movement of trucks. It was believed that despite the construction of new road connections and bypasses and improvements in traffic management, the increase in road congestion with general traffic growth would lead to traffic restrictions and jams. Forecasts for the average speed of freight vehicles during the period 2040–2050 ranged from 65–80 km/h (the average speed for non-stop distances during the time of the study was approximately 75 km/h). There were slightly fewer experts predicting an increase in speed compared to those predicting a decrease. Therefore, with some generalization: either the speed will remain more or less the same or will slow down slightly.

6.2. Maritime transport

During the expertise, it was decided to address ocean shipping and intra-European shipping (short sea shipping) separately in the analysis.

Factors with negative impact. Of these factors, fuel-related factors are considered by the experts to play the most important role. In the past, ships used the residue of oil refining, the lowest quality fuel, which was cheap but polluting. In the future, ships' engines will have to draw the energy they need to run from something other than oil-based fuels. However, the experts expected the transition to new energy sources to take a long time, with the coming decades seen as a period of reduced pollution, including through the use of hybrid ships and LNG carriers, rather than an immediate transition to completely emission-free fuels. It is assumed that hybrid and LNG ships, for example, are suitable for the transition period. The lack of a common understanding of what exactly will be the dominant marine fuel – LNG, hydrogen, electricity, ammonia, etc. – also makes it difficult to take a more radical course, and this uncertainty is holding back the development of the necessary infrastructure for new energy carriers. While believing that such infrastructure will be in place by 2050 and that most of the fleet will be replaced by ships designed to use alternative fuels, most experts believe that oil-based fuels will remain dominant until almost the end of this period. A minority (including a number of Estonian experts) thought that LNG would come to dominate and that this would happen sooner. The general perception is that, if implemented in one way or another, changes in fuel use will make shipping more environmentally friendly but more expensive. The serious problem, which was feared to worsen, was seen in the congestion of ports and the slowing down of ship services there, especially in the transcontinental ports along the North Sea.

Factors of positive impact. The most important were technological and organizational solutions to make ports more efficient. Solutions to fuel consumption, such as the introduction of more economical machinery, optimizing efficiency during voyages, and technical improvements, including in ship design, were also considered important.

In the case of ocean shipping, it was believed that there is still scope for further increasing the size of vessels (although there are limits to this, as the number of ports that can accommodate very large vessels is small). It was expected that volumes would be rebalanced between Europe and Asia in the future, which would alleviate the backloading problem. In short sea shipping (i.e., intra-European transport), opportunities were seen in the introduction of new logistical schemes.

The experts did not consider the introduction of autonomous, i.e., unmanned, vessels to be a major factor in lowering or holding back the price of maritime transport. A significant breakthrough in their use was seen after rather than before 2040, with some experts suggesting that for intra-European transport, it might be earlier.

Estimations about transport costs and speeds. The experts' assessment of the costs of ocean transport was fairly unanimous, with an increase over the period under review. Most consider that they will increase by 10 to 20% in comparable prices. Of course, the picture may differ for different sub-periods and routes, and in maritime transport, generally, tariffs are quite volatile. However, in the case of the problem we are examining, which is the change in the comparative competitiveness of the various modes of transport in the European context, what is happening in intra-European or 'short sea shipping' plays a more important role. Here, transport costs and fares per unit distance (nautical mile, km) are higher than for ocean transport. Experts differed more on the forecasting of their dynamics than for ocean transport, but most of them considered that some increase in costs was likely, albeit to a lesser extent than for ocean transport. While

the fuel component is very important for ocean transport because of the distance covered, other components have a greater influence on the final result for short-sea shipping. In the case of short sea shipping, competition from other modes of transport (including rail) also prevents transport costs from rising, which creates a strong incentive to engage in various cost reduction measures.

In terms of speed, a slight slowdown is expected in ocean shipping, despite improvements in ship design. The reason: even a few knots of speed increase will lead to higher fuel consumption and emissions. With strict ecological standards and higher fuel costs, this could be critical for ocean-going vessels. While at the time of the study, the container carrier reached Rotterdam from Shanghai in less than 30 days, in the future, it is expected to take more than a month. Whether the creation of 'transcontinental land bridges' could start to provide greater competition to maritime transport at the end of the period is a topic that needs to be addressed in its own right.

For intra-European transport, some experts predict that average speed of the vessel on the distance will remain more or less unchanged, others that they will increase slightly. For example, for a distance of 800 or 900 km, a difference of a few hours in the speed of arrival does not yet make a significant difference to the competitiveness of maritime transport compared with other modes of transport, but half or day longer to port may already have a significant impact. But the speed with which loading/unloading and onward shipment can be organized is not less important factor.

6.3. Rail freight transportation

When it comes to rail freight transport, we presented the issue to experts slightly differently than with other modes of transport. Specifically, for these hauls, efficiency indicators vary significantly across different countries and railway tracks. Hence, speaking of a universal baseline representing normalcy, which experts could address as a common starting point when compiling a prognosis, is not feasible due to this variability. In the case of international hauls, the use of rail transport becomes viable only after achieving success in harmonizing railway systems between countries, eliminating fragmentation within the EU economic area. While the EU policy favouring rail transport had been initiated, at the time of organizing our expertise, the harmonization process was still in its early stages. Much depends also on the specific technical parameters and capacity of the existing railway line. Therefore, we framed the question differently. We asked experts to envision a modern international railway line where EU-promoted harmonization has achieved its initial results, meaning that access to the railway line's capacity is not discriminated against for carriers from other countries, freight trains don't waste time at national borders due to various reasons, and locomotive changes aren't required at borders[4]. We wanted to know if and how such railway lines could reduce the costs of

[4] To ensure that experts have a similar understanding of the initial state, from which to begin forecasting a description of a hypothetical railway was provided for the experts: a recently constructed or renovated two-track electrified railway, with a gauge of 1,435 mm, axle load of 22.5 t, and a maximum length of freight trains of 740 m. The possible maximum speed for freight trains is 120 km/h, while the actual speed of freight trains on the track, considering stops and the need to allow passenger trains to pass, is approximately 95 km/h. These parameters were taken from the planned Rail Baltica railway project. Since Rail Baltica's construction was largely financed and supervised

providing freight services (infrastructure usage fees for carriers plus costs associated with organizing the transport) in the coming decades, by 2050.

Positive impact factors and possibilities. Rail freight experts identified opportunities for improving the future of this sector, highlighting the potential of IT solutions to enhance supply chain efficiency (considered the most crucial factor), further automating processes to achieve labour savings, as well as opportunities to increase energy efficiency. Especially Estonian experts emphasized the importance of well-thought-out and flexible tariff policies to attract and retain new customers. They did not consider the continued harmonization of the railway system and its operations between countries as significant, as at least technological alignment and integration take decades. They were followed in importance by organizational measures in supply chain transformation, increasing railway interoperability with connecting rail corridors, and the potential of digitization and new data processing methods. In general, unlike other modes of transport, directly carrier-related factors take a back seat among the major influencing factors; those that help integrate infrastructure usage with transportation into a unified operational process dominate.

Negative impact factors and dangers. This list is characterized by a near absence of factors directly linked to cost increase due to input factors. Experts only seriously considered perspectives on the rising cost of electricity. For electrified railways, the price of electricity is naturally significant, and an increase in its price could also result from the requirement to use so-called green electricity. It was commented that all inputs for railway operations, such as rolling stock and labour, will certainly increase in cost, but it is unlikely to assume that they will increase more than for competing modes of transport. Experts rather saw negative factors as those such as sudden changes in competing transport modes' technologies, like the potential rise of autonomous cargo trucks, or a situation where the pressing for railway development for ecological reasons in freight transportation could weaken over time. Most panel members did not believe this. Or possible changes in the structure of goods to be delivered, meaning that the flow of goods may become less "rail-friendly," less suitable for the combination of transport service parameters that fit rail better than other modes of transport.

Estimates about changes in transport cost and speed. Almost all experts believed that even on railway lines freed from the obstructive effects of inter-country railway fragmentation, there are other significant opportunities for further increasing operational efficiency that the rise in costs associated with providing freight transport services can be kept lower than the rise in input prices. It was suggested that the sum of costs (and closely related, the freight rate to the customer) per ton/km or TEU/km in comparable prices by 2050, would decrease, according to most, or at worst remain the same. Hope was largely associated with belief in IT applications, which can help achieve economies

by the European Commission, it could also be assumed that there should not be any significant problems with technological and institutional harmonization along this route from the Gulf of Finland to the Polish border. Rail Baltica was expected to be launched a few years before 2030, and it was generally assumed that by 2030, there would be significant progress in overcoming the fragmentation of the railway systems among EU countries. For these reasons, the results of the expertise could be used quite effectively to predict the future of Rail Baltica, and forecasts based on the planned parameters of Rail Baltica could well be used to predict the fate of other EU countries' railways in the period following 2030.

in practically all aspects of the transport process organization and control and maintenance of rolling stock and infrastructure. For those predicting a decline in costs, this decline ranged from a few percent to 20%. Foreign experts were somewhat more optimistic about this than Estonian experts.

Regarding speeds, experts were asked whether the hypothetical speed of 95 km/h proposed by the organizers of the expertise (calculated based on the total time to cover the entire distance including stops), would be sufficient for successful competition in rail freight transport with other modes of transport over a longer period, or whether it should be significantly increased. Half of the foreign railway experts deemed speed increase a necessary, but the majority, including most Estonian experts, believed that 95 km/h is sufficient for competition even in the distant future.

7. The changing competitiveness of freight transport modes and competition between logistic chains.

In previous text, the perspectives of different freight transport modes were considered in isolation from each other. Conclusions on their future comparative competitiveness and on perspective modal shifts can only be reached after the prognostic assessments from expert panels have been related to each other and placed in a broader context. We will focus on the changes in competitiveness between railway transport and road transport, and between railway transport and (short-sea) maritime transport. There is less competition between maritime and road transport. Road transport is too expensive for this purpose; in the logistics chain, it tends to be a cooperation partner for maritime transport, attempting to seize the onward transport from ports or transport to ports and competing with railway transport for it.

Based on the results of the expertise, it can be argued that if railway transport manages to overcome the problems associated with the fragmentation of the national railway systems in Europe, its chances of capturing additional freight volume from road transport in the future are very good. Road transport is characterized by greater flexibility and delivering goods directly to the customer or very close to them. However, there is no reason to assume that road transport should provide faster delivery on longer transport routes than railway transport in the future. Moreover, railway transport can ensure greater delivery precision.[5] Road transport is already significantly more expensive than other types of transport distances we have observed. In the coming decades, especially due to ecological pressures, it is likely to become even more expensive, while significant cost savings can be achieved on railways based on new technologies. Whether the introduction of autonomous, i.e., driverless, freight vehicles will provide significant savings in the coming decades for road transport is still questionable.

To realize the competitive advantage of railway freight transport, it is necessary for the movement of freight trains to be regular and for the schedule to be sufficiently dense. However, ensuring the filling of trains with a dense schedule requires that there is

[5] The railway's prerequisites are very good for serving transport on a route with a port at one end and an industrial enterprise with a large production volume in need of regular supply or export of production at the other end. In this case, it is very difficult for road transport to compete with railways, because it cannot use the first and last mile advantage.

sufficient freight nearby to consolidate for railway transport. If there are problems with this, the involvement of transit cargo volumes can be considered as a significant additional resource. The struggle for servicing transit volumes intensifies, particularly at the level of multimodal transport chains.

In the event of an increase in the efficiency of railway freight transport, it has the opportunity to capture goods that currently move by sea. For example, offering a larger portion of the route for goods moving between Germany and Finland by rail instead of sea (either via Sweden or along the Rail Baltica route) can be advantageous. In the case of such alternative routes, some shorter segments, such as the route between Tallinn and Helsinki, still need to be covered by sea transport, this can be done using rail ferry.[6] Rail-centric routes have a clear advantage in speed, but using sea-centric routes is likely to remain cheaper (the cost per kilometre is lower, and fewer kilometres are travelled when using maritime routes). The opportunities for competition on rail-centric alternative routes are better in cases where the starting or ending point of the cargo movement is further from the sea, for example, not in northern Germany close to the Baltic Sea coast but in southern Germany. Using a freight train line starting from there for sending goods to Finland without the need to transfer the cargo to another mode of transport in between can be much faster compared to the maritime route and also competitively priced. However, this requires regular and sufficiently dense movement of freight trains in the railway corridor, of course, as well as that crossing national borders does not cause additional time loss.

A significant potential for railway transport should open up if it can connect to new ocean shipping routes in the future, such as Asian cargo shipping to Europe not only through North Sea ports but also via the Adriatic Sea or the Arctic Ocean, and provide them with onward transport services from European entry ports. This service can also be provided by feeder vessels or road carriers for short-sea shipping, but since a large portion of the cargo needs to be transported to destinations far from the sea and the distances for onward transport are generally quite long, the railway's competitive position is good for capturing such transports.

8. Developments in recent years

The described expertise was conducted in 2019, with discussions held in 2020. What has changed by the spring of 2024? The pressure to make transportation more eco-friendly has rather strengthened. There are no signs of support reduction for greener transportation modes, including the increase in the importance of rail freight in the EU. It seems that the shift away from oil-based fuels in maritime transportation has begun to occur in a slightly more radical manner than experts predicted in 2019. The overall share of alternative fuels is still quite low (only a few percent), but a significant portion of newly ordered ships in recent years were designed to use alternative fuels. Initially, mostly LNG ships, but there is a noticeable increasing interest in other fuels as well. Ocean freight tariffs have risen, and the time spent on shipments between East Asia and Europe

[6] By constructing tunnels or bridges, it is possible in the longer term to eliminate the need for maritime transport on those routes.

has increased. The reasons behind this are multifaceted, including decreased security in the vicinity of the Suez Canal route.

It is still too early to assess whether experts underestimated the mass adoption of autonomous (driverless) freight vehicles as a game-changer in the competition between transportation modes or not, but significant progress in this direction is not yet observable. The growth of international and intercontinental trade has slowed down in the recent period, with talks even of a trend towards economic relocalisation. As previous long multimodal logistical chains shorten, this reduces the chances for railways to secure suitable shipments. Seeking cooperation and trade partners from neighbouring regions is advantageous for road hauliers.

However, a modernized and efficiently operating railway network plays an important role in better internal integration of the EU economic area, including better integration between core Europe and the EU member states located eastwards of it. In a more tense international situation, this role becomes even more crucial, such as for military shipments and the future reconstruction of Ukraine. The EU economic area is territorially large enough for railway transport interested in longer-distance shipments to find expansion opportunities there.

9. Conclusions of the study

In the following, we present two sets of conclusions: first, methodological conclusions concerning the implementation of the modified variant of the Delphi method, and second, our conclusions regarding probable modal shifts in transportation in future, based on the results of the experts estimations of dynamics of transportation costs and speeds of different modes of transportation.

Methodological conclusions regarding the use of Delphi method. Our study revealed that the challenges arising from the application of the standardized rigorous procedure inherent in the Delphi method in the context of complex and highly-structured tasks, can be effectively overcome through a two-phase approach. In this approach, the first phase is dedicated to aligning the background understandings of participating experts, and only after completing this phase is advisable to proceed with quantitative prognostic assessments, involving the provision, comparison, opposition, and convergence of such estimates. Our experience has shown that the work with impact factors of the process whose outcomes we are seeking to predict, creation the common picture of impact factors, serve well as an effective tool for converging expert background understandings. Although this common picture was not mandatory to for individual experts to follow during their subsequent work with quantitative prognostic assessments, the work invested in the creation of this picture facilitated a smoother and faster progression of the subsequent expertise procedure.

However, when employing a two-phase approach, it must be noted that the organizers of the Delphi procedure need to take a more active role in the first phase than is customary in conventional Delphi expertise. In this phase of work, it is necessary to operate with categories of fairly high level of abstraction and some misunderstandings between experts about these categories may arise. Organizers of the process should be prepared

to provide explanations if needed and assist experts if there is a need to reformulate impact factors.

In a broader sense, the modification of the Delphi method conducted by us can be interpreted as an updated and expanded approach to the work of independent experts in foresight. It's not merely an activity aimed at providing clients (public sector officials or politicians) with a straightforward forecast approved by the panel of experts, which the client can then use or not use at will. Instead, our approach positions expert work as one component (sub-process) in a broader collaborative process involving three groups of people: those preparing the expertise (researchers, consultants), the experts themselves, and practitioners interested in using the results. The success of such a collaborative process heavily depends on how well the interfaces between different sub-processes are designed. It depends on whether the input material provided to the experts by the organizers of the process is suitable for experts to refine and converge their background understandings, and whether the output from the expert panel helps activate practitioners' thinking processes in developing their future-oriented perspectives. To achieve the last mentioned effect, it is beneficial if the report of expert work, besides highlighting commonalities in expert opinions also includes possible alternative understandings and includes not only an explanations of the arguments behind e dominating opinion of the expert panel but also behind the opinions of the opponents.

The conclusions about probable transport modes shifts. Taking into account the impact of the factors highlighted by experts, considering the forecasts received from expert panels regarding changes in freight costs and speed for various modes of transportation in the coming decades, and generalizing these assessments, it can be assumed that there are significant opportunities for enhancing the competitiveness of rail transport in the European Union and capturing a considerable market share from road haulage. The expert consensus within the road haulage sub-panel was fairly unanimous in stating that the pressure, largely stemming from ecological reasons, including higher taxation on road usage for trucks and increases in input costs, will lead to a greater increase in the cost of road haulage than can be compensated for by various factors positively impacting the sector's development. Experts also do not believe that the speed of movement of goods vehicles on roads under conditions of road congestion can increase significantly. While experts do not deny the possibility of the introduction of autonomous freight vehicles, they believe that it will take some time and may only significantly impact the overall picture towards the end of the period under consideration. The opening up of the perspective of rail freight transport is hindered by the slow pace of harmonization of railway-related regulations between countries, but this mode of transport is less sensitive to increases in input costs compared to competing modes of transport. If the railway system is modernized and electrified and significant barriers to cross-border freight arrangements are removed, the rail system has very good opportunities to make infrastructure and freight management more economical and comprehensively develop through the implementation of information technology and mechanization over the next decades. This would help combat the increase in transport cost t costs, with most railway experts participating in the panel believing that it could even be reduced (in terms of ton-kilometres or TEU-kilometres at comparable prices).

The efficiency indicators of maritime transport are influenced by the transition to less polluting yet more expensive fuels. This affects ocean shipping to a greater extent than

short-sea shipping because the fuel component is more significant in ocean shipping. With fuel price increases and stricter pollution regulations, it becomes difficult for them to increase speed, as faster sailing increases fuel consumption and pollution. The majority of maritime experts participating in Delphi survey believe that the costs of ocean shipping per nautical mile travelled, in comparable prices, will increase during the period under consideration. Expert opinions on short-sea shipping were not as stringent and varied more. Reserves are seen in implementing more thoughtful logistical schemes and improving port efficiency, which reduces the time needed to service ships. In some cargo routes, competition for short-sea shipping may arise from rail freight transport, particularly for goods requiring faster and more precise delivery and expectedly more expensive cargoes.

Changes in competitiveness depend on many factors, some of these factors are quite well predictable, while for others, the degree of uncertainty is high. Every attempt to predict the changes in this sector over long term, including the Delphi expertise described in this article, can only be one step toward improving understanding of the processes occurring in reality and their further development possibilities. Therefore, it is advisable to regularly repeat forecasting attempts using different methods to account for ongoing changes and refine and adjust long-term forecasts.

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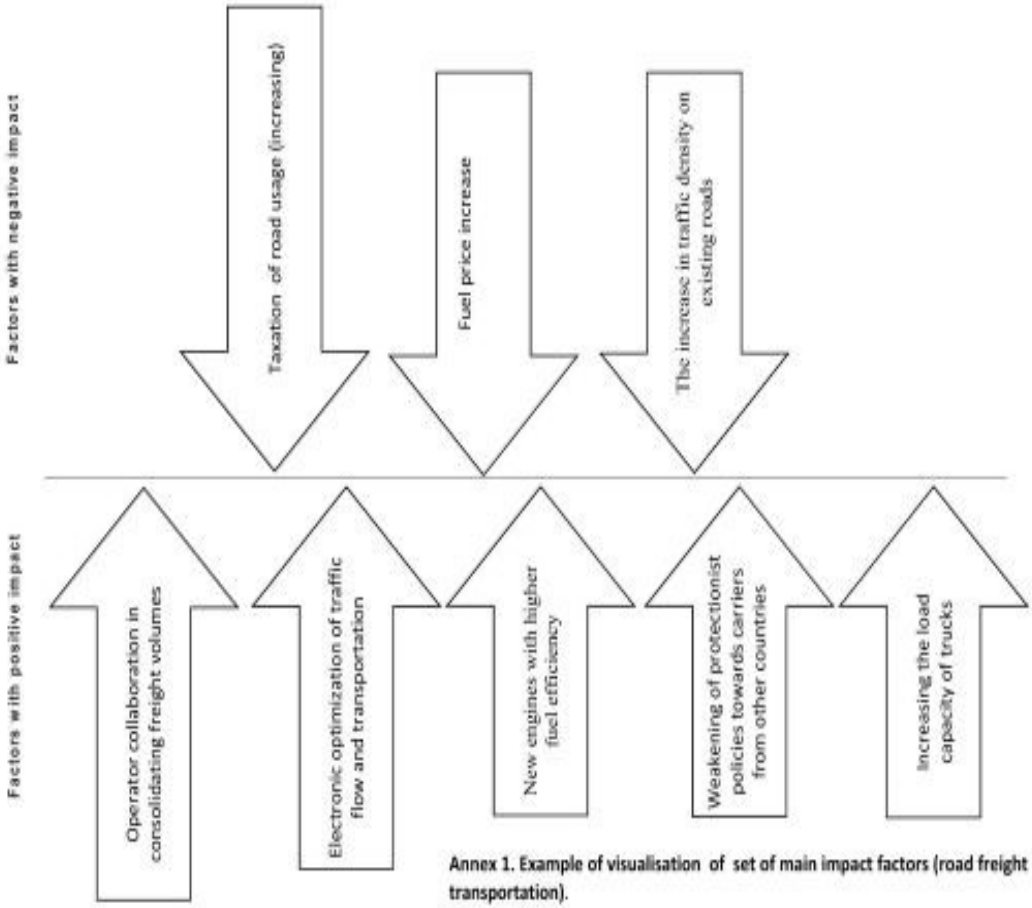
ANNEX



Annex 1. Example of visualisation of set of main impact factors (road freight transportation).