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Ro-Ro transport management in the southern Baltic

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RO-RO TRANSPORTATION MANAGEMENT IN THE SOUTHERN BALTIC

By

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DECLARATION

I certify that all material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Dissertation:	**Ro-Ro transportation management in the Southern Baltic**
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This dissertation is a study of the Ro-Ro transportation in the Southern Baltic. It is dedicated not only to analysis and evaluation of perspectives of the Ro-Ro transportation in this area but also to main current problems giving clear recommendations how to eliminate them.

At first a brief historical overview about Ro-Ro transportation is presented to the reader. This is followed by a description of the Ro-Ro ships operating nowadays in the Southern Baltic. Some important design aspects are considered and peculiarities of Ro-Ro cargo handling and transportation are determined.

A detailed look from the commercial point of view is taken at the setting up of a Ro-Ro shipping line and the role of ports in Ro-Ro shipping line foundation, operation and development is evaluated.

A general Ro-Ro market overview and analysis of Ro-Ro cargo transportation in the Southern Baltic during the last three years was carried out. Most Ro-Ro shipping companies operating as well as the leading ports in the Southern Baltic and the Ro-Ro shipping lines in this area with some technical data were briefly described. An interesting alternative is also presented to the Ro-Ro operators – to incorporate their shipping lines into an intermodal transportation chain and a thorough analysis of Ro-Ro transportation on a particular shipping route is presented. Finally, future developments of the Ro-Ro market in the Southern Baltic are foreseen and conclusions with recommendations for Ro-Ro operators how to act in today's competitive market are listed.

Keywords: Ro-Ro transportation, ship design, setting-up, line, market research.

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CHAPTER 1.
Introduction

The aim of this dissertation is to thoroughly investigate different aspects of Ro-Ro transportation in the Southern Baltic. The reason of choosing particularly this area is governed by the fact that the growing extent of Ro-Ro transportation in the Southern Baltic (especially in the Eastern part) is affected by several factors, which are still alien to other regions where this type of transportation also exists. On the other hand, it should be noted that the author's attention in this dissertation is somewhat focused to the Lithuanian Shipping Company (LISCO) and port of Klaipeda, because initially this work is dedicated to the improvement of such transportation in above stated company and port, mainly specialising in transit cargo flows.

After a brief historical overview of Ro-Ro transportation, the primary aim has been to survey the level of development and peculiarities of Ro-Ro technology in general, and in the Southern Baltic in particular. Therefore, the main types of vessels operating in this area have been presented, and the latest trends in the design of Ro-Ro ships are determined. Technological peculiarities of Ro-Ro cargo handling and transportation are analysed and some latest technical inventions in these matters are presented.

Another objective of this dissertation has been to fulfil a commercial research of setting-up of the Ro-Ro shipping line in the Southern Baltic. Hence, general considerations containing comparative analysis of commercial characteristics of main competing unitised short-sea modal systems are presented. This is followed by an analysis of trade between the states and liner shipping activities, ascertainment of shipping line service conditions and calculation of Ro-Ro shipping line optimum scheme. Critical success factors are determined and an edifying example of the Ro-Ro shipping line that failed to meet above stated requirements is given.

The role of port in setting-up, operation and development of Ro-Ro shipping line is of vital importance. Port adaptability level for Ro-Ro transportation is also determined in one chapter. However, the original aim of this chapter has been to prove that Port Authorities together with other port operators must work together closely and successful development of Ro-Ro transportation directly depends on all parties involved, and not only on the shipping company itself.

General world's and the Southern Baltic's Ro-Ro transportation market overview is also presented, shipping companies operating and lines together with leading Southern Baltic ports are described, which will give the reader a clear understanding of the current development level in the Southern Baltic Ro-Ro market. Perspectives of Ro-Ro transportation incorporation into the intermodal transportation chain are investigated and main obstacles, which need to be eliminated, are determined. Research of Ro-Ro transportation on the Kiel - Klaipeda route during the last two years is made concentrating the attention to the companies' tariff policy and how the macroeconomic changes affect Ro-Ro shipping line operation. That chapter ends with future and most likely developments of the Ro-Ro market in the Southern Baltic.

Finally, conclusions are drawn that expose the latest trends in the Ro-Ro transportation in general and the Southern Baltic in particular, determining the problems that Ro-Ro operators face nowadays or may encounter in the nearest future, and recommendations on how to solve or reduce them are also given.

CHAPTER 2.

Technological research of Ro-Ro transportation

2.1 Ro-Ro ship types

I think that it is worth starting with mentioning that this section will not contain a general survey of all types of Ro-Ro ships ever built but only describe those that are most commonly used nowadays. Particular attention will be paid to those types that are operating in the Southern Baltic and their main advantages or disadvantages will also be listed in further sections. However, at first a short historical view will be presented.

2.1.1 Historical view of Ro-Ro service

Some sources assert that Ro-Ro ships appeared because of rapid development of railway and wheeled technique. The first railway ferry was used in 1851 on the Firth of Forth. In the Mediterranean the first rail ferry that was crossing the Strait of Messina appeared in 1887. Since then the intensive appearance of Ro-Ro newbuildings began but according to Robert Hermansson (2000, p.27), it took until 1923 before the world saw the first Ro-Ro ferry for motor vehicles when the Canadian ship "Motor Princess" began regular traffic along the coast of British Columbia. However, these ferries became well-known world-wide only after the landing craft of World War II. Another boom of Ro-Ro ferries started at the end of the fifties when a lot of owners of personal cars began to travel across the English Channel or between the countries of Scandinavia. According to a Fairplay Publication (1985, vii), if the sixties were the principles of Ro-Ro transport laid down, the seventies were the years when the business of Ro-Ro shipping was to spread throughout the developed world and into most trades. R. Hermansson (2000, p.28) states that the advantages outnumbered the disadvantages and already the first generation of Ro-Ro ships showed that this system had come to stay. Nowadays the owners of Ro-Ro ships are looking for more and more specialised vessels in particular types of Ro-Ro cargo even though the most of the ships are perfectly fitted

to almost all types of this cargo. Nevertheless most of these ships also belong to one of the below stated groups:

1. Ro-Ro conventional ships.
2. Ro-Ro container ships.
3. Ro-Ro forest product ships.
4. Ro-Ro bulk carriers.
5. Rail ferries.
6. Freight only Ro-Ro ships.
7. Driver accompanied freight Ro-Ro ships.
8. PCC/PCTC vessels.
9. Ro-pax ferries.
10. Ro-Ro barges.

It goes without saying that only a part of them operate in the Baltic Sea and particularly in the Southern Baltic. That is why I will concentrate my further attention just to those of the aforementioned ships that operate only in this region.

2.1.2 Freight only Ro-Ro ships

This is one of the most commonly used types of these ships in the past. They were designed particularly to replace conventional Ro-Ro ships that were out-of-date. These vessels could carry no more than 12 passengers or drivers even if shipowners made every effort to classify the drivers of carried trucks as crewmembers. The spectrum of cargo carried by these vessels was rather wide – trailers, containers, cars, fork loaded cargo, etc. These vessels were started to be built having relatively small cargo carrying capacity of about 50 or 60 × 12 m trailers but finally the length of the decks increased up to 1500-1800 m. The tendency of replacing smaller vessels by much larger also lead to decreasing the number of calling ports which consequently raised dissatisfaction of customers. Ro-Ro shipowners tried to solve this problem by increasing the speed or minimising the cargo operations time but in both cases they met needs of big financial investments. In the former case, increasing of the speed

meant enormous fuel consumption. The latter was also a hardly feasible target in practice because it required high port investments.

Photograph 1: Freight only Ro-Ro vessel “Siauliai” of LISCO

2.1.3 Driver accompanied freight Ro-Ro ships

It is well-known that some trucking companies, especially those that specialise in expensive and perishable cargo transportation, prefer to deliver such cargo with their own truck and driver. On the other hand, most Ro-Ro ships under the international regulations were allowed to carry just up to 12 passengers. For some years this was one of the biggest obstacles for further development of this type of transportation because shipowners couldn’t fulfil shippers’ requirements to ship the cargo with their own trucks and drivers. The solution was achieved when IMO adopted resolution A323, an addition to the SOLAS 74. That was quite reasonable because there is absolutely no necessity to consider drivers as passengers being very old or frail. It was also taken into account that the main advantage of these vessels in quick loading/discharging is worth nothing if it is required to fit these vessels with the same number of watertight doors as passenger ferries. However, despite the fact that the drivers on these vessels are not considered as passengers anymore, that doesn’t mean that the service provided for them can be worthier. The first reason is that a lot of drivers nowadays, especially those from trucking companies in former Soviet Union countries, are allowed to chose the route of transportation themselves and,

therefore, once treated badly, in future will “forget” about this shipping line’s existence. The other reason would be that owners of serious and reliable trucking companies are very concerned about land-based cargo transportation quality and therefore prefer the route allowing the driver to have a proper rest.

Photograph 2: Driver accompanied freight Ro-Ro vessel “Kahlberg” of Scandlines AG

2.1.4 Rail ferries

As was mentioned before, almost one hundred and fifty years have passed since the first rail link was established in the Firth of Forth. Even though this type of Ro-Ro ship changed only little since its primal appearance, the overall spread of these vessels is somehow reduced by the requirement for a Ro-Ro terminal to have proper equipment for handling of rail wagons. In most cases that requires huge additional capital investments for building such specific shore ramps and infrastructure. The other obstacle that is not so common for Baltic ports is the requirement to equip the terminal with additional tidal linkspans because of water level fluctuations. Despite the above stated, the main advantage of rail ferries is the extremely short time required for loading/discharging operations if the aforementioned rail wagons are ready and proper co-ordination of operations between the ship and terminal operator is in place. Drewry Shipping Consultants Ltd (1998, p.40) has also pointed to the operational problems with rail ferries because of necessity to keep the shore and ship’s rails in alignment, and the avoidance of steep slopes. Therefore the wagons on board must be moved laterally, something that is achieved by hydraulic platforms or movable rails. Other common problem in the Southern Baltic region is the different gauge of rails in the former Soviet Union and Western European countries. This

obstacle can be overcome by re-fitting wagons with different structure of wheels. However, the latter also means additional expenses and delays of the cargo. Finally it should be noted that there is a great tendency to make rail ferries much more universal and fitted, not only for rail cargo, but also for the trucks, trailers, cars and sometimes even reconstruct them even as Ro-pax ferries. A perfect illustration of this statement could be the reconstruction of four rail ferries “Kaunas” and “Vilnius” of LISCO and “Greifswald” and “Petersburg” of Scandlines Euroseabridge to truck-friendly Ro-pax ferries that are still able to carry rail wagons.

Photograph 3: Rail ferry “Klaipeda” of LISCO

2.1.5 Ro-pax ferries

It should be noted that Ro-pax ferry services are much more developed in the Western part of the Southern Baltic and the main lines are of northern – southern direction, mainly operated by Scandinavian shipowners. There are a wide variety of such ferries from very small ones to the 2400 lane meter ferries “Robin Hood” and “Nils Dacke” of TT-Line operating between Travemünde and Trelleborg. Most of those ferries are drive-through, fitted with bow and stern doors and able to load cargo at two levels simultaneously. The deck height usually is about 4.5 up to 6.5 metres. The length of the trip can also vary from 1 to 24 hours or even more and that probably will be the main factor determining the facilities available to the passengers. In short passages the main income consists mainly of tickets with some additional income from duty-free sales or restaurant services. Much longer passages will present a slightly different picture and ticket sales will be considerable but

certainly not the main component of income. Usually such Ro-pax ferries are accommodated with bars, restaurants, different categories of cabins, casino, duty-free shops, conference halls, etc. In other words, this vessel looks more like a hotel than a ship. Ferry companies also pay a lot of attention to the entertainment facilities available on board that usually are designed for every age group of passengers and to make it even more attractive - reduce the ticket prices to a minimum. In some cases such a trip will be like a mini cruise – a very popular way of spending the weekend among the Scandinavian people. In the South-Eastern Baltic, the latter type of business has not emerged so far because of the low purchasing power of citizens of these countries that mainly consider ferries as a cheap way of transportation. However, another great issue worth discussion is a possibility for the South-Eastern Baltic ports to attract new shipping lines providing aforementioned mini-cruise services after the abolishment in the EU of duty-free sales.

Photograph 4: Passenger ferry "Stena Europe" of Stena Line

2.2 Design of Ro-Ro ships

2.2.1 Trends in the design of the Ro-Ro ships

It is well-known that from the beginning of the Ro-Ro services and up through the 70ies design concept of Ro-Ro vessels changed relatively little. Hans Kjaergaard (1993, p.163), employed with the Consulting Naval Architects and Marine Engineers of Copenhagen since 1970, currently by Knud E Hansen A/S, states that the vessels were only becoming bigger and, both hydrodynamically as well as mechanically, following general trends and development within shipbuilding. Only during the 80ies and 90ies have more stringent safety requirements caused noticeable changes in the basic design criteria, partly due to more severe safety requirements and partly due to future changes in the patterns of transportation systems. The above stated company KEH has since the beginning of Ro/Ro era counted a bouquet of 120 designs but also points out that these vessels are seldom built in large series (the largest series company was involved in were 11 Ro-Ro vessels contracted by Stena at Hyundai). The intensity of inquiries for new Ro-Ro projects at KEH office by shipowners can be determined from the below stated table:

Table 1: Intensity of inquiries for new Ro-Ro ships

		Short length voyages < 40 nm	Medium length voyages 40 nm < 200 nm	Long voyages >200 nm
Pure cargo	Fast	X	XXXX	XX
	Low speed		XX	X
Pass. Cargo	Fast	XXXX	XXX	
	Low speed	XX	XXX	XXXX

In view of the above stated and based on long-term KEH experience, some general trends in design of tomorrow's Ro-Ro vessels can be forecasted:

- Fast long voyage vessel monohulls with high ratios of slenderness
- Very fast short voyage vessels (shuttles) with rapid loading/unloading procedures

- Very fast long voyage vessels with multihulls
- Relatively slow long voyage vessels with extreme DWT/lightweight ratios
- Large Ro-Ro vessels with special requirements to sea behaviour, and
- Segregation of passenger and truck transportation

It is worth mentioning that current overall factors governing Ro-Ro design can be grouped into the following areas:

1. High degree of overall safety. The statistics, which state that as much as 37% of freight only Ro-Ro ships' accidents resulted in total losses, earned a very bad reputation for these ships. Therefore, according to H.Kjaergaard, future Ro-Ro designs could foresee the application of:

- Longitudinal bulkheads well within normal penetration depth of collisions
- Transverse watertight divisions or sections of the vehicle deck
- Subdivisions formed to minimise heeling during a period of flooding
- Protected machinery and auxiliary machinery spaces
- Degree of fire prevention and fire control higher than required by SOLAS today
- Utilisation, where possible, of less dangerous and more pollution-friendly fire extinguishing medium such as water fog

2. Environmental considerations which mainly should include:

- Fluids and matter released by accidents
- Exhaust from engines and boilers
- Waste
- Handling of possible pollutants (bunkering of oil, etc)
- Anti-fouling

3. High flexibility for later conversions. That will be discussed in a further section but before that a general statement should be made that the future Ro-Ro design should ensure a very flexible vessel with a high second hand value and give the shipowner an opportunity to convert the Ro-Ro vessel to whatever extent.

Before considering the design of Ro-Ro ships one should note that naval architects never could work out the design of this type of ship that could entirely satisfy a shipowner. There are a lot of reasons and conflicting requirements making naval architects look for compromises and the optimum solution. However, it is a matter of great importance to note that so far they succeeded and the confirmation of that can be a big variety of Ro-Ro ships construction specific items placed in the Appendix A.

2.2.2 Conversion of Ro-Ro ships

Conversion of Ro-Ro ships can be classified into four main types:

1. Lengthening
2. Increasing of ship's deck height
3. Adding of extra equipment
4. Reconstruction from other types of ships

Before a brief description of each of the above stated types it should be noted that conversion of Ro-Ro ships is popular enough because it is a rather simple procedure technically and takes as little time as possible. There are also a sufficient number of shipyards that have a good reputation in doing these works.

Lengthening is maybe the most attractive type of Ro-Ro ship conversion because it takes a very short period. The reason is that the additional section is usually made in advance and the whole lengthening operation consists just of dividing the ship and then joining it with a new section. This type of conversion is also attractive, not only because of little time consumed, but also because it changes the vessel's operating characteristics relatively little – the speed loss is often not more than 0.5 knot. That is why lengthening is considered by Michael Grey in Fairplay Publication (1985, p.97) as a cost effective, economic way of quickly increasing a ship's capacity.

Another type of conversion – increasing the ship's deck height also led to a considerable increase of cargo-taking capacity. A good example of this operation can be the conversion of two passenger ferries in Holland owned by Stena Line. After

that those ferries were able to carry 76 12 metres long trailers (45 previously) and 725 cars (425 previously). A much more expensive way to increase the cargo-taking capacity is to equip a Ro-Ro vessel with hoistable car decks. This type of conversion is most common for PCTCs ensuring maximum operational flexibility and use of available space. According to HamworthhyKSE, vehicle ferries equipped with such decks can lower them for maximum loading of automobiles or raise them to provide the necessary headroom for commercial vehicles.

Photograph 5: Conversion of the m/v "Hansa Link"

Adding extra equipment is a much more common type of conversion than those aforementioned drastic ways. Usually it includes adding an extra superstructure towards the stern for passengers or different types of lifts and internal or external ramps, bow doors or visors. This type of conversion is often used to help the ship meet the requirements of the specific port and at the same time to make it much more universal.

The last type of conversion becomes very attractive when the vessel is cheaply bought in the second hand market and after that reconstructed to a Ro-Ro ship. In this case the shipowner saves a lot of money compared to buying an already existing

Ro-Ro vessel of the same age. In most cases the ships intended to be converted are tankers, bulkers and general cargo ships. Usually conversion includes installing a number of decks, superstructure for passengers, cargo access doors or ramps and other necessary attributes of a Ro-Ro ship.

Finally it should be stated that conversion into/of Ro-Ro ships is a very common practice nowadays and a lot of ships during their lifetime have faced even several conversions. This can be explained by the fact that the Ro-Ro ships are structured in such a way that they can be easily converted. It also doesn't necessarily mean that shipowners and naval architects have failed trying to foresee future Ro-Ro market requirements. As was already mentioned before, currently shipowners ordering Ro-Ro newbuildings particularly look for high flexibility for later conversions.

2.2.3 Safety of Ro-Ro vessels

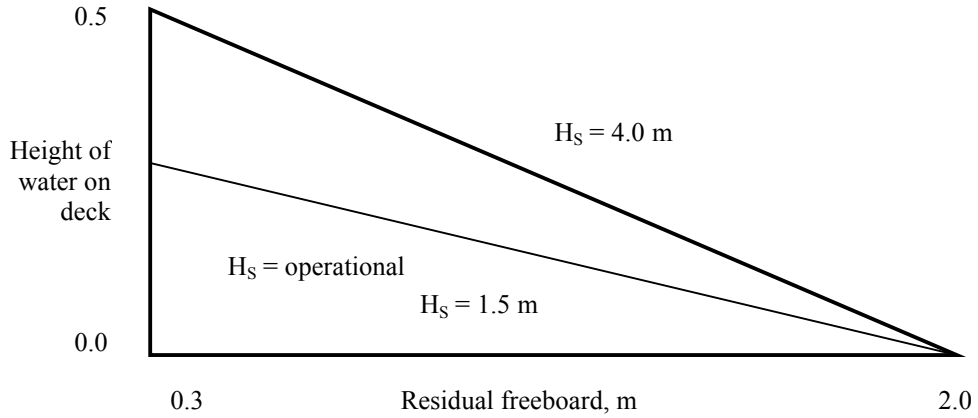
The safety of Ro-Ro vessels always was of a vital importance. However, during the past 14 years up to 1999, 44 Ro-Ro vessels have capsized. GP Wild (1998, p.161) states that most of them were following a similar scenario – the accumulation of water on the open Ro-Ro decks made the vessel assume a large angle of list and capsize. Nevertheless, it was only after two major disasters, which resulted in huge losses of lives ("Herald of Free Enterprise" capsized outside Zeebrugge harbour in 1987 with the loss of 193 lives and "Estonia" in the Baltic in September of 1994 with the loss of over 900 lives), that the international community took action to significantly improve the safety of Ro-pax vessels. A Panel of experts (POE) was created by IMO to make a thorough investigation of Ro-pax vessel safety. The findings and recommendations of the POE were presented to the IMO Maritime Safety Committee (MSC) in May of 1995 and generally proposed to change existing regulations so that the SOLAS 90 standard could be met with up to 50 centimetres of water on the vehicle deck. Further proposals made were mainly suggesting to apply this new standard not only to new ships but also to existing ones and phased in over a number of years. Although it seemed that the new proposed standard was

unacceptable to a number of nations, a final overall agreement was achieved that mainly stated that SOLAS 90 would be applied retroactively to all Ro-Ro ferries by 1st of October of 1998 for ships meeting 85% of the standard and 1st of October of 2005 for those meeting 97.5% or above. A number of resolutions that were to be introduced urgently were also adopted by IMO:

- Automatic local fire extinguishing systems.
- Escape arrangements in ships built before the 1st of July, 1997.
- New lower maximum evacuation times for new ships.
- Low-powered radio homing devices for life-rafts.
- Development of guidelines and prescriptive standards for public address systems, automatically self-righting life-rafts, fast rescue boats, launching appliances for fast rescue boats and helicopter landing and pick-up areas.
- Procedures and obligations for distress messages.
- Automatic ship identification transponder/transceiver systems.
- Working languages to be established.
- Operational limits to be set on all passenger ships.
- Voyage data recorders.
- Cargo securing equipment: minimum strength requirements to be set.

A new requirement for damage stability agreed among North-western European nations to account for the risk of accumulation of water on the Ro-Ro deck, known as the Stockholm Agreement, ameliorates the original proposals by demanding that a vessel satisfies SOLAS 90 requirements with, in addition to water on deck by considering a constant height rather than a constant amount of water as was originally intended. Dracos Vassalos, the Director of the Ship's Stability Research Centre in University of Strathclyde, Glasgow, and Osman Turan, his assistant, at the Ro-Ro Conference 1998 presented a figure from which the height of water on deck can be calculated:

Figure 1: Stockholm Agreement (Height of water on deck)



The above stated University of Strathclyde's Stability Research Group has also made considerable research on Ro-Ro survivability and the following conclusions were made:

- Boundary survivability for open deck and central casing designs appears to be almost identical and the only advantage an open deck might have over the central casing derives from the fact that under certain loading conditions the vessel may incline to the lee side, thus enhancing its chance of survival
- Boundary survivability for the side casing option (additional buoyancy sponsons fitted to the side of the vessel) and retractable transverse bulkhead designs appear to show a marked improvement on damage survivability, with particular advantages in the case of transverse bulkheads.
- A transverse bulkhead arrangement appears to render a vessel almost uncapsizable whilst offering a drastic improvement in a ship's static stability characteristics. It also seems that the amount of flood water accumulated between the bulkheads is not sufficient enough to cause the vessel to capsize.

A "Total Stability Assessment" study was later carried out by this Research group and very interesting concluding remarks were presented at the Ro-Ro Conference 1998:

The results derived from this study showed worrying inconsistencies between SOLAS 90 and Stockholm Agreement standards, which are not in favour of Ro-Ro operators. The following findings must be noted:

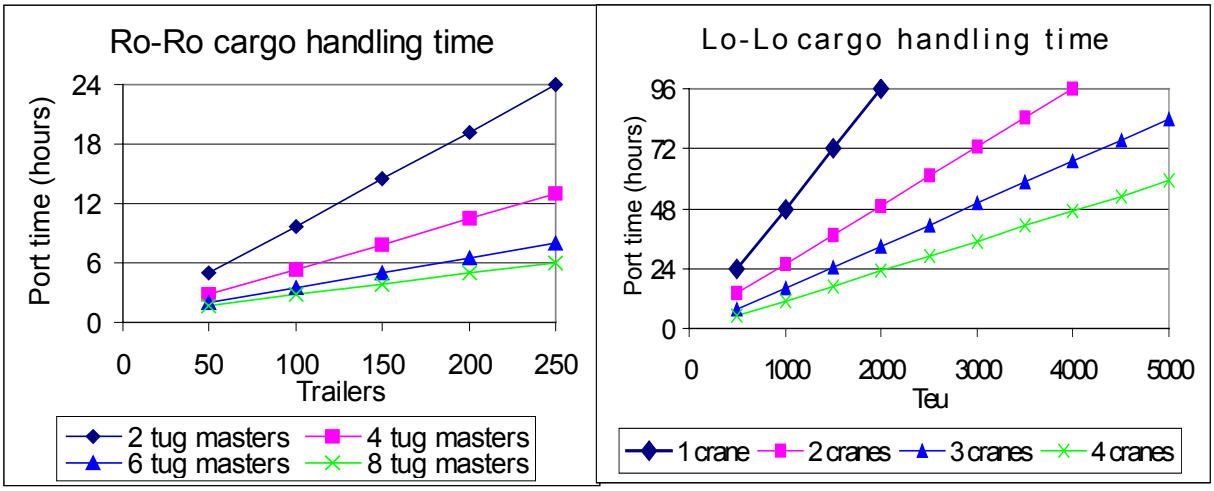
- SOLAS 90 is a "good" standard reflecting meaningfully the safety of Ro-Ro vessels at a level of safety that is generally in agreement with that determined through performance based methods.
- The Stockholm Agreement appears to be unrealistically stringent, in general, demanding a level of safety well beyond those determined through performance based methods and, at times, simply not attainable

In view of the above stated it remains unclear whether the new regulations will apply to freight Ro-Ro vessels. Drewry Shipping Consultants Ltd (1998, p.33) states that there is as yet no intention to extend the requirements for Ro-pax vessels to freight Ro-Ros but if further safety measures are required for Ro-Ro cargo ships then they will follow the new rules for Ro-pax vessels. An example again is given that Stena Line has already taken a decision to design 5 new freight Ro-Ro vessels that will equate to the new rules for passenger vessels. It is generally thought that these measures enhance ships' attractiveness on the charter market and their book value.

2.3 Ro-Ro cargo handling

There is no doubt that Ro-Ro ships regarding cargo handling have great advantages over general cargo ships, for which time spent in port is still measured in days and even weeks. According to Drewry Shipping Consultants Ltd. (1998, p.19), it is very important to note that Ro-Ro loading/discharging operations can still be faster than cellular containerships where the terminal productivity rate is less than about 30 moves per hour – which figure would include most developing nations and even a number of ports in OECD countries. This can be clearly seen from the figures below provided to Drewry Shipping Consultants Ltd. (1998, p.18) by Green Marine Services:

Chart 1: Ro-Ro and Lo-Lo cargo handling time



Nowadays, when time for cargo handling operations is reduced to a minimum, a big variety of highly specialised equipment has been developed to handle cargo aboard Ro-Ro ships. Therefore, the time for cargo loading/discharging on freight Ro-Ro vessels currently usually is from one to six hours. It should also be noted that the success of cargo operations is highly dependent on port operations – stevedoring company, customs and agent's activities and only those who responsibly look to their procedures will be able to guarantee smoothness. Another very important thing is the ship's design and access equipment deficiencies and Ro-Ro cargo standardisation. Now it can already be stated that the latter has greatly improved during recent years (except for project cargo and such standardised cargo that is not fitted to marine

transportation). Talking about the former deficiencies it is rather clear that a lot should be done to improve the current situation. Part of this problem in elderly vessels will be solved with their scrapping because the huge capital investment can't be justified in this case. On the other hand, the owners are greatly interested themselves in eliminating the aforementioned deficiencies because of the customers' requirements of quick shipping of cargo.

As was mentioned before, for successful and efficient Ro-Ro cargo handling operations, highly specialised equipment is required and it can be classified as:

1. Tug masters.
2. Straddle carriers.
3. Fork lift trucks.
4. Side loaders.

Tug masters

Ro-Ro cargo handling using tug masters has proved to be a very efficient operation and, therefore, is very widely used all over the world. These tug masters are indispensable, especially in places where the cargo is transported without normal tugs (trailers, rolltrailers), backwards and through narrow ramps. Such tug masters are very manoeuvrable and much more powerful than ordinary vehicle tugs.

Straddle carriers

This type of cargo handling equipment has several advantages and the main one would be that the terminal operator has relatively easy access to every handled container. However, despite the aforementioned advantage this type of equipment is not very common in Ro-Ro terminals partly because of its high price and unsparing use of terminal space and partly because the main part of Ro-Ro units are trailers instead of 20' and 40' containers.

Fork lift trucks

Fork lift trucks are more commonly seen in Ro-Ro terminals than straddle carriers mainly because of their high reliability and lower cost. They also can stow containers in such a way that practically no space at all is wasted even though number of containers the terminal operator can handle is highly restricted. Despite the above stated advantages he should also be aware of the stability problem of fork lift trucks. Another problem is pointed out by Fairplay Publications (1985, p.76), which states that most of the weight of the truck and the load is concentrated on the front axle, which considerably affects the ship's deck or terminal's surface. It is worth mentioning that this problem was mainly faced by an old generation of fork lift trucks and a new one greatly improved the performance by using wide and low pressure tires. It goes without saying that such fork lift trucks, being very manoeuvrable and capable of handling the cargo very quickly, are indispensable in the efficient work of a Ro-Ro terminal.

Sideloaders

This type of cargo handling equipment is not so common nowadays as it was ten or even twenty years ago. If used today, it has several advantages over fork lift trucks where the cargo space is very limited. The pressure imposed on the deck is also much lower and rarely exceeds 30 tons but, as was mentioned before, widespread use of tug masters and a new generation of fork lift trucks almost eliminated sideloaders from the Ro-Ro terminal.

To ensure quick and efficient Ro-Ro cargo handling operations it is not enough to have just perfect cargo handling equipment. Highly standardised Ro-Ro cargo is an absolute necessity nowadays. It should be admitted that a lot has already been done up to now in this matter but nevertheless, there are some types of cargo that always create additional difficulties (for example – project cargo).

All the cargo transported by Ro-Ro ships could be classified as:

1. Trailers and reefer trailers.
2. Autotrailers.
3. Swap bodies.
4. Rolltrailers with 20’ and 40’ containers upon them.
5. Cassettes.
6. Cars.
7. General and project cargo.
8. Rail wagons.

As can be seen from the table above, constant dimensions of Ro-Ro cargo are very useful in successful and quick cargo handling procedures. Nevertheless, each type of this cargo also has its own peculiarities that directly affects the way of handling. Therefore a brief description of each of them will be stated below.

Trailers

Trailers are usually driven into and out of the ship by tug masters. A lot of attention must be paid to the proper skills of tug master drivers, who must be capable of driving the trailer either forward or backwards. Another very common procedure when loading/discharging trailers is turning the trailers round and, therefore, a sufficient beam is an absolute necessity.

Autotrailers

This type of Ro-Ro cargo has a great advantage against all others because it is usually driver accompanied, not requiring any terminal cargo handling equipment. Consequently, the time to load/discharge autotrailers is reduced to the minimum. It can be even more reduced if the ship has both stern door/ramp and bow access. It can be stated with great certainty that autotrailers are one of the most Ro-Ro ship-friendly cargo types.

Swap bodies

It is stated by Drewry Shipping Consultants Ltd. (1998, p.24) that seagoing swap body overcomes previous restriction to operation on land, can be double-stacked, is competitively priced, and offers a high cube within a relatively low tare weight. It is worth mentioning that the 13.6 m/ 45' drop side, tarpaulin-type swap body costs about USD 13.000 and, therefore, represents a significant saving over semi-trailers when double-stacked on board. However, despite the above stated advantages, it is generally thought that it is still too early to say whether the swap body will eventually replace the standard semi-trailer.

Rolltrailers

This type of cargo is also very often called MAFI trailer and usually carries 20' or 40'containers or general cargo upon them. The main idea in creating the MAFI trailer was better cargo space height utilisation. They were first developed by the West German MAFI group and they differed from trailers by having very small diameter rubber wheels. Nowadays their main advantage against Chassi trailers is still the relatively small height (0.4 – 0.6 metres).

Cassettes

This type of Ro-Ro cargo, specifically designed for steel and paper coils, was developed much later than rolltrailers. The advantages of this system are cost effective procedures enabling efficient block stowing and rational handling and they are specially designed for heavy loads.

Cars

This type or Ro-Ro cargo includes passenger cars, minibuses and buses. There is no doubt that it creates fewer problems than any other type of Ro-Ro cargo. It is also customary for Ro-Ro ships to start the discharging of the ship with these cars and to load them as late as possible. The explanation for this method is that the cars can easily fill in small cargo spaces left and, therefore, less cargo space is wasted.

General and project cargo

General cargo transported by Ro-Ro ships is either stowed and lashed on rolltrailers or stowed on the ship's deck at particular places for that type of cargo. In the latter case it is usually handled by sideloaders or fork lift trucks. Project cargo is defined by B.Francou (1999, p.27) as all the cargo needed for the construction of large projects such as turn-key factory, chemical plant, refinery, etc. This cargo always includes heavy lift equipment, very diversified materials and implies different origins of the goods. It is clear that heavy and large dimensions project cargo usually creates much more difficulties in handling than any other Ro-Ro cargo. In most cases it is loaded on specially designed vehicles, which, because of their length, are restricted in manoeuvrability. That is why the project cargo can be loaded on board only those ships, which design and access equipment are perfectly structured, strengthened and meet a lot of other requirements. It is also common for shipping companies to charge extra for delivery of this type of cargo.

Rail wagons

As was already mentioned the loading of project cargo creates a lot of problems. The most Ro-Ro ship friendly are probably the rail wagons that can be loaded/discharged very quickly and also do not require stowage one by one. However, a lot of attention must be paid both by the ship's cargo officer and terminal operator to the cargo handling because improper loading/discharging of rail wagons can lead to highly negative consequences. The weight of rail wagons on the starboard and port side should not differ considerably, because neither an automatic list stipulation system nor manual pumping of ballast water will be able to eliminate a list when the train starts riding on board a ship. Another problem can arise if those trains do not enter the ship simultaneously, i.e. at least one or two wagons are ahead of the other train's wagons. Such a situation can lead to the immediate appearance of a considerable list and consequent huge damages.

Other types of Ro-Ro cargo usually do not encounter the latter problem because the speed of their handling is not so high and the automatic list stipulation system, which is installed in most Ro-Ro ships, is able to eliminate critical list. The advantage of this system lies in helping to avoid detailed calculations for cargo officer even though a preliminary cargo plan must always be worked out. Another problem that is very common especially during the loading is connected with the constant motion of the cargo. As was mentioned before, the inner ramps are much more efficient in ensuring constant cargo loading than elevators, which stop cargo operations while the elevator is moving up and down. However, even when inner ramps are used some problems can be encountered, especially when the cargo is moved backwards. Other critical situations when a lot of vehicles are waiting until the cargo unit will be lifted or turned round on the upper deck can occur. Those vehicles intending afterwards to ride on the same upper deck, block the way to the main deck and all cargo loading operations are stopped. In view of the above stated it should be noted that for successful cargo handling operations a proper and careful handling must be combined with deliberated actions of crew that should be greatly supported by port operators.

2.4 Ro-Ro cargo transportation

2.4.1 General requirements for transportation of Ro-Ro cargo

It is clear as a day that Ro-Ro cargo transportation includes more than just physical delivery of Ro-Ro cargo from one port to another. Besides that there are also a lot of other procedures and systems that must be carried out in a proper way in order to guarantee quick, safe and satisfactory cargo transportation. This section will contain some general requirements for all types of Ro-Ro cargo transportation.

It should be noted that some activities must be taken well in advance before the cargo enters the ship. That includes proper cargo documentation procedures, customs clearance, etc. A very important procedure must be done right before loading operations – every Ro-Ro unit must be checked according to a Damage Report list. Some ports have implemented an automatic photo checking system that usually produces up to 40 photos per unit. This must be done in order to avoid claims from a cargo owner stating that damage to cargo was done during the transportation by the Ro-Ro vessel. The same procedure should be repeated after the unit is discharged and, therefore, all the damages that occurred during the cargo transportation by the sea are easily detected. On the other hand, the shipowner can be fully confident that he will have to cover only those damages, if any, that were made on board his ship.

After the Ro-Ro unit has entered the ship it must be properly stowed and lashed. It is also common that during loading/discharging operations both automatic list stipulation and ventilation systems are engaged. During the voyage, especially in heavy weather, sudden manoeuvres as well as direct swells to either side of the ship should be avoided. A very big attention must be paid to the reefer and dangerous cargo units. The further sections will be dedicated to a brief analysis of all the activities ensuring the above stated.

2.4.2 Ro-Ro cargo lashing

Proper lashing of Ro-Ro cargo is a matter of vital importance because neglect in that can result in not only severe damages of transported cargo but also according to Fairplay Publication (1985, p.106), the shifting of a heavy package can start a chain reaction leading the ship into a critical situation. Therefore, a proper lashing of Ro-Ro cargo that will secure it against movement in either direction is an absolute necessity.

There are several critical points in choosing the right lashing system for the particular Ro-Ro vessel. The shipowner should pay a lot of attention not only to its reliability, but also consider whether it fits best for his ship and the cargo, which is intended to be carried, does the crew has good knowledge and experience of this system, etc. The latter is very important because every perfect system will fail if not used in a proper way. Therefore a technical Ro-Ro cargo lashing manual for every particular system must be developed and the crew trained according to it. Besides the above stated every lashing system should be chosen according to:

1. Ship's characteristics
2. Size, weight, centre of gravity of vehicle/cargo unit
3. Position of wheel trestles and jacks in relation to cargo load.
4. Number, position and angle of lashes
5. Coefficient of friction between the deck and bearing surface.

Photograph 6: Ro-Ro cargo lashing equipment

Even though the above stated cargo lashing equipment is widely used nowadays, a new system SAT was developed by Scandinavian Ro-Ro Construction, SRC. This system consists of an autotrestle, which is connected to the trailer kingpin, and the main advantage is that using it the trailer is secured in a far safer and more efficient way than with traditional lashing methods.

Photograph 7: The SAT lashing system

Another very important thing is to make sure that the lashing arrangements and lashing support equipment (trailer trestles, pedestals, jacks, wheel chocks) are well maintained and under constant care. Finally, it should be stated that constant control of cargo lashing during the voyage must be continuously done and under any circumstances the vessel shouldn't leave the port before the cargo is safely secured.

2.4.3 Fire fighting systems

Fire protection requirements vary from one type of Ro-Ro ship to another but the strictest regulations are certainly for Ro-pax ferries. The fire hazard is much bigger on Ro-Ro vessels mainly because of vapours produced by vehicle engines and fuel tanks. Consequently a proper ventilation system is required that will be described in the next section. Ro-Ro vessels usually are equipped with a carbon dioxide (CO_2) extinguishing system, fixed sprinkler and drencher systems, have different fire – smoke and heat detection devices and necessary portable equipment for crew fire-

fighting parties. It is a matter of great importance to ensure that all crew-members, especially those participating in fire-fighting operations, are well trained and familiar with all the aforementioned equipment and the actions that must be taken in case of fire.

2.4.4 Ventilation system

A proper ventilation system is necessary, not only because of concentration of gases between the decks than can easily explode, but also for the people that are constantly in the cargo stowage area. Therefore, it is a matter of great importance to choose a ventilation system that would be sufficient to keep the gas concentration within permissible levels. Another important issue is spreading the system in such a way, which could ensure that no unventilated spaces are left. The shipowner choosing the system should be well aware of how big the quantity of the exhaust gases can be and what they contain. The below stated table will give the answers to the above stated questions.

Table 2: Different types of exhaust gases

Exhaust gases	Percentage in petrol gases	Percentage in diesel gases
Carbon monoxide	1 –10	0.1 – 0.25
Carbon dioxide	8 –15	2 – 10
Nitrogen oxide	0.1 – 0.5	0.002 – 0.1
Hydrocarbons	0.1 – 0.2	-
Sulphur dioxide	0.003 – 0.004	0.02 – 0.04

Source: Fairplay publication on Ro-Ro ships and shipping

It should be noted that the ventilation system must be well maintained and under constant care, which could ensure that no dirty corks are within it.

2.4.5 Transportation of perishable cargoes

During the recent years transportation of perishable goods in reefer containers and trailers has become increasingly popular. The reason for that is very simple – this type of transportation ensures an unbroken transportation chain, which finally leads to a much better quality of goods. It should also be stated that transportation of perishable goods in aforementioned trailers and containers creates some additional problems for the Ro-Ro shipowner. In most cases the cargo officer checks whether the actual load temperature conforms with that in the cargo manifest. It is also common for the crew to supervise the temperatures during the entire voyage. In most cases Ro-Ro reefer units can work either on electrical connection or diesel. Therefore, a lot of attention must be paid to the quantity of fuel in the trailer or container tank that must be sufficient for the entire voyage. If the reefer works using diesel, it should be stowed on the weather deck or at least on an open upper deck. This must be done in order to avoid noxious gases.

Another way to attract reefer cargo owners to sea transportation is to ensure that reefer technicians are on board a ship so that all repair works, if necessary, could be carried out during the voyage. To make reefer unit transportation by sea even more attractive, Maersk Sealand suggests providing the shippers with the necessary assistance including recommended temperatures, ideal stowage pattern and optimum treatment of the products prior to shipment. Of course, this service could be provided only in case of shipments of big volumes of reefer cargo.

2.4.6 Transportation of dangerous goods

Before transportation of dangerous goods the chief officer or other person responsible for such transportation must personally make sure that the vessel is in every respect ready for that, the crew is well instructed about such cargo peculiarities, possible dangers and are fully competent about the necessary procedures if dangerous cargo is spilled or evaporates. On the other hand, a full capability to sea transportation of that dangerous cargo must be ensured. It goes

without saying that it can be transported only if it entirely meets the requirements of the IMDG code. Those requirements are also imposed on the ship, especially regarding the stowage of dangerous cargo. It should be noted that large amount of this type of cargo can only be transported on the weather deck and even larger amounts cannot be carried by passenger vessels at all. This cargo must also be properly labelled and stowed in positions that are far away from working reefer units, other types of dangerous cargo and possible sparks from the ship's funnel and lashed in such manner that aforementioned sparks could not come out.

CHAPTER 3.

Commercial research of setting up of the Ro-Ro shipping line

3.1 General considerations before setting up of the Ro-Ro shipping line

It goes without saying that shipping company setting up the Ro-Ro shipping line must be well aware of all the advantages of such transportation strengthening its position and disadvantages in order to be able to suggest the customer the best solution for transportation in each particular case. It should also be noted that Ro-Ro transportation faces fierce competition from other types of ships and, therefore, table stated below clearly points to the above mentioned pros and cons of the operational and commercial characteristics of main competing unitised short sea modal systems:

Table 3: Characteristics of main competing unitised short sea modal systems

Positive features	Negative features
Ro-Ro accompanied road trailers	
High cubic capacity Door-to-door transit time advantage (no interchange delays) Added security (driver presence) High service frequency Low terminal costs and ultra-fast vessel load/discharge Limited port infrastructure and terminal yard area Potential to mix with passenger/car traffic Ease of cargo loading	Higher running costs (driver's wages) Poor utilisation of onboard space (additional cube of wheels and tractor unit) High capital/leasing cost of equipment High equipment maintenance costs High capital cost of vessels (freight Ro-Ro) or ferries High tare weight Inability to stack Modally inflexible – Ro-Ro only
Ro-Ro unaccompanied road trailers	
High cubic capacity Potential for transit time advantage (limited interchange requirements) High service frequency Limited port infrastructure Ease of cargo loading Low terminal costs and reasonably fast vessel load/discharge	High capital/leasing cost of equipment Poor utilisation of onboard space (additional cube of wheels) High equipment maintenance costs High capital cost of vessels High tare weight Inability to stack Modally inflexible – Ro-Ro only
Containers	
Stackability of equipment Security against bad weather and pilferage Lower per diem equipment costs Modal flexibility – Lo-Lo or Ro-Ro International standardisation of equipment (network potential) Equipment flexibility – a range of unit dimensions and types Equipment interchange facilities (network potential) Greater vessel availability and lower cost Compatability for shippers with systems/package dimensions used on deep sea trades	High terminal handling costs Slower vessel turn-round Cube limitations (except Euro-pallet wide equipment) Need for specialist port handling facilities – or geared ships Perception as slow over short distances Relatively infrequent sailings Unit loading/unloading difficulties (end access only)

Source: Drewry Shipping Consultants

There is no doubt that the following distribution according to cargo value exists – lower value cargoes are transported in containers by container vessels and more expensive – in trailers on Ro-Ro ships. The further distribution according to the cargo value is between accompanied and unaccompanied Ro-Ro units. This statement can be well illustrated by the below stated table:

Table 4: Average value of short-sea unitised cargo by shipping mode

Shipping mode	£/ton
Ro-Ro accompanied	3248
Ro-Ro unaccompanied	1673
Container	1361
Rail wagon	887

Source: HM Customs&Excise

Ro-Ro operator should also be well familiar not only with all aspects of the service he offers but also with the shippers' priorities. Fred.Olsen has reported to Drewry Shipping Consultants Ltd (1998, p.27) that nowadays they are:

- More frequent sailings.
- Lower freights.
- Quicker sea transport (faster ships).

Even it goes without saying that there will always be a trade-off between reduced time and high fuel consumption, Drewry Shipping Consultants Ltd (1998, p.27) states that in the short-sea trades potential savings could be faced from operating one fast ship as against two slow ones. An example is also given that the one faster ship can cut overall costs by up to 25% despite increasing total fuel costs by around 50%.

However, when the discussion regarding the setting up of the Ro-Ro shipping line is started, the prevalent opinion that was also stated by Mr.W.Wilhelmsen during WMU students fieldtrip in Norway in 2000 is that all the Ro-Ro cargo traffic flows are well-known and, therefore, creating of a new shipping line means just an attempt to distribute existing cargo flows between current and new lines. However, this is not often the case in the Baltic Sea, particularly in the southern part. The reason is that

those Ro-Ro cargo flows have formed very recently and are affected by a huge amount of factors and regulations that are very alien to other regions and besides are in constant change. As will be described more precisely in Chapter 5, the shipping lines in this region must also compete, not only among themselves, but also with the land-based routes, for example through Poland, or fixed links. Nevertheless, further sections in this chapter will be dedicated to the setting-up of a new Ro-Ro shipping line in the Southern Baltic region and the main steps to be taken will be briefly described further.

3.2 Analysis of trade between the states and liner shipping activities in the Southern Baltic

The first major part of the work could be called "Analysis of trade between the states and liner shipping activities in the particular region". That includes:

1. Analysis of the import and export structure of the region. If the possibility of opening a shipping line between Lithuania and Germany is considered, an analysis of the structure of import and export commodities must be made, not only of Lithuania and Germany, but also the neighbouring countries – Latvia, Estonia, Russia and Byelorussia on the one hand and the Netherlands, France, Italy on the other hand should be considered. This analysis will provide us with a much clearer picture of possible cargo flows through our shipping line.
2. Present volumes of Ro-Ro cargo: import – export and transit cargoes must be determined.
3. The possibility to attract Ro-Ro cargo from land-based transport corridors and other shipping lines should be investigated. The deficiencies of existing transport routes must also be determined.
4. Main possible shippers through our shipping line must be determined, contacts, inquiries and preliminary proposals should be made. Possibilities for long-term contracts should be investigated.

After this major part is done, a final report needs to be made and principal decisions taken. These must rely on the basis of information gathered and give a clear answer

whether the potential for setting-up of a new Ro-Ro shipping line in this region exists.

3.3 Ascertainment of shipping line service conditions

After the previous investigation is approved the second major step can be called "Ascertainment of shipping line service conditions" This part mostly will contain much more detailed gathered information and will provide answers to whether the project meets following requirements:

1. Thorough selection of possible calling ports and analysis of all operational costs in those ports must be done. Every selected port must be properly evaluated and advantages/disadvantages determined. It should also include the number of Ro-Ro berths and quality of each berth, terminal's stevedoring company and its used cargo handling equipment quantity and efficiency must be evaluated. All available statistical data must be gathered and sorted, reasons for ship detentions, if any, investigated, border and customs officials' work quality estimated.
2. This information is detailed with the agents and nominated representatives. The final picture of stevedoring, custom clearance, harbour dues (and payments) costs, cargo owners' requirements for the ships and terminals, influence of seasonal effects on cargo flows, tariffs of other shipping lines and land-based transportation, terminal efficiency, etc. should be given.
3. Selection of different shipping lines and traffic forecasts through each of them as well as preliminary cash flows must be made.
4. A fundamental decision for preliminary Ro-Ro shipping line service conditions must be taken. At this stage the company must choose either a fierce competitive struggle or co-operation with other companies of already existing shipping lines. The other important question that must be answered and recommendations must be given regarding the integration of the Ro-Ro shipping line into an intermodal transport chain.

This part must also be properly evaluated and a final report made where either a positive or negative answer to the Ro-Ro shipping line setting-up must be given.

3.4 Calculation of Ro-Ro shipping line optimum scheme

The third major part of the setting-up of a Ro-Ro shipping line is much more technical than the previous two, because it includes a lot of calculations and technical details. This part generally will include the following stages:

1. Selection of Ro-Ro shipping line type – direct, radial, rotational or combined. A lot of attention must be paid to the seasonal variations and increase or decrease of the number of voyages or even suspension during the "dead" periods should be considered.
2. Selection of the ship or fleet that corresponds with to the current market requirements, present cargo flows and port restrictions. At this stage the shipowner often faces several opportunities, for example he can choose one or a few high-speed ferries that reduce the time of cargo delivery considerably. On the other hand, he can choose slower ferries but much more economical and this factor will greatly affect the transportation tariff. Therefore the main task is to determine whether the shippers are willing to pay more for the quicker delivery. It should be stated that a compromise situation is possible when the same shipping line is served by ferries with different speed of cargo delivery and tariffs and the customer is able himself to choose the speed and cost of transportation. As an illustration for this statement can be the TT-Line service on the Rostock – Trelleborg route on which the company offers quick transportation of passengers by catamaran, holiday trips by Ro-pax ferry or services for freight cars.
3. This section contains construction of the final route of the Ro-Ro shipping line, the timetable, rotation of ports of call, schemes of ships' motion, etc. It is also advisable to include a time reserve of 5 – 10% of all voyage time in case of heavy weather or other unforeseen reasons. As was mentioned before, a lot of attention must be paid to the calling frequency that is very closely related to the intended shipments of Ro-Ro cargo. The frequency must be chosen in such a way that would ensure the possibility to ship bigger volumes of cargo (at least 20 - 25%).

This is considered as a special reserve for a further development of the Ro-Ro shipping line as well as a guarantee of 100% cargo shipment in case of sudden "peaks". This part of work must also prepare a very flexible tariff policy that states considerable but also reasonable discounts for major customers. As was already mentioned before – signing of long-term contracts is an absolute necessity for the opening of a Ro-Ro shipping line.

It is also common before the opening of a shipping line to prepare a forecast of expected volumes of Ro-Ro cargo, cash flows and the line's economical efficiency. Another very important issue is creating an effective network of agencies/offices. Nowadays the liner agency must be capable not only of fulfilling its direct responsibilities but also of providing the customer with value added services. This is explained by two reasons. The first is that according to most representatives of liner agencies the profitability just from agency service is reduced to a minimum and the company is forced to look for other profit resources. Another thing is that the shipowner would like to have the agent that could also offer freight forwarding or even multimodal transportation services where one of the transportation legs would be his Ro-Ro shipping line. It is worth mentioning that the liner agency can be either independent or owned by the shipping company. The latter is mostly preferred by shipping companies nowadays because it is generally thought that there is more loyalty in this case.

It goes without saying that most of above stated stages of setting up a Ro-Ro shipping line can be reduced to some degree but never ignored and should be dependent only on the size on the planned project. This is clearly explained by the fact that implementation of the above stated stages is a very expensive and time-consuming procedure and therefore can be fully justified in case of huge investments.

A very interesting and edifying example of Ro-Ro shipping line setting-up was presented by Colin Crawford, the former General Manager of Mannin Line, at the Ro-Ro 96 Conference. It should be noted that it was implemented, not in the Baltic

Sea region, but between Ijmuiden in northern Holland and Great Yarmouth, England. However, in this particular case I will pay more attention to the setting-up activities undertaken before the service was started than to the operation itself.

The first step was to make an advance agreement with the customers for certain basic traffic flows. As was stated by C.Crawford, an important element of the plan was that basic weekly traffic flows had already been agreed in principle with the customers, which was sufficient to provide a substantial part of traffic volume for one vessel. A strict confidentiality until ready to start the service was stated as an absolute necessity because it was thought that otherwise competitive action could have been taken against it to its disadvantage. Meetings with the Port Authorities in the UK and Netherlands were also held. An experienced Traffic Manager responsible for traffic planning, documentation implementation and line manning was appointed. Two offices in Great Yarmouth and Ijmuiden were obtained. Negotiations on bareboat charter of the vessel were started and m/v "Belard" (operating for Amber line in the Southern Baltic nowadays) was fixed to start the service. After that, a crew manning agent was selected and stevedoring companies in both ports were chosen. Staff in both offices was appointed, which unfortunately lacked experience. Conditions of carriage were formulated by experienced shipping lawyer. An experienced Freight Sales Manager was also appointed who together with the Traffic Manager made a detailed analysis of the likely customers that could use the new service and all these were systematically contacted and visited. It should be noted that the company didn't intend to compete with large shipping companies offering services in Harwich and Felixstowe and was only interested in those clients that, according to C.Crawford, could save road haulage miles by using them. After thorough investigation was done, two conclusions were made:

1. Most of the customers preferred a two-ship service.
2. The vessel operating on the Ro-Ro shipping line should have been of driver accompanied vessel type, i.e. to be able to provide the drivers with cabins during the night passage.

Nevertheless, the company started offering the service with just one vessel that could carry up to 12 drivers. Even though this vessel was very manoeuvrable, perfectly fitted for loading/discharging operations and was making 5 round voyages a week, the company was under constant pressure by customers to provide the above stated service by two vessels. This requirement was fully reasonable because it was clear as a day that a service, which is completed in 24 hours and provided by only one vessel, will be imbalanced very quickly. That was the case when, at the beginning of 1995, the weather in the North Sea was the worst since 1947. Nevertheless, the company could not find the vessel that could meet the restrictions of Great Yarmouth port. Finally the trips and traffic were lost, the company made a substantial loss and the Ro-Ro shipping line was closed even though the service, according to its founders, clearly met niche requirements.

In view of the above it can be stated that a much more detailed preliminary analysis should have been done before starting the service and, even though this procedure is very costly and time-consuming, we could clearly see from the above stated example that much bigger losses could be avoided in the future. Of course, the exhaustiveness and wideness of such an analysis must be determined by the company itself or, as in most cases, by the means that the company can afford.

CHAPTER 4.

The role of port in Ro-Ro shipping line

4.1 The role of port in setting-up of the Ro-Ro shipping line

There is no doubt that every port is highly interested in being a part of a shipping line because that ensures stable and solid income. Therefore a lot of efforts by port authorities and operators are and will be done to make the port very attractive both for ship-owning companies and customers. The main steps of this work will be described in further sections but the most important thing that all the parties involved in this matter must keep in mind is that the successful setting-up, operation and development of a shipping line can be faced only if the aforementioned parties will fulfil their duties in a proper and reconciled way.

Before making proposals to a shipping line, which is planning to start up, the port must make a detail analysis of all the factors and advantages of its own and neighbouring ports. Therefore the main factors influencing setting-up of the shipping line must be determined and evaluated:

Table 5: Factors influencing setting-up of the shipping line

Influencing factors	Weight, %
Transportation price, T_1	30
Transportation time, T_2	20
Safety of transported cargo,T_3	20
Possibility of changes in legal matters, T_4	15
Traditions and customs, T_5	15

Source: Port management and logistics

All those above stated factors are combined in one formula that gives a clear picture of each potential transport corridor:

$$T = 0.3C_{T1} + 0.2C_{T2} + 0.2C_{T3} + 0.15C_{T4} + 0.15C_{T5}$$

The most common method to evaluate those factors is to calculate a ratio between the potential new shipping line through one port and existing shipping through a neighbouring port.

A coefficient of transportation tariff is calculated:

$$C_{T1} = T_{1i} / T_{10}$$

Where: T_{1i} – tariff using new shipping line

T_{10} – tariff using existing shipping line

Coefficient of transportation time is calculated:

$$C_{T2} = T_{2i} / T_{20}$$

Where: T_{2i} – time using new shipping line

T_{20} – time using existing shipping line

It goes without saying that cargo security must be expressed and evaluated in some different way. Therefore a table is presented below for different levels of cargo transport security.

Table 6: Different levels of cargo transportation security

Cargo transportation security	Meaning
5	An absolute cargo security (insurance always available)
4	Possibility to loose or damage cargo due to accidents (insurance always available)
3	Rare occasions of pilferage or robbery (insurance available)
2	Frequent occasions of pilferage or robbery (insurance complicated)
1	War and disturbances zones (insurance impossible or premium is very high)

Source: Port management and logistics

According to this table, the coefficient of cargo transportation security is calculated:

$$C_{T3} = T_{3i} / T_{30}$$

Where: T_{3i} – level of cargo security using new shipping line

T_{30} – level of cargo security using existing shipping line

Sometimes C_{T3} can also be determined by using insurance premium as a standard. Then C_{T3} is calculated:

$$C_{T3} = T_{3i\ (insurance)} / T_{30\ (insurance)}$$

Where: $T_{3i\ (insurance)}$ – insurance premium using new shipping line

$T_{30\ (insurance)}$ – insurance premium using existing shipping line

A coefficient of possibility of changes in legal matters can be determined using the same model as with cargo transportation security.

Table 7: Possibility of changes in legal matters

Possibility of changes in legal matters	Meaning
3	Minor changes or no changes at all (Western Europe)
2	Considerable changes but not more frequently than once in a year (Poland and Baltic States)
1	Frequent changes in legal matters (Russia, Ukraine)

Source: Port management and logistics

Then a coefficient of the possibility of changes in legal matters can be evaluated:

$$C_{T4} = T_{4i} / T_{40}$$

Where: T_{4i} – possibility of changes in legal matters using new shipping line

T_{40} – possibility of changes in legal matters using existing shipping line

Traditions and customs are very important in critical situations, for example when a ship is waiting for berth on the outer roads while it is occupied or when the fairway to the port is frozen. This factor is evaluated in a similar way as cargo transportation security and possible changes in legal matters.

Table 8: Traditions, customs and other conditions in ports

Traditions, customs and other conditions in ports	Meaning
5	Western European countries
4	Ports of the Southern Baltic up to Ventspils
3	Ports from Ventspils to Tallinn
2	Gulf of Finland from Tallinn to St.Petersburg
1	Very severe and icy conditions in the Northern Baltic during winter period

Source: Port management and logistics

The coefficient of traditions, customs and other conditions in ports is calculated:

$$C_{T5} = T_{5i} / T_{50}$$

Where: T_{5i} – traditions, customs and other conditions using new shipping line

T_{50} – traditions, customs and other conditions using existing shipping line

It is worth mentioning that the above stated method, provided by Vytautas Paulauskas, professor of Klaipeda University, can be used, not only to compare a potential new shipping line with an already existing one, but also to compare several already existing shipping lines and even a line with a land-based corridor. However, it should be noted that very clear differences in most cases could not be seen in Baltic Sea short-sea shipping. The above stated conditions are rather similar between the Western European countries on the one hand and between the ports of the Eastern Europe on the other hand. An exception in the latter case could be the Baltic States that can ensure better cargo transportation security, less possibility of changes in legal matters and less obstacles for cargo transportation related to traditions and customs. Looking at the competitiveness of ports in the Baltic States – Klaipeda, Liepaja, Ventspils, Riga, Tallinn - the main influencing factors are absolutely the same and the port of Klaipeda has the only advantage in that because it never freezes in winter time. Nevertheless, when the services and conditions in each port are similar then port competitiveness is defined by the level of co-operation between

ship-owning company, trucking companies, port authorities, stevedoring company and customs and border officials.

Going back to evaluation of a new shipping line, some conclusions should be made. According to V.Paulauskas (1998, p.130), setting-up of a Ro-Ro shipping line is rational if its efficiency, calculated by the formula above, is higher by at least 15% and every influencing factor is far away from the critical limit. These can also be determined in this way:

1. Critical point of transportation tariff – transportation is 30% more expensive than using other shipping line as transport corridor.
2. Critical point of transportation time – transportation takes 40% longer than using other shipping line or transport corridor.
3. Cargo transportation security critical point – evaluated with 1 or 2 points.
4. Possibility of changes in legal matters critical point – evaluated with 1 point.
5. Critical point of traditions and customs factor – evaluated with 1 point.

Finally it should be stated that a number of criteria that a shipping company intending to open new shipping line must consider, exist. These were formulated by the scientists of Klaipeda University when a National shipping concept was in the preparation process and are listed below:

1. Present loading of existing shipping lines. If they are overloaded – a new shipping line is an absolute necessity.
2. Timetable of already existing shipping lines. If there are free days, setting-up the new shipping line has a purpose.
3. Possibility to demonopolise Ro-Ro transportation but very complicated because a severe and competitive struggle can be encountered.
4. Attractiveness of new cargo flows that is closely related with the foundation of mutual enterprises or mergers and alliances.

It goes without saying that the setting-up of a new shipping line has a great effect on the existing lines. However, it should be noted that this effect varies and is very dependent on whether a new line is geographically very close to the existing ones or a sufficient distance is between them. To illustrate the former case we can take the

existing lines Klaipeda – Kiel, Klaipeda – Travemünde and try to consider the influence of the line Klaipeda – Rostock that could be established. We can assume that a part of the cargo flow would be transferred to the new line but what are the factors governing this process and how is the level of importance distributed between them? It is clear that the influence of the possibility of changes in legal matters and traditions, customs and other changes (especially in countries of Western Europe) are reduced to a minimum. Therefore the main governing factors will be:

- Transportation tariff
- Transportation time
- Transportation security

According to V.Paulauskas (1998, p.132), in this case the above stated factors will correlate as 9:6:5 and the formula under which the aforementioned influence could be calculated is stated below:

$$P = 0.45P_{T1} + 0.3P_{T2} + 0.25PC_{T3}$$

Where: P_{T1} – coefficient of transportation tariff

P_{T2} – coefficient of transportation time

P_{T1} – coefficient of transportation security

If the shipping line is far away from the others (for example Klaipeda – Åhus) only a part of the cargo flows will be transferred from other existing lines (for example from a combination of the shipping lines Klaipeda – Sassnitz and Sassnitz – Trelleborg). In this case the major part of the cargo flow will be formed from other transport corridors and, therefore, an influence of a new shipping line to the existing ones will be calculated according to the formula:

$$G = 0.3G_{T1} + 0.2G_{T2} + 0.2G_{T3} + 0.15G_{T4} + 0.15G_{T5}$$

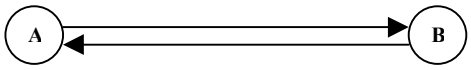
Finally it should be stated that the role of the port in attracting new cargo flows and, consequently, in the new shipping line setting-up is of a great importance and it goes without saying that the port plays a very important role in the operation and development of Ro-Ro shipping lines.

4.2 The role of port in Ro-Ro shipping line operation

Every port puts a lot of efforts into attracting new cargo flows or to be a part of as many transportation chains as physical restrictions allow. The benefit for a port being a part of a shipping line is obvious – stable and guaranteed income. The main aim of this section will be to define a port's liner service and planning activities briefly describing the work of port operators, concentrating the attention mainly on their present deficiencies.

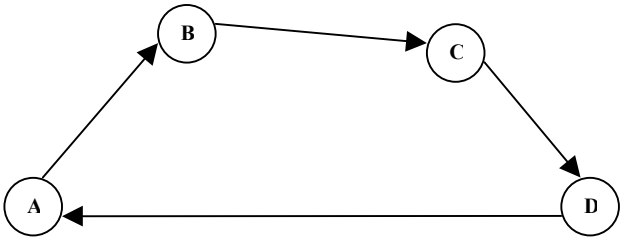
There are a few types of Ro-Ro shipping lines. The first is the most common type in the Baltic Sea – the direct shipping line (for example Scandlines AG: Liepaja – Rostock, TT-Line: Travemünde – Trelleborg, etc).

Figure 2: Direct shipping line



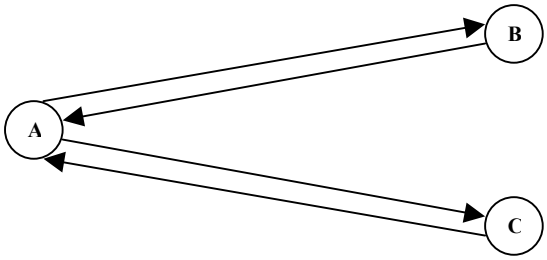
The second type is the rotational shipping line when the Ro-Ro ship calls at several ports one after another. This type can also be as a transformation of the previous line when a lot of cargo is concentrated in one port and the other ship of the same company can not take all of it (for example LISCO: Klaipeda – Kiel – Mukran – Klaipeda).

Figure 3: Rotational shipping line



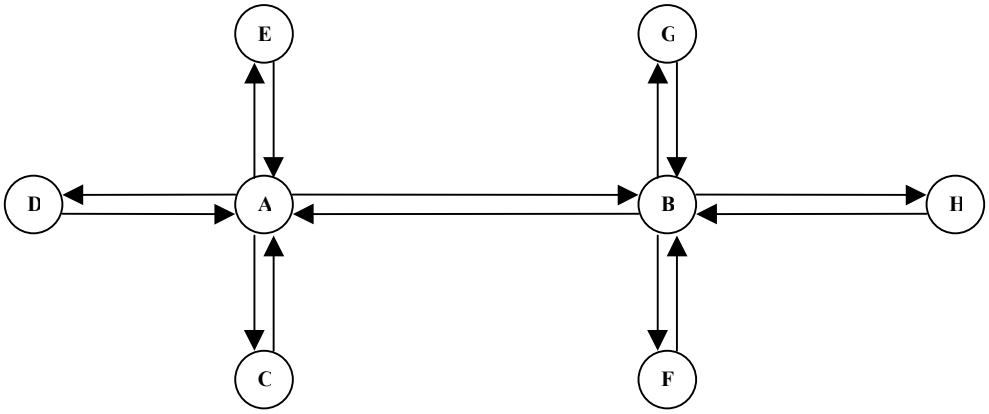
The third type is the radial shipping line that is used when the cargo flow is too small for calling at port every second or third day (for example Scandlines AG Klaipeda – Aarhus and Klaipeda – Abenraa).

Figure 4: Radial shipping line



The last type of shipping line is very common for Ro-Ro ocean transportation but not in the Baltic Sea region. The main flows of cargo are usually delivered by ocean carriers in hub ports A and B and after that they are distributed by feeder vessels.

Figure 5: Combined shipping line



It goes without saying that ports are most interested in being a part of direct shipping line, because quick turn-round of the ships guarantees bigger income and the cargo flow also is not spread. Nevertheless, a lot of efforts and work need to be done by port authorities to attract the cargo owners from different ports, especially if they are geographically more convenient for them.

Another very important thing that must be planned very carefully by shipowners and port operators is the terminal berth utilisation coefficient that is calculated:

$$C_u = U_1/24*7$$

Where: C_u – coefficient of berth utilisation

U_1 – actual utilisation of the berth in hours during the week

It should be kept in mind that this coefficient should never exceed 0.6 ($U_1 \cong 100$ hours). This figure allows mooring of up to 14 vessels a week if we assume that one Ro-Ro vessel spends on average of 6-7 hours at the berth. Cargo flows, sufficient for a Ro-Ro ship should be at least 60-65% of the vessel's carrying capacity and the time for cargo transportation should be at least 330-350 days a year. These figures should be well kept in mind by port operators and the shipowner must be supported in every way. Otherwise, the shipping line may be closed because of lack of profitability.

I also think that it is a matter of great importance to point out the main deficiencies of port operators that are the most common nowadays in the Baltic region and in some cases make Ro-Ro transportation less attractive than land-based. Therefore, it is advisable at the setting-up of a shipping line stage to make necessary agreements with port authorities where the number of ships that will serve the Ro-Ro shipping line must be defined. It is also common in this agreement to consider those vessels as liner vessels that have a priority of calling at the port at any time, especially where a narrow entrance channel restricts proceeding in several directions. These vessels should also be given a concession on harbour dues and the masters allowed calling at the port without pilot's assistance. However, this is often not the case and some ports looking for more profitability have reduced such aforementioned concessions to a minimum (port of Klaipeda) and masters facing a lot of difficulties in getting permission to enter the port without pilot's assistance (port of Kiel). Some port authorities trying to attract more shipping lines to their ports highly exceed the berth utilisation coefficient C_u and a lot of ships must wait in the outer roads in the long queue during heavy weather conditions, which reflects very negatively on their customers.

A lot of problems in most of the Eastern European ports and in a few German ports (especially in the port of Kiel) are created by customs officials. In the former case - a high level of corruption and frequent changes in legal matters often force shippers

to turn their cargo flows to the neighbouring ports. For example, a substantial loss of Ro-Ro cargo flows was faced in the beginning of 1999 when the head of the Lithuanian Customs Department fighting with smuggling gave an order to open each Ro-Ro unit, unload all the goods and weigh them. As a consequence, each unit had to spend a lot of time in the terminal and a considerable number of shippers quickly turned their cargo flows to ports of Latvia – Liepaja and Ventspils. A lot of criticism can be presented against border officials, too. Even though the importance of their work and benefit for the state are obvious, it should also be noted that their actions should never exceed certain limits, which could force flows of cargo and passengers to look for less severe control. Unfortunately, a similar situation is also faced in some German ports. For example, due to enormous strictness of police in the port of Kiel, which usually resulted in imposing of huge fines even for minor infringements, a lot of drivers preferred Travemünde to Kiel because of less strict control. There are also a number of ports in the Baltic region where passport control takes an unjustifiably long time that always raises dissatisfaction of passengers and truck drivers.

The efficiency of the stevedoring company should also be discussed, because its non-effective work can lead to either the shipping company or shipper being willing to choose another port. It is a matter of great importance to make sure that the stevedoring company has the right type and number of cargo handling equipment. It is also worth mentioning that according to Drewry Shipping Consultants Ltd (1998, p.20), the typical inventory requirement for a Ro-Ro terminal nowadays is as follows:

Table 9: Ro-Ro stevedoring – representative equipment costs

Equipment	No. required	Unit cost ($'000)	TTL cost ($'000)
40' fork lift truck – low mast for shipboard use	3	280	840
15' fork lift truck	4	180	720
Tugmaster – 4 wheel drive for shipboard use	3	120	360
Tugmaster – 2 wheel drive for shipboard use	3	85	255
Rolltrailer 40'	10	7	70
Mafitrailer 40'	10	5.5	55
Total			2300

The drivers of tug masters, fork lift trucks or side loaders must be very skilful and damage done by careless handling should be an absolute rarity. Another very important factor that often leads to potential conflicts between the ship and stevedoring company is the time and cargo handling equipment used for cargo loading/discharging. It is common for the shipping company to pay the stevedoring company in advance an agreed amount of money for handling of each Ro-Ro cargo unit. Nevertheless, in most German ports stevedoring companies pay wages for their employees regardless of the quantity of cargo handled but according to the time spent for these operations which often leads to intentional delays by personnel of stevedoring companies.

4.3 The role of port in Ro-Ro shipping line development

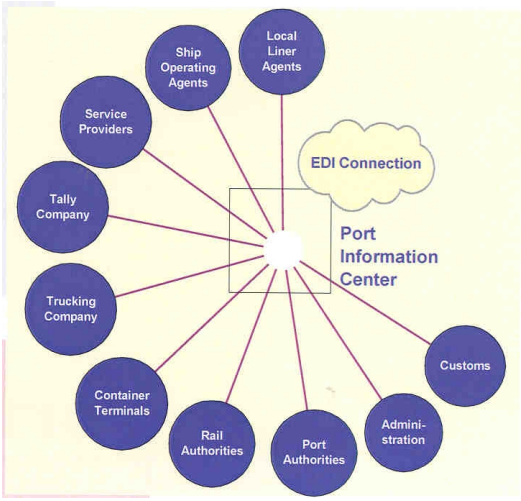
It is an erroneous view to think that Ro-Ro shipping line development is only the shipowner's concern. The ports that have chosen such a strategy will become aware of their wrong decision very quickly. The explanation is more than simple - the ports that do not think about the future of an existing Ro-Ro shipping line will face a lot of difficulties and most probably loose the shipping line through their ports. Therefore Port Authorities put a lot of efforts (that will be discussed further) nowadays to make their ports competitive in the future. Another very important issue is to make ports understand that the right to dictate terms of co-operation has already shifted from port to major carriers. As an evidence of that statement is that most major carriers all over the world and in the Baltic region have their own terminals. This fact, of course, does not fascinate the Port Authorities but they understand very well that otherwise they will lose both the shipping line and cargo flows completely.

Another very important tendency nowadays in the ports of the Eastern Baltic is the declaration the territory of the ports as free port zones (FPZ). It is widely thought that FPZ will attract a lot of new customers and cargo flows. It is also worth mentioning that the ports of Tallinn, Riga and Ventspils are already free ports. The port of Klaipeda intends to get this status at the beginning of 2001. Nevertheless, it should also be stated that FPZ is very effective in the transhipment ports and therefore Baltic ports probably will not gain as big effect as they could expect.

One of the most recommended ways to attract new customers and, consequently, expand the level of transportation through that port is a great reduction of the time the Ro-Ro unit usually spends in port until all necessary formalities are finished. Such a reduction should also meet the requirements of MTOs and FFs that are particularly concerned about transportation time. It should be mentioned that this idea is already implemented in a few Western Baltic ports and the initiative mainly belongs to the stevedoring company of the port of Aarhus that primarily implemented this idea due to fierce competition with the port of Hamburg. The

concept of this idea is the creation of a Port Information System (PIS) that involves all the parties concerned with the Ro-Ro cargo unit. A Port Information System generally can be described as a huge database and every aforementioned party has access to it:

Figure 6: Terminal Operating Management System TOMaS



Source: Port Information Centre

This PIS helps all the terminal operators and officials to finish necessary formalities even before the ship's arrival and, therefore, the Ro-Ro unit, except those that are excluded by custom for some reasons for checking, spends as little time as possible in the terminal. I think it is worth presenting a short description of the work that is done by all the parties. Most of the information reaching the PIS is in EDI/EDIFACT format. The ship's agent provides all necessary information about the ship and its arrival. Freight forwarders or MTOs present all information related to the Ro-Ro units and the goods carried. The above stated data allows the terminal operator to plan in advance free space for Ro-Ro units if there is a need for cargo to be stowed in the port for some time. Customs officials, having this data, can put the papers in the right order on the ship's arrival. The consignee or trucking company is well aware about cargo arrival time and, therefore, the necessary number of trucks will be available just after the cargo is discharged. It goes without saying that this PIS is very attractive for all the parties and ports that are interested in transit cargo flows should implement it as quickly as possible.

4.4 Port adaptability to Ro-Ro transportation

It goes without saying that port adaptability to Ro-Ro transportation plays a major part both for customers and shipowners. The shipper - customer is interested in that as little damage as possible should be done during cargo handling operations, which is directly related to the terminal layout and design. The shipowner is also very interested in having a good and safe berth, having equipment that could ensure quick and safe cargo handling operations. It should also be noted that the port should be able to offer good service regardless of the season of the year or icy and tidal conditions. It is worth mentioning that icy conditions in the Baltic often can become an invincible obstacle and, therefore, icebreaker service should always be available. Water level fluctuation is not a very common thing in the Baltic Sea but, nevertheless, at the end of 1999 when hurricane “Anatolij” passed, the water level in the Western Baltic ports dropped considerably – up to 1.5 metres and cargo handling operations at that time became highly burdening and time-consuming.

It is clear that Ro-Ro terminals are much more attractive than others are because usually they require much less initial capital commitment than conventional and highly specialised container terminals. Some shipping companies nowadays even declare that all they need from a terminal is 25-30 metres of reliable pier to moor the ship stern-to. Despite that advertising device, in fact there are a number of requirements for terminal cargo handling equipment, which were discussed in the Chapter 2; terminal paving strength, layout and berth access arrangements. Therefore, a number of primary requirements are presented to the port authorities. These were systematised by Fairplay Publications (1985, p.82) and are stated below:

1. Provision for sufficient hard standing and shed space should a vessel be delayed causing outwards traffic to bank up.
2. The adequate provision of lighting all over the ground area, not merely around the vessel
3. Correct positioning of mooring bollards so that they do not interfere with quarter ramps landing on the quay.

4. Roadways arranged so as to avoid tight bends, which cause pavement damage as well as slowing the operation down.
5. Roadways, parking areas should be clearly marked, markings being cleaned of oil and grease regularly.
6. Adequate provision should be made on the terminal (or at least close to it) for a repair and maintenance bay for terminal equipment.
7. A permanent building, well supplied with communication systems should be erected or made available for terminal and stevedoring staff.

It goes without saying that a Ro-Ro terminal must also be equipped with railway that enables it to participate in the intermodal transport chain. The terminal's territory should also be divided in special stowage areas – truck, trailer, container, passenger car, general, dangerous cargo, etc.

It is worth mentioning that the pavement of the terminal must be chosen only after the expected Ro-Ro cargo flows and the right cargo handling equipment for them have been determined. This can be easily explained by the table stated below provided by BPA Guide according to which the terminal operator can choose the type that best corresponds to his requirements:

Table 10: Major features of various types of terminal systems

System	Recommended for settlement areas	Durability	Ease of maintenance	Suitability for very heavy loads	Suitability for high contact stresses	Cost for Ro-Ro area (£/m^2)
Rigid concrete	No	High	Poor	Good	Good	20
Bituminous material	Yes	Low	Average	Average	Poor	18
Grouted bituminous material	Yes	High	Average	Average	Good	26
Precast concrete rafts	Yes	High	Good	Poor	Good	32
Precast concrete blocks	Yes	High	Good	Good	Average	19
Clay brick paviour	Yes	Very high	Good	Good	Average	22

Source: Ro-Ro ships and shipping

Another very important decision must be taken very carefully when choosing the right type of berth access equipment. This was systematised by Ghazwa M Alwani-Starr, Head of Process Group CIRIA, UK, Richard J E Marks, Senior Associate Posford Duvivier, UK and Stephen Osborn, Principal Engineer Posford Duvivier, UK and presented at the Ro-Ro Conference 1998. It was stated that two main families of shore access equipment exist – where the seaward support is provided by pontoon or other flotation unit and by lifting machinery. Floating facilities were further divided into the following:

- Pontoon type shore ramps that are completely self supporting and able to operate without any additional support.
- Ramps supported on semi-submersible floats or tanks that rely on additional support from the ship.
- Ramps supported on integral tanks being like a pontoon attached rigidly to the link bridge and completely self supporting.

Photograph 8: Ro-Ro ferry facilities – linkspan and pontoon

Despite some advantages of other types of berth access equipment, floating facilities have become very popular nowadays because they can ensure a high flexibility for ports using them and high adaptability for cargo handling operations minimising the angle between the berth and ship's deck as much as possible. Some ports have chosen the cheapest way of arranging berth with certain slope that is calculated only for particular types of ships and, therefore, have already limited possibility to attract

new shipping lines. Others, like Klaipeda and Mukran (Sassnitz), have built very expensive berth access units that are perfectly fitted to specially designed ships but not giving so much advantage to other mooring ships as expensive they are. The question remains open – what will happen with these arrangements, having very high operational costs, if the vessels move to another line or are scrapped?

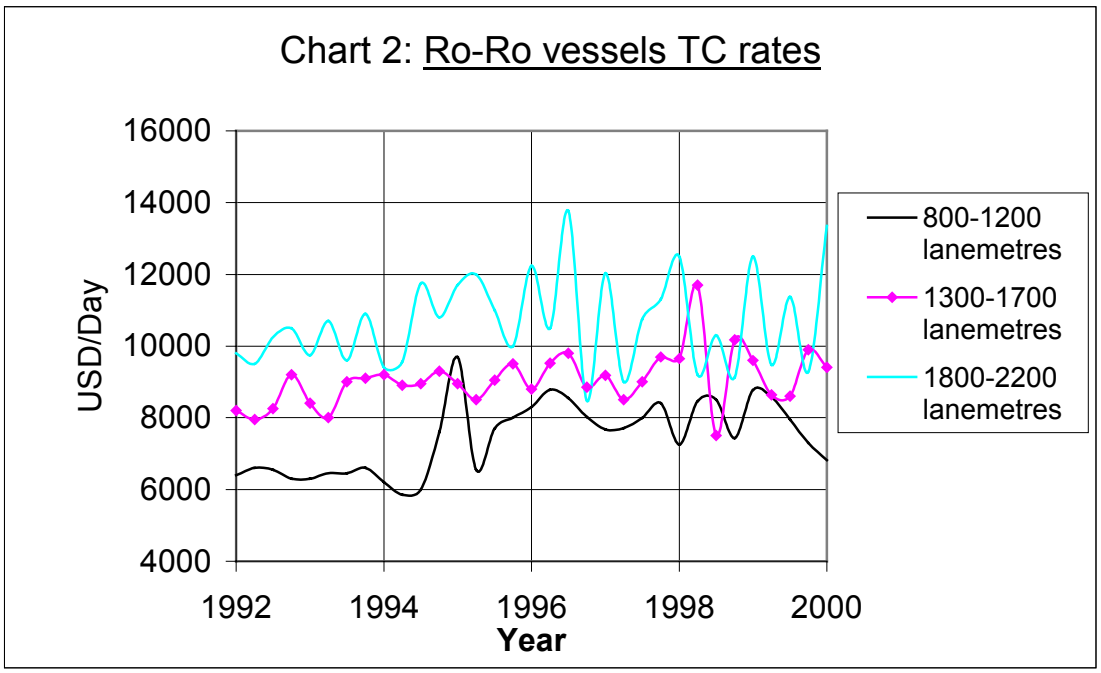
CHAPTER 5

Research of the Southern Baltic Ro-Ro transportation market

5.1 Analysis of Ro-Ro cargo transportation flows

5.1.1 General world's Ro-Ro market overview

At the beginning of 1999 the total order book by number of vessels stood at 115 vessels or 1.45 million tons deadweight and about 80% of the world's current Ro-Ro fleet operated on short-sea trades. The time-charter rates for different size Ro-Ro ships during the past 9 years are stated below and provided by ECOWIN 2000.



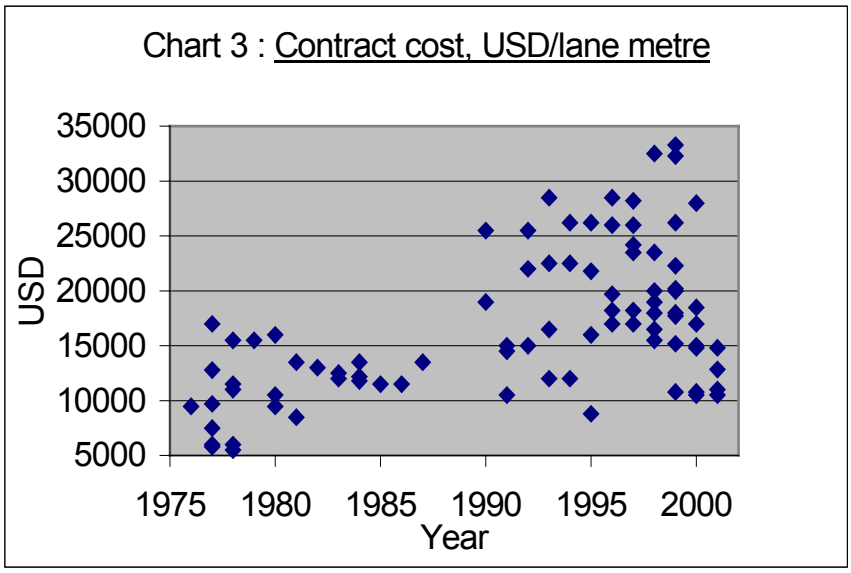
Source: ECOWIN 2000

It is worth mentioning that much of today's Ro-Ro world fleet exceeds 20 years of age and very little has been scrapped. Jon Boyce, Director of Sea-Roll Ltd, UK, stated to the Motorship (1998, p.17) that this is partly due to the structural longevity of Ro-Ro vessels, and partly due to standards of construction at Western European shipyards and

good maintenance, particularly of medium speed machinery. Based on a Drewry Shipping Consultants Ltd report, C. Haindl (1998, p.17) states that in this industry Ro-Ro ships, which bear high capital and operating costs, can only be successful in commanding premium rates when they are capable of exploiting the cargo flexibility afforded them by their ramp and deck configurations. Therefore, a number of ship operators, for example DFDS Tor Line or Stena Ro-Ro, order faster and larger ships that are able to offer optimum performance, particularly in terms of speed and flexibility towards cargoes.

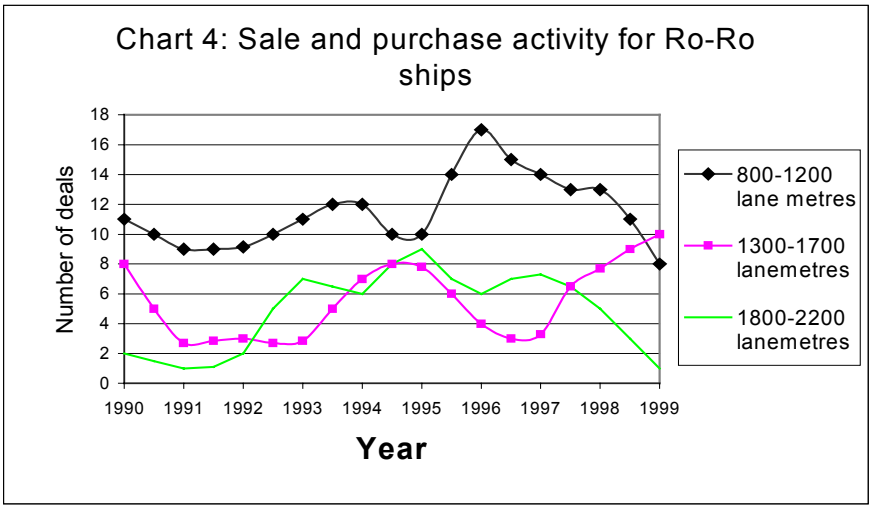
It is worth mentioning that the Ro-Ro fleet was fairly stable during the last 5 years and in contrast to the dry bulk sectors was able to withstand the world financial crisis in 1997. It is stated by Barry Rogliano Salles (1998) that the main strengths of the Ro-Ro ship market is certainly its modest size and, even more important, the fact that it is run by protagonists whose only vocation is shipping. The years 1998-99 were also marked by mergers and acquisitions by large operators. For example Wallenius Wilhelmsen became the largest Ro-Ro operator all over the world. Such tendency can be explained by several ways. A number of these merging operators either wanted to face a drop in freight rates or were looking for larger market share. There is no doubt that this stability is also the consequence of container concept development and it is worth mentioning that the Ro-Ro fleet transports up to 6% of the world container transport capacity. Another great tendency in recent years is ordering PCTCs with carrying capacity of 2200 – 2800 lane metres, speed 23 – 25 knots specifically for shot-sea trades except Wallenius Wilmhelmsen and Grimaldi, which still continue their investments in deep-sea Ro-Ro vessels. Finally, I think it is worth looking at the statistics provided by ECOWIN 2000 and various Shippax Statistics issues 1998 – 2000 in order to have a clear picture of the current world-wide Ro-Ro market.

Contract cost in USD per lane metre varies a lot and according to Shippax Statistics, the upper indication is for the ships with a very high specification. However, the contract cost can drop considerably after recent ordering wave of those ships in China.



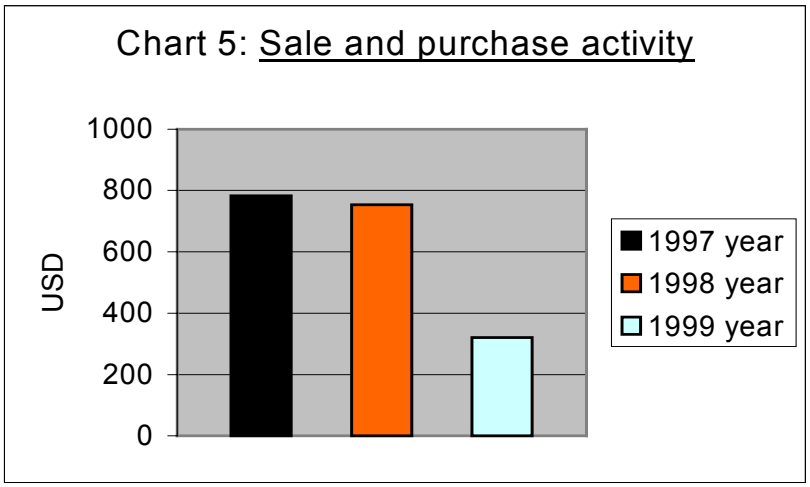
Source: various Shippax Statistics 98-00 issues

It is not a secret that sale and purchase activity has always attracted a lot of attention. Therefore the figure stated below shows us a number of sale and purchase deals from where we can easily see that relatively small Ro-Ro vessels attract most of these deals.



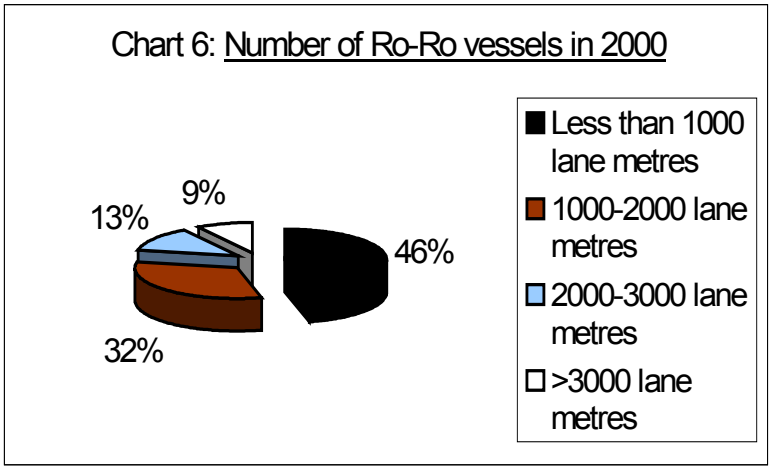
Source: ECOWIN 2000

It goes without saying that the aforementioned sale and purchase activity and, moreover, the total amount of contracts very well represents the current Ro-Ro world market. According to Shippax Statistics, 79 Ro-Ro's or about 7% of the world market were sold at 753 million USD in 1998 but only 57 of them or 5% of the world market were sold at a combined amount of 320 USD in 1999.



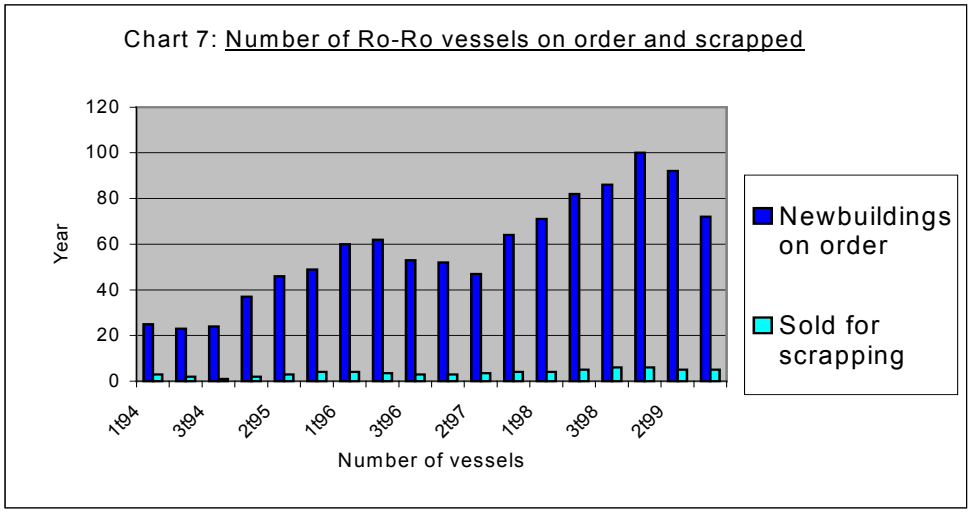
Source: various Shippax Statistics 98-00 issues

Another very interesting issue is distribution of Ro-Ro ships' carrying capacity. There are a total of 1158 such vessels without newbuildings (64).



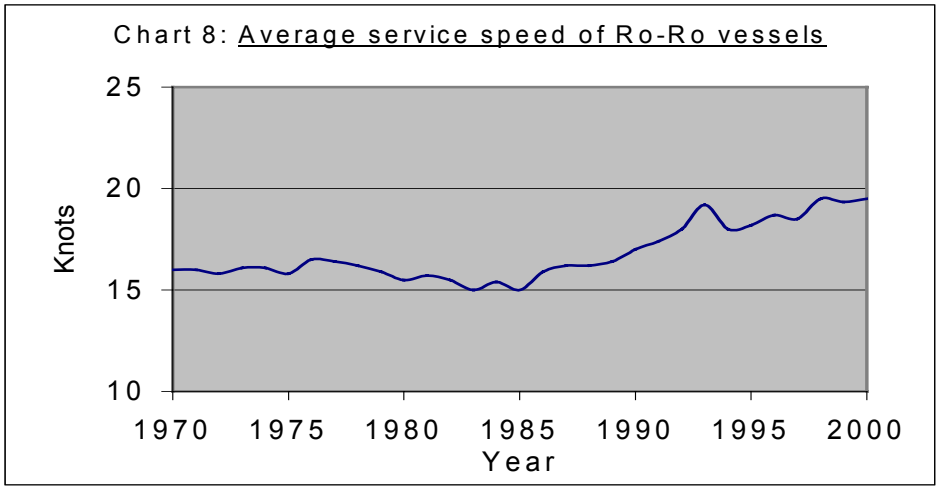
Source: various Shippax Statistics 98-00 issues

It is a matter of a great importance to have a proper understanding of the number of Ro-Ro vessels on order and sold for scrapping. A number of freight only Ro-Ro ships on order are presented in the Appendix B. However, some sources claim that ordering data could be even higher.



Source: various Shippax Statistics 98-00 issues

Finally a figure of average service speed in knots of Ro-Ro vessels' delivered during the past 9 years is provided by Shippax Statistics and stated below.



Source: various Shippax Statistics 98-00 issues

5.1.2 Southern Baltic region analysis

The figures of Ro-Ro cargo and passenger transportation during the 1999 in the Baltic region were as follows:

- Trailers – 4.296.335
- Buses – 259.020
- Cars – 47.469.014
- Passengers – 136.572.262
- Trips – 3.150-498

As was already mentioned before, this region, especially the Southern Baltic, differs a lot from others because it is still affected by a number of factors that are very alien to other regions where this type of transportation also takes place. It is also a matter of great importance to note that only a minor part of cargo flows are formed in these countries (especially the Baltic States) and, therefore, any changes in legal, bureaucratic or other matters can turn the aforementioned flows to other ports.

It is clear as a day that Ro-Ro operators in the Southern Baltic must compete not only between themselves but also with the land-based rail or truck companies and fixed links. However, it must be stated that during the last ten years the Ro-Ro operators transporting cargo in the east – west directions were in a much better position than those rail and road companies because of several reasons. The first is that a big number of cargo owners, especially owners of high value cargoes, were particularly afraid of constant robberies on Polish roads. The second is the catastrophic or at least unenviable situation at the Poland/Germany and Poland/Lithuania borders due to very complicated and time-consuming procedures as well as high level of officials' corruption. The third is that during summer season in Poland and weekends in Germany there are huge restrictions for movement of heavy freight cars. The fourth is that a number of transportation quotas for trucking companies are highly limited.

In view of the above it can be stated that there were a number of cases when cargo owners simply were forced to use transportation of cargo by sea and these artificially created cargo flows sometimes enabled Ro-Ro operators to define groundlessly high tariffs. However, after Poland and the Baltic States started negotiations with EU, the situation on roads and at borders of Poland has been getting much better, the Ro-Ro market has become more and more competitive and Ro-Ro operators started loosing this artificially created advantage. Therefore, in order to avoid a fierce competitive struggle and further cut their tariffs, LISCO and Scandlines AG entered into conference co-operation on the routes from Germany to the Baltic States.

A Completely different picture rises in the north – south direction (we will pay attention only to the Ro-Ro transportation between the Baltic States, Poland, Germany and Southern Swedish ports). This market can bravely pretend to be recognised as a competitive market. For example, both Scandlines AG and TT-Line operate with their own vessels the same Rostock – Trelleborg line. However, after recent mergers and acquisitions of companies, it seems that this competition can be easily eliminated. Another very important difference between the north – south and the east – west transportation is that in the former case transportation of passengers brings the Ro-Ro operator substantial income even after abolition of duty-free sales. In the east – west direction the number of passengers using Ro-pax vessels grows annually but is still far away from the huge flows in the north – south direction.

Finally, I think that the best estimation of Ro-Ro cargo transportation in the Southern Baltic region will be gathered statistics of Ro-Ro cargo flows between the states and Ro-Ro cargo turnover in the Southern Baltic ports, presented in Appendix B. Cargo volumes shipped by different Ro-Ro operators will also be presented and 5 major ports will be briefly estimated in further sections.

It is a matter of great importance to note that this region is also very interesting because cargo type, flows and Ro-Ro operators are under constant change. For the illustration of this statement we can take statistics of the port of Klaipeda, Lithuania.

Table 11: Ro-Ro cargo turnover in the port of Klaipeda (in thousand units)

Years	90	91	92	93	94	95	96	97	98	99
Road transport	0.3	3.9	16.2	56.3	77.2	101.6	136.6	159.3	133.1	89.6
Wagons	85.6	81.5	40.8	46.2	34.7	20.9	22.2	18.1	11.4	11.7
Total	85.9	85.4	57.0	102.5	111.9	122.5	158.9	177.4	144.6	101.3

Source: http://www.spk.lt

From that table we can clearly see that during the 1990 – 91 period wagons were the main portion of Ro-Ro cargo turnover in the port of Klaipeda. That was mainly because only rail ferries were serving the only shipping line Klaipeda – Mukran (Sassnitz) and a big part of the cargo was the military equipment moving from former Eastern Germany to the Kaliningrad area. During the year 1992 the amount of wagons transported dropped considerably but the number of road vehicles transported started to grow rapidly, especially after LISCO reconstructed the rail ferries “Kaunas” and “Vilnius” into trailer-friendly Ro-pax ferries and purchased another Ro-pax ferry “Palanga” that were serving shipping line Kiel – Klaipeda. The peak of Ro-Ro transportation was during the 1997 when port of Klaipeda handled 159.3 thousand Ro-Ro units. This enormously growing cargo flow attracted the former Euroseabridge (currently Scandlines Euroseabridge) shipping company to open a new shipping line Travemunde – Klaipeda with the Ro-pax ferry “Greifswald”. The aforementioned Euroseabridge was later acquired by Scandlines AG that put two other Ro-pax vessels “Urd” and “Ask” to this traffic. Unfortunately, the Russian crisis in August of 1998 reduced the cargo flows considerably in the eastern part of the Southern Baltic area (in the port of Klaipeda down to 144.6 thousand units in

1998 and 101.3 in 1999). It should be stated that nowadays, due to recovery of the Russian economy this cargo flow has started to grow little by little and there are serious expectations to think that in the nearest future it will reach at least the level of the 1996 year.

5.1.3 TINA Project

It is clear as a day that Ro-Ro transportation is not isolated from other transport types and global projects that affect even much bigger regions we are particularly interested in this dissertation and therefore cannot be estimated using the methods that ignore on-coming and global changes. Therefore it is a matter of great importance to discuss briefly one major project that will affect not only infrastructure of states by the Baltic Sea but also EU and future candidates to it and, consequently, Ro-Ro transportation. This project generally is called TINA (Transport Infrastructure Needs Assessment) and is primarily designed to initiate the development of a multi-modal transport network within the territory of the candidate countries for accession: Estonia, Latvia, Lithuania, the Czech Republic, Slovakia, Hungary, Poland, Slovenia, Romania, Bulgaria and Cyprus. The TINA network comprises 18683 km of roads, 20924 km of railway lines, 4052 km of inland waterways, 40 airports, 20 seaports, 58 river ports and 86 terminals (out of which 20 are situated in seaports and river ports, and 66 stand alone). The main concept of this project is that this network development should comply with the principles, objectives and criteria set out in “Guidelines for the development of a Trans-European Union” (Decision of the European Parliament 1692/96/EC). The general TINA process can be divided into two main stages:

1. The first concerns the definition of the network where cost estimates play a major role. It also must define the TINA multi-modal transport network, which could be realised in the time horizon of 2015.
2. The second stage concerns the identification of investment measures by which the identified network would be brought up to a desired quality level and consequently

determines possible investment measures. This stage leads to a solid basis of cost estimates for the network.

Finally the main general steps are set up by the Secretariat:

1. To set the main rules on which the hypothesis of constructing the network should be built
2. To identify a multi-modal backbone network using global criteria, such as those which led to identification of Crete Corridors and their adjustments and additions as endorsed at their third Pan-European Transport Conference of Helsinki
3. To identify those additional network components, i.e. links (rail, road, inland waterways) and nodes (airports, ports, terminals), which are necessary to transform the Helsinki "Corridor approach" into a real transport "network approach", with similar attributes to those described in Decision 1692/96/EC for the TENs
4. To indentify all possible investment measures which contribute to the development of the TINA network as defined in the previous steps and to make an estimation of their cost
5. To report on the network development in certain years (2000, 2005, 2010 and 2015)
6. To develop a GIS for the TINA network linking geographical, economic and traffic information.

In view of the above stated a natural question arises – how will this project and other global changes affect Ro-Ro transportation in the Southern Baltic? According to professor Paulauskas, all transport systems and companies, especially those of the Baltic States, should actively participate in multimodal transportation services and creating of MTOs that will help those countries to turn the cargo flows through their ports. A very important role should be played by Ro-Ro shipping lines in this service but at first Ro-Ro operators must make co-operation agreements with a sufficient number of trucking and rail companies as well as with the main freight forwarders in this region. This must be done because of several reasons:

1. The first is that after such co-operation will take place, the VOCC will gain more knowledge, expertise and know-how.
2. The second is that a Ro-Ro operator, after becoming a VOCC, will be able to increase his profitability. The reason is that nowadays, transporting cargo from Western Europe to central Russia, the transportation cost is about 150 USD/ton but only 25% is received by the Ro-Ro operator.

5.1.4 Ro-Ro operators in the Southern Baltic

This section will be dedicated to a brief analysis of the main Ro-Ro operators and shipping lines in the Southern Baltic.

Scandlines AG

Scandlines AG is one of Europe's largest Ro-Ro companies and was established in 1998 when the largest national ferry companies of Denmark and Germany joined together. Currently the company transports cargo and passengers on 20 international and domestic routes in Danish, German and Swedish coastal waters and the Southern Baltic. In its Annual Report 1999 Scandlines AG states that it is very interested in further development of freight services to and from the Eastern Baltic to Russia – regions that are fast becoming the world's most interesting areas of economic growth. In 1999, 25 million passengers travelled with Scandlines, along with 3.9 million cars, 856000 lorries and 110000 coaches. The company also transported some 142000 railway carriages (both passengers and freight) and total of approximately 166000 crossings were made by Scandlines AG's 35 ferries in 1999. The company's turnover fell from DEM 1258 million in 1998 to DEM 1009 million in 1999, mainly as a result of the closing down of the Great Belt service in 1998 and abolition of duty-free sales on board the ferries since the 1st July, 1999. However, Scandlines AG had a profit of DEM 52 million compared with a loss of DEM 50 million in 1998.

Rodby – Puttgarden. 10 nm, 1.00 hr, 48/day

This line is operated by four double-ended ferries and proved itself reliable, sustaining an intensive and round the clock sailing pattern.

Ferry	Built	Pax	Beds	Cars	Lane metres
Prins Richard	97	900	0	294	580
Prinsesse Benedikte	97	900	0	294	580
Schleswig-Holstein	97	900	0	294	580
Deutchland	97	900	0	294	580

The number of cars transported on this route increased by 6.3% to 991.644 and passengers – by 4% to 5.616.722. The number of lorries decreased by 2% to 259151, buses by 7.8% to 31248, rail wagons by 3% to 9.638.

Rostock – Gedser. 26 nm, 1.15/2.00 hrs, 6-9/day.

This line is served by two conventional ferries “Kronprins Frederik” and “Dronning Margrethe II” that replaced the monohull fast ferry “Berlin Express”.

Ferry	Built	Pax	Beds	Cars	Lane metres
Kronprins Frederik	81	2280	0	260	625
Dronning Margrethe II	73	1500	0	211	344

The number of lorries transported during 1999 remained stable at the 33.000, number of cars fell by 2.9% to 169.903 and passengers by 4.8% to 1.292.327. The number of buses transported increased by 3.3% to 14588.

It is worth mentioning that both above stated Ro-Ro lines were greatly and negatively affected by the abolition of duty-free sales.

Rostock – Trelleborg. 85 nm, 6.00 hrs, 3/day.
Two vessels "Skåne" and "Mecklenburg-Vorpommern" that can carry rail wagons, lorries, cars and passengers serve this line.

Ferry	Built	Pax	Beds	Cars	Lane metres
Skåne	98	600	600	-	3295
Mecklenburg-Vorpommern	96	887	400	100	2150

According to the Annual Report 1999, this route also produced a regular, reliable service and a satisfactory result during the 1999 year. The volume of lorry traffic increased by 16.7% to a total of 82.471, the number of passengers grew slowly up to 263.560 while cars were down by 2.1% to 47475.

Sassnitz – Trelleborg. 54 nm, 3.45 hrs, 5/day.
This line is served by two vessels "Sassnitz" and "Trelleborg" and is run on a pool basis with Scandlines AB of Sweden.

Ferry	Built	Pax	Beds	Cars	Lane metres
Sassnitz	89	1000	0	120	711
Trelleborg	82	800	50	-	680

The number of cars transported during 1999 fell slightly by 0.6% to 112.980 but lorry traffic was up by 2.3% to 25.516. The number of passengers carried was down by 4.4% to 754.193 and buses by 10.2% to 4.387, mainly due to abolition of duty-free sales.

Helsingör – Helsingborg. 3 nm, 0.20 hrs, 55/day.
This route is operated in a 50/50 joint venture with the Scandlines AB and served by three modern, double-ended ferries "Tycho Brahe", "Aurora" and "Hamlet".

Ferry	Built	Pax	Beds	Cars	Lane metres
Tycho Brahe	91	1250	0	238	539
Aurora	92	1250	0	238	539
Hamlet	97	1250	0	240	553

The number of cars carried increased by 6.8% to 1.745.444, lorries by 8.0% to 349.190, passengers by 7.0% to 10.449.644 and buses by 6.3% to 40.923. Advanced measures aiming towards competition with the fixed link across the Öresund between Malmö and Copenhagen were taken – costs were trimmed in order to better cope with the new competitive scenario and a co-ordinated marketing initiative was launched to promote the route that is 60 km shorter than via the fixed link.

Sassnitz – Rönne (- Ystad). 39 nm, 2.30 hrs, 1/day.
This route was served by the ferry "Rügen" that could carry passengers, cars, lorries, etc. On the 28th of December, 1999 the leg Ystad – Rönne was closed due to the loss of duty free sales, difficulties serving two lines with one vessel and the entry onto the route by Danish state-owned company Bornholms Trafficen.

Ferry	Built	Pax	Beds	Cars	Lane metres
Rügen	72	1468	56	220	480

The number of cars transported on the Sassnitz – Rönne route fell by 12.5% to 24.229, passengers by 13.5% to 98.876 while the number of lorries carried remained rather stable. The number of cars transported on the Rönne – Ystad route fell by 3.9% to 14.155, lorries by 1.9% to 372 and passengers by 6.4% to 49.968.

Böjden – Fynshav. 7 nm, 0.50 hrs, 8/day.
Being a contract route and served by the ferry "Thor Sydfyen", this route was positively affected by the Great Belt fixed link.

Ferry	Built	Pax	Beds	Cars	Lane metres
Thor Sydfyen	78	300	0	50	250

The number of cars transported increased by 11.6% to 82.385 and passengers by 9.8% to 254.736 but the number of lorries declined by 7.7% to 2.676.

Dan-link Copenhagen – Helsingborg. 21 nm, 1.50 hrs, 10/day.
Two railway ferries "Öresund" and "Trekroner" serve this line that is run as a contract route in co-operation with Scandlines AB.

Ferry	Built	Pax	Beds	Cars	Lane metres
Öresund	86	-	-	-	817
Trekroner	79	-	-	-	806

The number of loaded rail units carried decreased by 6% to 77.423 but the number of empty rail units increased by 10% to 44.411. The number of sailings also was increased to 4783 trip per year and gave complete 24 hours coverage seven days per week. However, this route was closed down on 1st July, 2000 as a result of the opening Öresund bridge.

Travemünde – Trelleborg. 120 nm, 8.00 hrs, 1/day.
This line is served by the ferry "Götaland" and the line was opened just on the 2nd of September, 1998.

Ferry	Built	Pax	Beds	Cars	Lane metres
Götaland	73	400	148	50	550

The number of passengers carried was 28.166, trailers 28.670 and the number of trips made during 1999 was 714.

Travemünde/Kiel – Klaipeda. 390 nm, 24.00 hrs, 5/week.

According to the Annual Report 1999, up to November of 1999 the route Travemünde – Klaipeda was served by the vessels "Greifswald" and "Ask" but did not develop satisfactory result due to low sailing frequency and competition from the LISCO Kiel – Klaipeda line. Therefore, a conference co-operation joined forces of LISCO and Scandlines AG under the new name Kiel – Klaipeda Express and converted Travemünde – Klaipeda and Kiel – Klaipeda into one route Kiel – Klaipeda, which is served by the LISCO Ro-pax ferries "Vilnius" and "Kaunas" and Scandlines AG's "Greifswald". From the beginning of May, 2000 the Ro-Ro vessel "Panevezys" of LISCO re-opened the line Klaipeda – Travemünde.

Ferry	Built	Pax	Beds	Cars	Lane metres
Greifswald	88	95	95	-	1570
Ask	82/91	186	40	291	1110

The number of cars carried by "Greifswald" and "Ask" up to November of 1999 was 6.980, trucks 1.659, trailers 8.737 and 273 trips were made.

Amber Line Karlshamn – Liepaja. 221 nm, 15.00 hrs, 3/week.

The four-year-old Amber Line is owned by Scandlines AG and is run as a freight route with limited capacity for drivers and passengers. Primarily served by Ro-Ro vessel "Inzhenieris Nechiporenko", "Sea Clipper" was shortly added in October of 1997 when

traffic volumes increased by 53%. The former vessel currently is replaced by the ferry "Kahlberg" that was transferred from the Rostock – Liepaja route to include an offer for passengers. This line mainly competes with LISCO line between Klaipeda and Åhus.

Ferry	Built	Pax	Beds	Cars	Lane metres
Kahlberg	83	75	75	0	784

Rostock – Liepaja. 349 nm, 24.00 hrs, 2/week.

Up to January 1st of 2000 this route was served by the vessel "Kahlberg" that was replaced by the Ro-pax ferry "Ask" with higher cargo and passenger carrying capacity and higher service speed.

Ferry	Built	Pax	Beds	Cars	Lane metres
Ask	82/91	186	40	291	1110

Aarhus – Aabenraa – Klaipeda. 323/468 nm, 30.00 hrs, 2/week.

According to the Annual Report 1999, the restructuring in Scandlines Balticum Seaways line after it was acquired in1999 and m/v "Belard" was chartered out, resulted in an improved service coverage for both the northern and southern parts of Jutland, particularly as regards export flows, as from the food industry, to Russia and the Baltic States. Currently the line is served by the ferry "Urd" that can sustain higher cargo volumes at lower costs. It is worth mentioning that operating results on this line still remain unsatisfactory.

Ferry	Built	Pax	Beds	Cars	Lane metres
Urd	81	610	0	291	920

Sassnitz – Klaipeda. 298nm, 18.00 hrs, 4/week.

This route is being operated by Scandlines Euroseabridge in a conference co-operation with LISCO and two railway Ro-pax ferries “Petersburg” and “Klaipeda” serve this route.

Ferry	Built	Pax	Beds	Cars	Lane metres
Petersburg	88	140	140	100	1350
Klaipeda	87	12	12	0	1350

The number of passengers carried by those two ferries in 1999 decreased by 8.5% to 14.439, cars by 37.5% to 4.837 and trailers by 46.1% to 7.551. The number of rail wagons transported increased by 3% to 11.716. However, the operating result of this line is unsatisfactory, which even lead to decreasing the sailing frequency.

LISCO (Lithuanian Shipping Company)

Lithuanian Shipping Company (LISCO) started offering Ro-Ro services in 1987 when their first rail ferry “Klaipeda” was built. Nowadays LISCO operates on a regular basis with 6 Ro-Ro or Ro-pax vessels on the Klaipeda – Kiel, Klaipeda – Sassnitz, Klaipeda – Stockholm and Klaipeda – Åhus routes. The number of Ro-Ro units was growing considerably annually up to the August of 1998 when the Russian crisis occurred and cargo flows dropped dramatically. It is worth mentioning that another reason, which reduced cargo volumes, was the fact that the South-eastern Baltic market was entered into by Scandlines AG. For some time regular customers faced a very fierce competitive struggle of the above stated operators that resulted in a considerable drop of tariffs. However, as was already mentioned before, at the end of 1999 Scandlines AG and LISCO joined their forces on the Klaipeda – Kiel route, afterwards called the Klaipeda – Kiel Express. It is worth remembering that a conference agreement on the route Klaipeda – Sassnitz was signed previously between those two companies as well. As the

Klaipeda – Kiel, Klaipeda – Sassnitz and Klaipeda – Travemünde routes were already analysed, only the Klaipeda - Åhus route will be briefly described.

Klaipeda – Åhus. 233 nm, 18.00 hrs, 3/week.
This line was served by two Ro-Ro vessels "Siauliai" and "Panevezys" up to the May of 2000. From this date the latter was transferred to the Klaipeda – Travemünde line.

Ro-Ro vessel	Built	Pax	Beds	Cars	Lane metres
Siauliai	85	12	12	370	713
Panevezys	85	12	12	370	713

The number of passengers transported by those two vessels during 1999 increased by 59% to 4.198 but the number of cars shipped fell by 16.2% to 177 and trailers by 16.0% to 7.268.

DFDS Tor line
DFDS Tor Line so far operates just one shipping line in the Baltic Sea but they have already reported that after full recovery of the Russian economy thus intend to enter this market with new ships and lines. The route the company currently operates in the Baltic is Klaipeda – Copenhagen – Fredericia that is served by the Ro-Ro vessel "Dana Corona", which carries 20'/40' containers on rolltrailers, including reefer units, general cargo, heavy lifts, vans, etc.

Klaipeda – Copenhagen – Fredericia. 323/468 nm, 30.00 hrs, 2/week.

Ro-Ro vessel	Built	Pax	Beds	Cars	Lane metres
Dana Corona	72	12	12	-	1270

The number of trailers transported by m/v "Dana Corona" in 1999 declined by 27.1% and totalled 180.000 lane metres.

Rederi AB Nordö – Link

Nordö – Link started to operate in 1982 and so far has maintained a successful cargo service between Malmö and Travemünde. Two jumbo carriers "Malmö Link" and "Lübeck link", which offer two departures per day for lorries, trailers, containers and wagons, serve this line.

Malmö – Travemünde. 141 nm, 9.00 hrs, 3/day.

Ro-Ro vessels	Built	Pax	Beds	Cars	Lane metres
Malmö Link	80	184	184	-	3050
Lübeck link	80	184	184	-	3050

During 1999, the number of trailers carried increased by 16.2% to 109.627 but the number of rail wagons transported fell by 5.9% to 6.003. However, the sailing frequency was increased by 26% to 1.855. Nowadays, the shipping line Nordö – Link is viewing the opening of the Öresund bridge on 1st July, 2000 calmly. The Line's Marketing Director Rudiger Meyer stated at the "Ro-Ro 2000" that the advantages for Ro-Ro services in the Southern Baltic are obvious. He also presented a calculation showing that transportation costs via the shipping line Malmö – Travemünde for a 17 metres truck will be DEM 765 when the cost of using the Öresund bridge will be up to DEM 960.

Stena Line

Stena Line is an international transport and travel service company and one of the world's largest ferry operators. Currently it operates 12 routes in Scandinavia and around the UK. The company also has interests in 3 other ferry routes through its ownership in P&O Stena Line. Stena line has 25 modern vessels – fast ferries, multi –

purpose ferries, Ro-pax ferries and pure freight Ro-Ro ferries. At the beginning of 1999 the company closed the Halmstad – Grenå route and on the 15th of November of the same year signed an agreement to acquire Scandlines AB of Sweden. However, a loss of SEK 496 million during 1999 was reported and that was mainly affected by the abolition of duty-free sales and increased competition in a number of market areas.

Purely in the Southern Baltic Stena Line operates the line Karlskrona – Gdynia with only one vessel "Stena Europe".

Karlskrona – Gdynia. 170 nm, 10.00 hrs, 2/day.

Ro-Ro vessels	Flag	Built	Pax	Beds	Cars	Lane metres
Stena Europe	Pol	81	2076	1332	450	950

Passenger volumes on this route rose by 32.0% to 239.900 due to Polish citizens' travelling to Sweden and cruise trips from Sweden to Poland. The number of cars transported increased by 19.3% to 30.505, trailers by 3.6% to 16.720 and trips by 9% to 636.

The other lines operated by Stena Line (partly in the Southern Baltic) are Gothenburg – Kiel and Gothenburg – Travemünde. The former was greatly affected by the aforementioned abolition of duty-free sales and, therefore, both ferries "Stena Germanica" and "Stena Scandinavica" serving this line were converted to increase freight capacity. The number of passengers carried by these ferries fell by 34% to 552.900, cars by 14% to 95.627 but the number of trailers transported remained stable – 37.792. The freight service by "Stena Carrier" and "Stena Freighter" between Gothenburg and Travemünde also suffered declining volumes due to a high level of competition in Southern Sweden. The number of trailers carried by the above stated

ferries decreased by 7.2% to 59.664 even though the frequency of sailings was increased by 3.4% to 723.

Gothenburg – Kiel. 217 nm, 14.00 hrs, 1/day.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Stena Germanica	87	2400	2440	550	1320
Stena Scandinavica	88	2400	2440	550	1320

Gothenburg – Travemünde. 268 nm, 15.00 hrs, 1-2/day

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Stena Carrier	78	0	0	0	1700
Stena Freighter	77	0	0	0	1700

Grenå – Varberg. 64 nm, 4.30 H, 3/day.

The closing of Grenå – Halmstad route increased cargo volumes on the Grenå – Varberg route. The latter route currently is served by two ferries “Stena Prince” and “Stena Nautica”. The latter ferry was transferred from Grenå – Halmstad route.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Stena Prince	69	1305	144	360	810
Stena Nautica	86	2000	148	411	620

The number of passengers transported on this route increased by 28% to 360.400, cars by 27% to 82.173, trailers by 63% to 23.826 and trips by 4.8% to 1.380. However, there have been reports that this route will also be closed down, at least during the off-season.

Finnlines Group

Finnlines is one of the largest European liner shipping companies specialising in freight services. Finnlines’ route network covers all Finland’s major ports and 20 other in the

rest of Europe. However, we will be interested only in those lines that are connected with the ports of the Southern Baltic. The Finnlines group during 1999 operated a 66 vessel fleet that consisted mainly of freight Ro-Ro and Ro-pax vessels. 23 of them are owned by Finnlines itself and the total capacity of vessels in liner service is about 67000 lane metres and the average age of the Group's vessels is ten years. However, some of these vessels were owned by German company Poseidon Schiffahrt AG, which was recently acquired by Finnlines.

Finnlines operates both in the Baltic and the North Sea and the main Finnish ports served by the group's liner services are Helsinki, Turku and Naantali. It is worth mentioning that since the beginning of 1999 transport operations in the Baltic, Scandinavia, North Sea and Bay of Biscay were marketed under the Fincarriers service brand. The liner service also includes the Railship railferries service between Turku and Travemünde. Traffic to Russia was under the TransRussia Express name, between Finland and Poland under the Polfin name and between Finland and Sweden under the Finnlink name. The group's external partners in the Baltic Sea in 1999 were:

- Baltic Sea/Rostock – Euroseabridge GmbH, Rostock
- Polish Traffic, Polfin line – Euroafrica Shipping lines Co.Ltd. Szczecin
- Germany – Russia traffic, TransRussia Express – ZAO Baltic Transport Systems (BTS) St.Petersburg and Friedrich Sanger GmbH, Hamburg.

Helsinki – Lübeck. 630 nm, 36.00 hrs, 1-2/day

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Finnclipper	99	440	440	-	2500
Finnhansa	94	90	90	-	3200
Finntrader	95	90	90	-	3200
Finnpartner	95	90	90	-	3200
Finnoak	91	0	0	-	1278
Transeuropa	95	90	90	-	3200

Helsinki – Travemünde. 624 nm, 36.00 hrs, 2/week.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Translubeca	90	84	84	200	2100

Helsinki/Kotka/Rauma – Lübeck. 694 nm, 1/week.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Transfinlandia	81	12	12	100	2340
Oihonna	84	12	12	-	2160

Kotka – Lübeck/Rostock. 680 nm, 36.00 hrs, 1/week.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Aurora	82	12	12	-	2170

Helsinki/Rauma – Kiel. 630 nm, 36.00 hrs, 1/week.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Finnmerchant	82	12	12	-	2170

All the above stated carriers transported 155.000 trailers during 1999.

Travemünde – Turku. 540 nm, 32.00-34.00 hrs, 6/week.

This line is served by 3 rail Ro-Ro vessels “Railship I”, “Railship II” and “Railship III”.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Railship I	75	10	-	-	1710
Railship II	84	12	-	-	1949
Railship III	90	12	-	-	1989

The number of rail wagons transported during 1999 decreased by 13.2% to 17.234.

Polfin line

Helsinki/Kotka – Gdynia/Szczecin. 4/week.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Amber	93	-	-	-	1230
Inowroclaw	80	-	-	-	1400

TransRussia Express

Kiel – Sassnitz – St.Petersburg. 48 hrs, 2/week.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Aristaios	75	-	-	486	876
Transrussia	77	-	-	486	876

Unfortunately, it was impossible to get data of cargo transported by the last two Ro-Ro shipping lines.

TT-Line

The first route served by TT-line was Travemünde – Trelleborg. In 1991 TT-line started offering ferry services between Rostock and Trelleborg when Rostock was in a phase of reorientation. Nowadays TT-Line operates two lines Rostock – Trelleborg and Travemünde – Trelleborg with 7 vessels and presents itself as a specialist in direct traffic to Sweden on both its lines.

Rostock – Trelleborg. 85nm, 2.45/6.00 hrs, 5-6/day.

Two Ro-pax ferries “Saga Star” and “TT Traveller and one catamaran “Delphin” serve this line.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Saga Star	81	250	181	-	1404
TT Traveller	92	244	204	-	1800
Delphin	96	600	0	175	-

The number of passengers transported during 1999 slightly decreased by 1.9% to 433.197 and trips by 1.3% to 3.096 but the number of trailers transported increased considerably by 45.9% to 65.797.

Travemünde – Trelleborg. 120 nm, 7.30 hrs, 4-5/day.

Four Ro-pax ferries “Peter Pan”, “Nils Holgerson”, “Robin Hood” and “Nils Dacke” serve this line.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Peter Pan	88	1020	1020	500	1480
Nils Holgerson	89	1020	1020	500	1480
Robin Hood	95	300	300	-	2400
Nils Dacke	95	300	300	-	2400

The number of passengers transported remained stable – 638.267 as well as cars – 106.713, but the number of trailers increased by 21.4% to 175.774.

Easy Line

Easy line began traffic between Gedser and Rostock in June 1998. According to R.Berner, the concept of the shipping company was to establish an alternative to the already existing Scandlines traffic between Rostock and Gedser, with unconventional service focusing entirely on the customer with fast and simple booking systems and rates. Today, the company operates two ferries “Anja 11” and “Gitte 3”.

Gedser – Rostock. 26 nm, 2.15 hrs, 8/day.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Anja 11	88	253	-	170	580
Gitte 3	88	253	-	170	580

Bornholms Trafikken

Bornholms Trafikken is a state-owned Danish company founded in 1973 and operates 2 year-round ferry routes to Bornholm. The company is involved both in the passenger and freight transportation as well as in travel agency activities. It is worth mentioning that the company has a subsidiary in Ystad and employs about 620 people on a yearly basis distributed between the ferries and an administrative office in Ronne.

Ronne – Sassnitz. 59 nm, 3.30 hrs, 2-6/week.

Ronne – Ystad. 38 nm, 2.30 hrs, 2-5/day.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Peder Olsen	74	1150	19	222	382
Jens Kofoed	79	1500	490	262	515
Povl Anker	78	1500	490	262	515

The number of passengers transported by “Peder Olsen”, “Jens Kofoed” and “Povl Anker” on the Ronne – Ystad route in 1999 decreased by 9.1% to 677.298 and trailers by 3% while 4.077 and the number of cars remained stable. The number of passengers carried by “Peder Olsen” on the Ronne – Sassnitz route in 1999 decreased by 7.2% to 75.565, cars by 5.9% to 21.446 but the number of trailers increased by 5.5% to 421.

Silja Line

In the Southern Baltic Silja Line operates just one route Helsinki – Tallinn – Rostock. In 1999 Rostock substituted Travemünde as the German port of call and a call in Estonia was added as well. The traffic is seasonal (June – September) and in the other period the ferry “Finnjet” is serving the Helsinki – Tallinn route only.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Finnjet	77	1790	1790	374	612

The number of passengers carried during 1999 decreased by 4.1% to 95.634, cars by 18.0% to 19.101 and trailers by 33.5% to 121.

Transfennica

Transfennica was established in 1976 to handle shipments from the Finish forest industry and today it is a very modern shipping company with the fastest scheduled liner services between Belgium, Germany, UK and Finland. Transfennica operates 20 vessels with a service speed in excess of 21 knots and 14 of these modern vessels were built during the last three years. The company offers for its customers daily departures on the Hanko – Lübeck line. According to Transfennica's Press Release of 2nd May, 2000, Transfennica can also arrange fast on-carriage to Russia and other former Soviet Union countries. The main ports in Finland where Transfennica's Ro-Ro vessels call are Kemi, Oulu, Rauma, Hanko, Kotka and Hamina. The number of trailers transported by Transfennica from Lübeck to Finland varies from 30000 to 40000 annually. However, the company expects further growth in transit volumes to Russia in particular.

Transfennica was acquired by Finnlines group in June 2000. Finnlines president and CEO A.Lagerroossaid (2000, p.17) stated that the value of the transport agreement together with the free-of-debt value of the Transfennica shares is about USD 65 million.

Polish Baltic Shipping Company (Pollferries)

Polish Baltic Shipping Company operates 4 shipping lines that are served by four vessels.

Gdansk – Nynäshamn. 283 nm, 19.00 hrs, 7/week.

This line is served by 2 Ro-pax ferries "Rogalin" and "Nieborow"

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Rogalin	72	984	412	146	270
Nieborow	73	1100	626	225	444

The number of passengers carried in 1999 increased by 18.2% to 112.096, cars by 24.0% to 21.595 and trailers by 40.7% to 2.529.

Gdansk – Oxelösund. 265 nm, 17.00 hrs, 1/week.

This line is served by the Ro-pax ferry "Rogalin". The number of passengers carried in 1999 decreased by 68.2% to 5.374, cars by 68.0% to 1.294, trailers by 62.3% to 325 and trips – by 60.0% to 40.

Swinoujscie – Malmö. 123 nm, 4.00/9.00 hrs, 1/day.

This line is served by the Ro-pax ferry "Nieborow" and the catamaran "Boomerang".

Catamaran	Built	Pax	Beds	Cars	Lane metres
Boomerang	97	700	0	175	-

The number of passengers carried in 1999 decreased by 49.1% to 125.563, cars by 44.5% to 31.167, trailers by 52.4% to 4.306 and trips – by 45.2% to 777. However, "Boomerang" was put up for sale for the current season but no sale materialised.

Swinoujscie – Ystad. 95 nm, 7.00/10.00 hrs, 1/day.

This line is served by the Ro-pax ferry "Silesia". The route was opened in June of 1999.

Ro-Ro ferry	Flag	Built	Pax	Beds	Cars	Lane metres
Silesia	Bah	79	984	426	277	468

The number of passengers transported from June of 1999 was 53.642, cars – 12941, trailers – 5139 and trips made - 419.

Unity Line Ltd.

Unity Line Ltd. is a relatively young shipping company that was established in July of 1994 by two shipping companies – Polish Steamship Joint Stock Company and Euroafrika Shipping Ltd. both having 50% of the shares. The company started offering services on the 1st June 1995 with a very modern ferry "Polonia" on the Swinoujscie – Ystad route and currently 3 ferries operate on the same route – the aforementioned "Polonia" and "Mikolaj Kopernik" and "Jan Sniadeckij"

Swinoujscie – Ystad. 95nm, 7.00 hrs, 2/week.

Ro-Ro ferries	Built	Pax	Beds	Cars	Lane metres
Jan Sniadecki	88	50	50	0	615
Mikolaj Kopernik	74	41	41	0	414
Polonia	95	1000	586	172	2200

The number of passengers transported in 1999 increased by 21.2% to 194.853, cars by 20.5% to 41.925, rail wagons by 78.0% to 42.508 and trailers by 14.4% to 72.407 even though the number of trips was slightly reduced to 2.078.

It is worth mentioning that a new operator - stocklisted Greek ferry company Attica Enterprises, operator of the Superfast Ferries, will enter the Baltic market in the spring of 2001. Four Ro-pax ferries of 29,800 gt, a length of 203.9 m and a speed of about 29 knots, have been ordered from Germany's Howaldtswerke Deutsche Werft, will link Rostock in Germany with the Hanko in Finland and Soedertaelje in Sweden. The vessels are also 10 decks high, can hold 650 passengers, are in compliance with Finnish Ice Class 1A Super and cost $400m. With service speeds of more than 29 knots, the ships are expected to complete the routes to Sweden and Finland in about 17 and 21 hours respectively. The company intends to offer overnight crossings, with departures at the same time daily throughout the year, and its strategy seems to be the filling of specific

gap in the market with regard to both Sweden and Finland. The route Rostock – Hanko, including the mixture of services, is expected to be the main assets of Superfast Ferries Baltic Service.

5.1.5 Main Southern Baltic ports

The number of Ro-Ro units handled by ports during the last 3 years is presented in Appendix B and ,consequently, the cargo flows can also be easily determined. However, it is clear that often shippers choose the route of transportation, not only from the geographical point of view, but also consider other factors governing this type of transportation. Therefore, I think it is a matter of great importance to point out the leading ports in the Southern Baltic and to find out those advantages attracting present and future customers.

Port of Rostock

Rostock – Warnemünde had a railway ferry connection with Gedser since the beginning of the last century. Nowadays the port of Rostock offers perfect conditions for passengers, rail and truck traffic. The four berths for Ro-Ro vessels at the southern end of the Warnow quay with the terminal of 140000 sq.metres handle both railway and passenger ferries. Just a few hundred metres from the ferry berths is a terminal for intermodal freight traffic. The ferry terminal with over 1100 metres of quay and five multi-purpose berths for superfast catamarans and jumbo ferries is one of the most modern in Europe. More than 30900 swap bodies, semi-trailers and containers were handled at the combined terminal in Rostock in 1999.

Port of Kiel

Cellpap Terminal Kiel considers itself as one of Northern Europe's premier transhipment and cargo service companies, specialised in the handling, storage and transport of forest products as well as ferry services. In close co-operation with the

shipping line partners the company provides reliable, proven and safe logistical concepts for all routings via Baltic, Russian and Finish premier ports and is equipped for the handling of all major transportation methods. Long-term contracts are also made with the German Rail System (Deutsche Bahn AG), Transfracht, Transwagon and Cargowagon to guarantee high performance of rail transport and meet transport volumes of the customers.

The company consists of Cellpap Terminal Kiel Ostuferhafen, Nordhafen and Cellpap Stanereis Kiel Gmbh with a total berth capacity of 1500 metres, draught 9-12 metres and 6 Ro-Ro ramps. The following service facilities are provided:

- 3000 metres of railway tracks
- 1500 sq.metres open air storage for stationary reefer connections and dispatch station for veterinary products
- 1500 sq.metres IMDG cargo open air storage area.

Port of Lübeck

The port of Lübeck considers itself as the largest Baltic seaport with more than 105 calls per week, 17 destinations, 4 specialised terminals and the most modern equipment. It is worth mentioning that substantial investments were made that would enable the port of Lübeck to meet the increasing demands of the future:

- 1996 – 1999 about DEM 300 million were invested
- until 2010 another DEM 700 million are to be invested in the extension of the terminals

Terminal Skandinavienkai

Located at the mouth of River Trave, Terminal Skandinavienkai is the biggest of Lübeck's terminals and a major Ro-Ro and ferry port. It offers more than 70 vessel arrivals and departures per week from and to Sweden and Finland – Gothenburg,

Trelleborg, Malmö, Helsinki, Turku, Hanko, etc. Recently Terminal Skandinavienkai experienced growth of cargo volumes and increase of a number of liner vessels linking it with other major ports of the Baltic Sea. Nowadays Terminal Skandinavienkai is undergoing major reconstruction.

Terminal Nordlandkai

This terminal is multi-purpose and designed particularly for handling of forest products and Ro-Ro units. The terminal offers daily traffic to Helsinki and further calls at Rauma, Turku and other places in Finland. Being the centre for the automobile export to Sweden and Finland, Terminal Nordlandkai is also connected with Hamburg and other main hinterland centres in Germany and Europe by railway.

Terminal Konstinkai

This terminal is also multi-functional and mainly focused on seatrade from and to Finland by daily Ro-Ro service Hanko - Lübeck.

Terminal Schlutup

The terminal has huge storage capacities and proper equipment to handle cargo directly from the cassettes or via shed into wagons, trucks and containers.

Lübecker Hafen-Gesellschaft mbH (LHG) at the "Ro-Ro conference 2000" in Gothenburg, has presented a developed "Integrated Harbour Logistic System (IHS)" for Ro-Ro terminal in order to optimise its co-operations and improve productivity. The system supports all operations required today in a modern Ro-Ro terminal – storage, distribution of any type of cargo, handling of Ro-Ro units - trailers, containers, etc and is currently implemented in the terminals Skandinavienkai, Konstinkai, Nordlankai and Schlutup.

Port of Trelleborg

The port of Trelleborg presents itself as one of the biggest ferry ports in Scandinavia. Geographically, Trelleborg is Sweden's most southern port and only 85 km from the German border. The port also made a long-term commitment to upgrade its infrastructure and a major reconstruction of the port has recently been successfully completed. It is worth mentioning that a brand-new intermodal terminal offers new possibilities for the customers to set up intermodal transport chains corresponding to their needs. There are about 40 daily connections, creating an efficient link to the continent. Moreover, all ferry operators are independent and, therefore, the existing competition is the customers' guarantee for an efficient and inexpensive service. The port of Trelleborg handles about 15% of Swedish foreign trade in terms of value and during 1999, 135000 rail wagons, 357000 trucks, 400000 passenger cars and buses and 2.2 million passengers passed through this port.

Port of Klaipeda

There are two terminals in the port of Klaipeda that are capable of handling Ro-Ro units – International Ferry Terminal and Klaipedos Terminal. The first one was built in 1985 as the Lithuanian end of a rail ferry service between Klaipeda and Mukran in Germany and had two highly specialised berths to accommodate the five custom-built ships dedicated to the run. With double-deck ramps multiple track loading was possible on two levels simultaneously. It is worth mentioning that this route was primarily developed for military purposes and was widely used transporting ammunition of the Soviet Army leaving Eastern Germany. Today, International Ferry Terminal has 5 Ro-Ro berths with total length of 900 metres. An extension up to 1500 metres is planned in the nearest future.

Klaipedos Terminal is a private stevedoring company, which started with a small one-quay terminal for discharging low-tonnage feeder vessels in 1994. Today the company

operates a modern, well-equipped, wide-purpose terminal handling Ro-Ro vessels, container and general cargo carriers. Apart from its main activities, the company also offers a wide range of other services – cargo storage, stripping and stuffing, transhipment to railway, sorting, weighing, services for reefer units, etc. The length of the two Ro-Ro berths is 145 metres, draught 7.5 metres.

5.2 Perspectives of Ro-Ro transportation incorporation into the intermodal chain

Gerhardt Muller (1999, p.1) has proposed the following definition of intermodal transportation:

"The concept of transporting passengers and freight on two or more different modes in such a way that all parts of the transportation process, including the exchange of information, are efficiently connected and co-ordinated".

In general, intermodal transportation offers:

- possibility to transport goods from door to door without their transhipment
- quicker delivery speed
- more safety for goods

However, Ro-Ro operators willing to incorporate their shipping lines into an intermodal chain should ensure:

1. Required number of ships and arrivals according to schedule.
2. Departures every day.
3. Reduce time for cargo handling operations to the minimum.
4. Transportation by selected route must be much quicker and more comfortable than using other types of transportation.

It is clear that only Ro-Ro operators' efforts are not enough for successful development of an intermodal chain. Therefore, the below stated should also be done:

1. Ro-Ro terminal readiness for these operations in every respect.
2. Delivery of goods and means of transport in accordance to agreed schedule.
3. Proper agreements on Ro-Ro shipping lines' routes and schedules.
4. Creation of an analogous system in the other port.

It is worth mentioning that Ro-Ro transportation incorporation into the intermodal chain is not a brand-new idea. It is already and successfully implemented in a number of Baltic ports. As was mentioned before, the port of Trelleborg has recently built a new intermodal terminal that offers a lot of possibilities for the customers intending to set up intermodal transport chains. The port of Rostock also offers a shuttle train to and from Verona seven times a week. The cargo shipped by Ro-Ro vessels is afterwards destined for Denmark, Sweden and Finland with further departures to Basle, Bratislava, Bochum, Coevorden, Dresden, Duisburg, Frankfurt, Cologne, Karnwestheim, Kosice, Leipzig, Ljubljana, Mannheim, Nürnberg, Villach, Vienna, Aarau, Brno, Ceske Budejovice, Ostrava, Pilsen, Prague, Split, Zagreb and Zibina. In addition to these destinations there are direct Inter-Cargo trains to the industrial centres of Hamburg, Saxony, Berlin, Halle/Leipzig, Magdeburg, Hannover and Braunschweig.

However, in this section we will not discuss already existing intermodal chains but try to find out what are the reasons preventing the starting of a service Mukran/Sassnitz – Klaipeda – Minsk – Moscow.

The concept of this idea is to develop an intermodal transport chain on the above stated route using shuttle trains and railway carriers of LISCO and Scandlines Euroseabridge. The main transhipment works road/railway, railway/railway will be carried out in Sassnitz and Moscow. In Klaipeda and Minsk rail wagons or platforms will just be coupled or uncoupled and transhipment of containerised cargo will be done well in advance or after train departure in order to reduce idle time to the minimum. It is worth mentioning that Lithuania in this project will appear just as the transit state, because obviously the shuttle train will not be competitive compared to the transportation by road using the highway Klaipeda – Vilnius. However, major benefits are expected for development of the recently built container terminal in the port of Klaipeda and it is generally thought that a shuttle train service will attract huge flows of containerised

cargo. The port of Klaipeda would act as the transhipment port and Minsk will be the centre of cargoes from and to the rest of Byelorussia and Ukraine.

The detailed analysis and calculations as well as preliminary timetable were prepared by parties involved in this project. According to them, the route Sassnitz – Moscow will take 58 hours, Sassnitz – Minsk 38 hours, Klaipeda – Moscow 37 hours. A computer system, monitoring all transportation steps and documentary procedures was considered as an absolute necessity. The purpose of such a system is to minimise the idle time as much as possible and to meet the customers' requirements.

The main advantage of this intermodal transportation chain should be attractive time of cargo delivery, transportation regularity and bigger safety guarantees. It is clear as a day that transportation of trailers and containers by rail nowadays is a very good alternative to transportation by road, especially through Polish roads, where robberies are still a common thing. It becomes even more attractive because idle time and the number of stoppages are minimal. Constant control in all steps of the transportation chain reduces risk even more.

The main aim of this section will also be to analyse technological peculiarities of such transportation and try to foresee possible deficiencies. The shuttle train should consist of not more than 50 wagons and the proportion of micro-wagons and wagons-platforms should be as follows:

- 35 four-axes micro-wagons for trailer and TEU transportation.
- 15 four-axes wagons-platforms for transportation of 40' containers and other types of cargo – up to 60'.

Detailed market analysis showed that the number of wagons on every route should entirely meet current customers' requirements but generally shouldn't exceed:

- On the route Sassnitz – Klaipeda – 37 wagons.
- On the route Klaipeda – Minsk – 50 wagons.
- On the route Minsk – Moscow – 45 wagons.

Port of Sassnitz – Mukran Terminal

As was already mentioned, Mukran Terminal is nominated as a transhipment place for the shuttle train and, therefore, before starting to offer this service, full assurance that the terminal has all necessary equipment to carry out these works must be given. According to a report from the port of Sassnitz, current industrial capacities of the terminal are sufficient to perform the nominated work in time. However, if the road and rail traffic through the port of Sassnitz grows at least 25% to 165.000 units, a quick investment in purchasing additional cargo handling equipment will have to be made.

Scandlines Euroseabridge and LISCO

The shuttle train between the ports of Sassnitz and Klaipeda will be transported by the rail ferries “Klaipeda” and “Petersburg”. It should be noted that these ferries were built particularly for the cargo handling equipment of the complexes of Mukran and International Ferry terminal in Klaipeda. Such equipment with double-deck ramps allows multiple track loading on two levels simultaneously. However, the shortage of cargo on this route forced the named companies to reduce the number of voyages at first to three and finally to two per week.

International Ferry Terminal

The essential deficiencies of the terminal regarding this project are due to inefficient work of the central train station located 5 km from the terminal. This leads to transpositioning of separate wagons up to several days. Big delays are also faced due to limited working hours in the train station “Draugyste”. It goes without saying that before the shuttle train service is started, those deficiencies must be eliminated.

It is generally thought that the timetable of vessels' arrival and departure in Klaipeda port is not properly co-ordinated and, therefore, there is great possibility, especially during heavy weather, of delays by the berth and in outer roads. The situation is also burdened by the fact that only one vessel can proceed in 3 nm length fairway to the International Ferry Terminal.

Finally, it should be stated that probably the main deficiency of this terminal is very inefficient work of customs officials that also takes some very valuable time.

Lithuanian Railways

The main deficiencies of the Lithuanian Railways were determined in the section above. It should be noted that modernisation of the main railways has begun in 1997 and there are great expectations of future, bigger industrial capacities and shorter time for cargo transportation. It also should be noted that an average time from International Ferry Terminal to the Lithuania – Byelorussia border is 11 hours including technically necessary stoppages. According to information received from the Lithuanian Railways, there is a sufficient number of powerful locomotives that are ready to offer services for a shuttle train.

Lithuanian – Byelorussian border and Byelorussian railways

Quicker customs procedures and formalities are an absolute necessity. A computerised information system for these procedures must also be implemented. According to received information, there should be no major obstacles for a shuttle train in the territory of Byelorussia. However, contrary to the competitive route through Brest, the exchange of diesel locomotives to electrical will have to take place in Minsk. At the same time wagons destined to Byelorussia and for its neighbouring countries – in the

first place to Ukraine, must be uncoupled and those destined to Moscow – coupled. It is generally thought that the industrial capacity of Byelorussian locomotives is sufficient.

Byelorussian – Russian border and Moscow terminal

According to primarily collected data, major obstacles for transportation in this route shouldn't be encountered. The responsibility from Smolensk, where the locomotives will have to be changed once again, till Moscow for the delivery of cargo in time will be borne by the Railway Company "Moskovskaja". Industrial locomotive capacities should be sufficient to perform effectively, especially after the Russian crisis when the cargo flows transported by railways dropped considerably.

As was mentioned before, the Moscow terminal should be another major transhipment centre. To perform this task terminal "Kostevo 2" was selected. Even if it has four platforms and all necessary cargo handling equipment, some other works can also be performed by the Odinstov Terminal, privately owned by "Sever Logistic AOZT", which is near the road M1/E30 (Moscow – Minsk – Brest – Berlin) and just 8 km from the Moscow transport ring. Those two terminals are connected by a 10 km length railway and 2 locomotives. "Sever Logistic AOZT" also has a customs office that can ensure quick procedures of customs formalities. According to given information, the total area of the terminal is 800000 sq.metres, heated warehouses are of 45000 sq.metres divided into sections from 3500 to 17000 sq.metres. However, a proper security system in both terminals should be implemented as quickly as possible.

In view of the above stated it is clear that all parts of the transportation chain have enough initial industrial capacities to start offering shuttle train services. One problem that still remains unsolved is shortage of low-bed wagons for trailer and container transportation and, therefore, their purchasing should be included into an on-coming investment program. There is no doubt that lack of modern communication technology,

knowledge of intermodal transportation organisation and logistics can greatly affect the success of this project or even put it in an awkward position.

The implementation of this project should have been done in October of 1995 but it has been postponed, at first because of minor containerised cargo flows through the port of Klaipeda, later because of different tariff policies of the Lithuanian, Byelorussian and Russian Railways. After the brand-new container terminal in Klaipeda was built, the container transportation line "Conline", performed by LISCO, was opened and all necessary agreements on the international level were made, it seemed that all obstacles were eliminated. However, the Russian crisis in August of 1998 occurred, cargo flows dropped considerably and the final stage of project implementation was postponed once again. Even though the Russian economy started to recover little by little, the transportation tariffs are still very low and, therefore, it is clear that the shuttle train service will not be offered until the tariffs for containerised cargo transportation reach sufficient levels.

I think it was very interesting to see how macroeconomic changes can affect one or another project but the most important conclusion that can be drawn after this analysis is that nowadays Ro-Ro operators face another very interesting alternative. The main idea of the aforementioned alternative is that prudent Ro-Ro operators, instead of choosing a fierce competitive struggle with other shipping lines and operators can join their forces together in order to incorporate their lines into intermodal transport chains and at the same time pay more attention to and make every effort towards quality of their services, which always guarantee better long-term profitability.

5.3 Research of Ro-Ro transportation in a particular shipping line

The title of this section suggests analysing a particular Ro-Ro shipping line. However, I think it is more worthwhile to try to look at the Ro-Ro transportation as one of the components of an unbreakable transportation chain and find out the main advantages and disadvantages comparing to land-based transportation. Therefore, a particular route Munich – Moscow was selected and will be analysed further in this section.

The aforementioned route can be plotted in many different ways but the most probable ways of transportation are stated below:

- Munich – Kiel – Klaipeda - Moscow
- Munich – Poland – Moscow

The deficiencies of land-based transportation in the Baltic region, especially through Poland, were listed in previous chapters and mainly consist of frequent robberies on roads in Poland, huge delays due to long-lasting custom formalities, traffic restrictions at specific periods on roads in Poland and Germany and limited number of transportation quotas for trucking companies. However, probably the governing factor when choosing a transportation route has so far not been considered. It should be admitted that quality and safety factors in the Southern Baltic region so far were not considered equally with the tariff factor and in most cases the latter will determine the choice of route. This conclusion will make clear that Ro-Ro operators must be very careful when preparing a tariff policy even if they can also offer other great advantages. That is why this section will mostly be dedicated to a comparative analysis of land-based and Ro-Ro transportation tariffs during the last two years. I also think that before that it is a matter of great importance to be well familiarised with the cargo flows of the same period. During the last two years the Ro-Ro shipping line Kiel – Klaipeda faced several major impacts. The first one was when Euroseabridge (later Scandlines Euroseabridge) opened a competitive Ro-Ro shipping line Travemünde – Klaipeda and, owing to a successful

tariff policy, considerably reduced cargo flows on the Kiel – Klaipeda route. Another major factor and even greater than the first one was the Russian Crisis in August of 1998 when cargo flows decreased so enormously that the Ro-pax ferries "Kaunas" and "Vilnius" of LISCO sometimes were loaded to just 10-15% of their carrying capacity. From the below stated figures we can easily see how different types of cargo units were changing on the Ro-Ro shipping line Klaipeda – Kiel from January of 1999 up to the present time.

Table 12: Ro-Ro cargo flows on the Klaipeda – Kiel route

Mode of transport (%)	1998.01 – 1998.08	1998.08 – 1999.08	1999.08 – up to present time
Trailers	40	20	27
Trucks and lorries	35	57	46
Rolltrailers and containers	10	12	14
Passenger cars	8	6	7.5
Freight passenger cars	1	0.5	0.5
IMDG cargo	5	3.5	4
General cargo	1	1	1

Source: LISCO Statistics Database

Cargo flows in both the Kiel and Klaipeda directions were also determined. The figures stated below clearly show us that before the Russian Crisis transit cargo to Russia from Germany and Holland played a major part. After August of 1998 this cargo flow gave up its leading position for the cargo flows for domestic needs of Lithuania and Latvia.

Table 13: Ro-Ro cargo flows in the Klaipeda direction

Direction (%)	1998.01 – 1998.08	1998.08 – 1999.08	1999.08 – up to present time
Russia (GER)	27.5	12.0	18.5
Russia (NED)	20	10.5	12.5
Lithuania (GER)	12	19.5	17.5
Lithuania (NED)	9.5	16.5	12
Lithuania (DEN)	2.5	6	4.5
Lithuania (BEL)	1.5	4	3
Latvia (GER)	9	11	10
Latvia (NED)	6	8	6
Other	12	12.5	16

Source: various Cargo Manifests on board ferries "Kaunas" and "Vilnius"

The cargo flows in the Kiel direction did not encounter such dramatic changes. However, cargo flows from Latvia through the port of Klaipeda decreased due to competition with the Amber shipping line.

Table 14: Ro-Ro cargo flows in the Kiel direction

Direction	1998.01 – 1998.08	1998.08 – 1999.08	1999.08 – up to present time
Germany (LIT)	32	29	33
Holland (LIT)	24	22	20.5
Denmark (LIT)	10	12	10.5
Belgium (LIT)	9	10	8
Germany (LAT)	11	8	5
Holland (LAT)	9	6	5
Other EU	5	13	18

Source: various Cargo Manifests on board ferries "Kaunas" and "Vilnius"

I think it would also be very interesting and helpful to determine the ratio between the cargoes of different trucking companies transported by sea and land. According to the

data, given by several trucking companies that responded to the inquiry, the distribution during the last two years was as follows:

Table 15: Distribution of ro-ro units transportation by sea and land-based

Trucking company	Göllner Spedition			A.Griciaus ATI			Mitupe		
Period	98.01-98.11	98.11-99.11	99.11 up to present	98.01-98.11	98.11-99.11	99.11 up to present	98.01-98.11	98.11-99.11	99.11 up to present
Land-based (%)	39	33	22	59	50	33	80	66	30
By sea (%)	61	67	78	41	50	67	20	34	70

Source: individual interviews with the above stated companies

It should be noted that these data are very rough and must be considered with great caution and just for learning purposes. However, from the table above we can state that the distribution varies a lot depending on the trucking company. There are probably several reasons that can explain this situation:

1. These trucking companies transport cargoes that differ both by their cost and transportation peculiarities.
2. Financial capability of these trucking companies differs a lot.
3. Those trucking companies own very unequal number of trucks and trailers.

The first factor is obvious – expensive and perishable cargo always restricts the possibility to choose the route. The second factor can be explained with a statement that financially unstable trucking companies (like Mitupe) are forced to choose more risky transportation ways but at the same time – more profitable. The third factor states that major trucking companies (like Göllner Spedition) transporting huge amounts of cargo are able to sign contracts with Ro-Ro operators and get rebates up to 15 or even 20%.

On the other hand, Ro-Ro operators know very well their own advantages and difficulties that trucks meet transporting cargo on the land-based route (especially on the leg from the Lithuanian border to the Polish border) and therefore often raise their tariffs groundlessly. The table below reflects the LISCO tariff policy on the route Kiel – Klaipeda during the last two years.

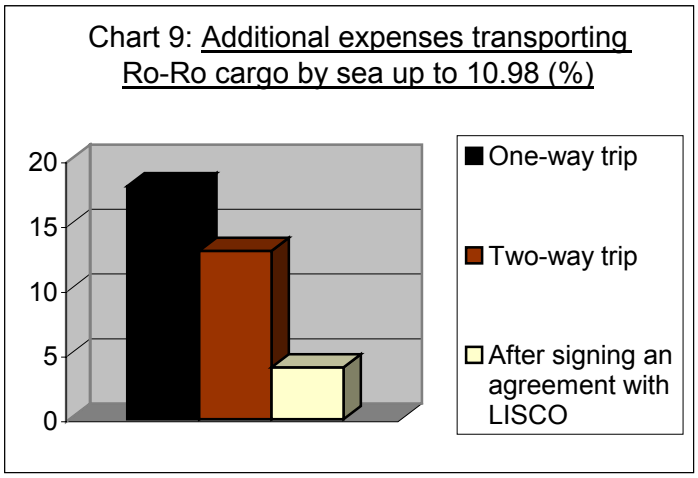
Table 16: Liner tariffs on the route Kiel – Klaipeda (in DEM)

Period		Up to 98.10	98.10- 99.12	From 2000.01	
Week day		1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4	5,6,7
Trailer/Truck	Per				
Loaded	commencing	74	63	65	69
Empty	lanemeter	47	42	40	40
Minimum per vehicle		-	-	530	565
Car	Per unit				
New		520	450	430	460
Used		260	230	220	230
20’ container on mafi	Per unit				
20’mafi					
Loaded		572	510	540	575
Empty		364	360	380	405
40’ container on mafi	Per unit				
40’mafi					
Loaded		1196	850	870	920
Empty		676	490	490	520
Drivers	Per person				
First		140	140	Free	Free
Second		210	210	210	210
General cargo	Per ton or m^3	104	80	70	70
Minimum		-	-	100	100
Surcharges	Per unit				
Refrigerator plug in el.		73	73	70	70
Refrigerator on diesel		31	31	30	30
IMDG		156	156	150	150
IMDG < 2500 kos		78	78	80	80

Source: http://shipping.lt

It is very easy to calculate that a one-way ticket for a 16 metre length truck up to November of 1998 cost DEM 1324 and only in this case if the aforementioned truck was standard, the cargo transported not dangerous or requiring electrical connection. It should also be noted that this price included transportation of only one driver. For the transportation of the second driver (which is very important on Western European roads because of strict regulations) the trucking company had to pay an additional amount of DEM 210. It is a matter of great importance to state that even though the Russian Crisis can be dated at August of 1998, the advance signals of possible Russian economy default were given long before when transit cargo flows and transportation tariffs to Russia dropped considerably at the beginning of 1998. As a consequence of that the cargo owner for transportation from Munich to Moscow was not ready to pay more than DEM 4800 – 5000, from Munich to Klaipeda – no more than DEM 2500. It is clear as a day that transportation by sea in this case takes a considerable amount of the trucking company's income. According to the data given by the aforementioned trucking companies, cargo transportation through Poland cost at least DEM 500 less. Therefore, the first conclusion can already be made that only those companies that are financially stable and never look for quick profitability, transporting expensive and perishable cargo can afford transportation of their trucks by Ro-Ro carrier. Such trucking companies, due to big shipments of cargo, are also able to get rebates up to 15 - 20%.

According to the same data provided by those trucking companies, the transportation of cargo up to November of 1998 from Munich to Moscow, for which the haulier was paid DEM 4800 – 5000, via the LISCO Ro-Ro carrier costing DEM 1324 for a one way ticket comparing to the road haulage through Poland, was DEM 650 more expensive. Both way transportation by sea resulted in additional expenses of 13% or DEM 480 each way. The hauliers that had signed contracts with LISCO were in a much better position but even their expenses were DEM 150 higher each way.



Source: individual interviews with different trucking companies

It should be noted that amortisation expenses were also included for the trucks that were moving through Poland. However, shipping companies should also bear in mind that the situation on the roads in Poland can get much better in the nearest future and, therefore, their chosen tariff policy must be very accurate.

The above stated situation lasted until October of 1998 when even the financially stable trucking companies, in order not to become bankrupt, declined the LISCO Ro-Ro carrier services and the shipping company realised that the current tariff policy lead to the deprivation of even constant transportation partners. The Ro-Ro ferries were filled to just 25 - 30% of their carrying capacity. Therefore, in late October of 1998, LISCO somewhat reduced the tariffs and for the truck of 16 metre length a one-way ticket cost DEM 176 less than before. This rebate at least aimed to retain the shipping company's major customers. However, the situation developed in a completely different scenario than was expected because of invasion of Scandlines AG Ro-pax ferries on the Southern Baltic routes. Due to a fierce competitive struggle with Scandlines AG the cargo flows through LISCO Ro-pax ferries further reduced even though Scandlines AG admitted that their tariffs were cut to the break-even level. Obviously, neither LISCO nor Scandlines AG were happy about that complicated situation and the only advisable thing for these

companies was to enter a conference co-operation and convert the Travemünde – Klaipeda and Kiel – Klaipeda operations into one route Kiel – Klaipeda. That was implemented on the 1st November, 1999 and, according to Scandlines Annual Report 1999, lead to an improved, more competitive service offering a high frequency. The tariffs for the Kiel – Klaipeda Express line were revised again and according to the latest figures, a one-way ticket for a 16 metre truck including driver costs DEM 1040 from Monday to Thursday and DEM 1104 during the weekends. It is worth mentioning that the cargo flows transported by sea grew considerably and currently Ro-Ro ferries on this shipping line are filled up to 85%.

Another new line was opened by LISCO and Scandlines AG between Klaipeda and Travemünde served by the Ro-Ro ferry "Panevezys" and was greeted by customers with great enthusiasm. However, many trucking companies are afraid that with the Russian economy recovery in the nearest future the tariffs can be raised once again.

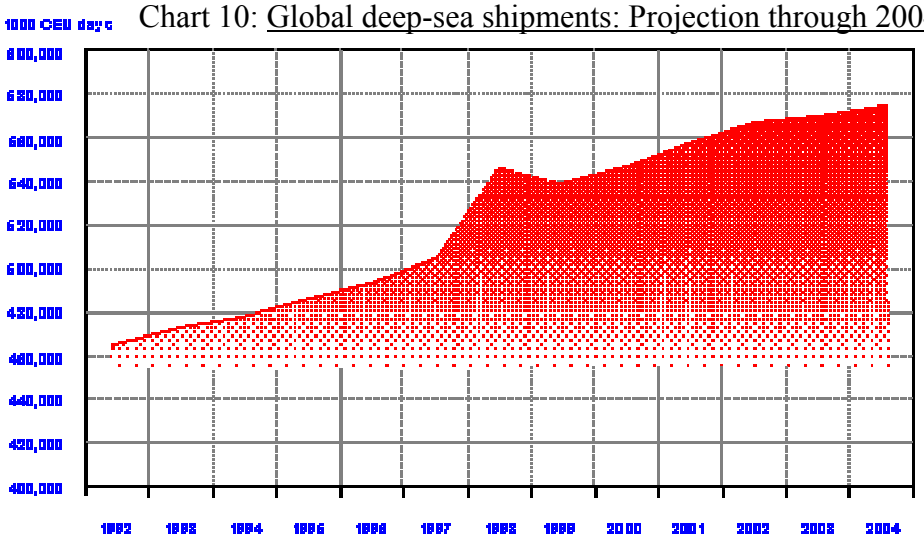
The recommendation for both shipping companies in this situation would be to bear in mind that up to 600 trucks cross just one border post between Lithuania and Poland and still a lot can be done to turn a part of this cargo flow to utilise the above stated shipping lines. Therefore, in the current situation tariffs by no means should be raised but proper advertisement campaigns should be carried out and additional vessels must be put into service simultaneously.

5.4 Future developments of the Ro-Ro market in the Southern Baltic

I think that instead of going straight to the point – the Southern Baltic's Ro-Ro market, it is worth analysing what is the current and on-coming situation in the global Ro-Ro market. I also think that a brief description of current trends in this very specific market will be very helpful to compare and define the specific character of the Baltic Sea region.

According to Christopher Pallson (2000, p.46), the Ro-Ro market is more a set of markets, where liner (or short-sea) shipping, integrated industrial shipping and deep-sea vehicle shipping, i.e. PCC/PCTC, are distinguished. The modern PCC/PCTC vessel was introduced in the middle of the 70-ies and the fleet at the end of 1999 consisted of 383 vessels with a total capacity of 1,7 million CEU. According to Fairplay (2000, p.36), in both 1998 and 1999 capacity corresponding to about 8% of the existing fleet has been delivered and the same proportion between new buildings and existing capacity is expected in 2000. However, it is reported by Fairplay (2000, p.37) that the average fleet age is about 13 years and the proportion of scrapping candidates is rapidly increasing – the vessels older than 20 years account for 13% of the combined capacity at the end of 1999 – increasing to 22% by 2001. However, the situation is not so tragic, especially if we look at the global deep-sea shipments forecast for the next 5 years.

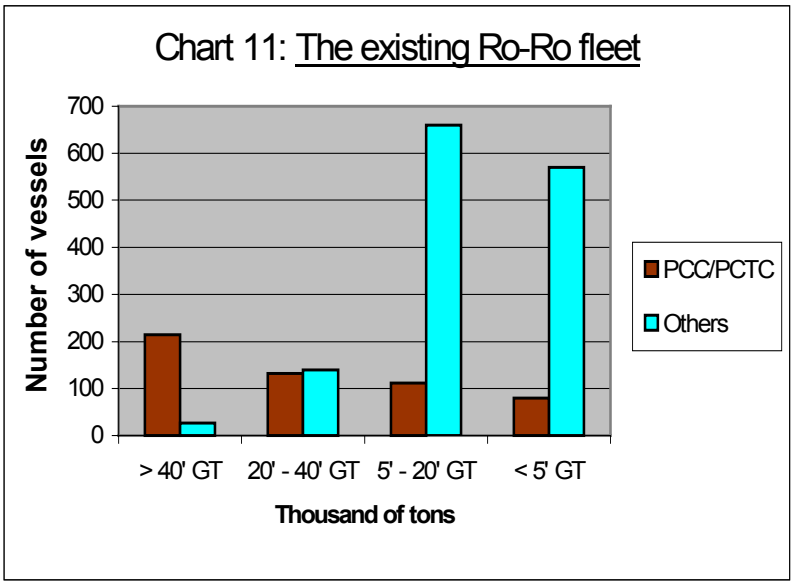
Chart 10: Global deep-sea shipments: Projection through 2004



Source: Fairplay

Industrial shipping should be understood as an integrated part of an industrial manufacturing and distribution process. Based on long-term contracts it isolates itself from the changes in capacity utilisation. It should also be noted that this service is mainly provided by highly specialised vessels and, therefore, the availability of such types of vessels in the spot market is very limited.

According to airplay's ships' register, more than 1930 Ro-Ro ships exist in the world at this time. It is also stated that about 73% of those vessels are smaller than 20.000 gt and as much as 40% of the total number of Ro-Ro ships were delivered more than 20 years ago.



Source: The Scandinavian Shipping Gazette

According to the Institute of Shipping Analysis (2000, p.47), estimations show that short-sea shipping account for a good 35% of the total intra-European volumes of transportation of goods. However, even though the growth is positive, large tunnel and bridge investments have held the seaborne share of the total back.

The Baltic Sea region is still under the effect of duty-free sales abolishment. As it is utopian to believe that heavy subsidies for ferry companies could be introduced, many of

them are trying to reorganise themselves and looking for new routes to non – European Union countries or for expansion of already existing ones. Therefore, it is highly anticipated that traffic to Poland will increase in the next years and several shipping lines to the Baltic States will be opened.

Another great issue worth serious discussion is fierce competition between the ports. According to Shippax Statistics 2000 (2000, p.72), a new leader should appear in a few years in Western Europe. Brilliant perspectives are forecasted for the ferry terminal in Mukran (Sassnitz) although so far Sassnitz has been failing to attract additional cargo volumes due to the intense competition from the port of Rostock. However, the article states that the decisive factor in this story will be the building of an Autobahn to and through Stralsund that will ensure Mukran terminal the name of the most important ferry hub in the Baltic.

It is also stated that Finnlines on the Finland route have almost reached a monopolistic situation. Scandlines AG could also reach a similar situation in this summer when, after purchase of LISCO, it could have its own monopoly from the main German ports to the Baltic states and all the transit cargo flows to Russia. However, even though the privatisation process of LISCO is not finished yet, it seems that another Scandinavian operator DFDS Tor Line is entering the Baltic market (being a part of consortium of B.B. Bredo that was chosen by the Lithuanian privatisation agency to acquire a 75% stake in the country's largest shipping company, LISCO). It is worth mentioning that DFDS Tor Line has already reported that they are looking at this area with great interest and it seems that the Russian economical recovery can make us the witnesses of very interesting further developments in the Southern Baltic market. There is only question that still remains open – will we see again a very fierce competitive struggle or a conference partnership?

It is also obvious that the land-based infrastructure in the post – communist countries is getting much better and will be even more improved after the TINA project will be implemented. Therefore, there is no doubt that most of the Ro-Ro shipping companies understand that competition with land-based transportation is a very costly procedure. It goes without saying that more and more examples of incorporation of Ro-Ro routes into the intermodal transportation chains will be seen in the nearest future.

After the abolishment of duty-free sales and sharp reduction in passenger numbers, ferry companies were attempting to plug the hole with a mixture of new products in the shops and large increases in ticket prices. However, after this shock some of them already reorganised themselves and according to Motor Ship (1999, p.32), in the nearest future in the Southern Baltic we can also see a swift movement towards offering customers a total transportation package by the addition of road transport companies and port cargo handling facilities to their operations. Another direction that was chosen by owners of Ro-pax vessels is travel agency service activities via their own ferries. Currently, Scandlines AG and TT-Line already offer a variety of trips and it is generally thought that positive results will be achieved.

CHAPTER 6.
Conclusions and recommendations

Having started almost 150 years ago with just one rail ferry, today's Ro-Ro transportation system, counting a bouquet of more than 120 ship designs, 10 types and even greater number of Ro-Ro transportation units, clearly shows that it has come to stay. However, the technological research of Ro-Ro transportation in the Southern Baltic carried out in this dissertation makes it possible enabled to draw the following conclusions:

- Even though only four main types of Ro-Ro ships are operating in this area, each of them looks for more universality and tries to be attractive to as many Ro-Ro units as possible.
- Naval architects designing the Ro-Ro ship for this area face a lot of conflicting requirements from shipowners. The main factors governing today's Ro-Ro design are:
  a) High degree of overall safety. However, an investigation made shows that the Stockholm Agreement appears to be unrealistically stringent and the inconsistencies between it and SOLAS 90 are certainly not in favour of Ro-Ro operators. It also remains unclear whether the new regulations will apply to freight Ro-Ros in the nearest future.
  b) Environmental considerations.
  c) High flexibility for later conversions to whatever extent. Conversion of Ro-Ro ships is also considered to be a cost effective, economical and quick way of increasing a ship's capacity.

  Particular attention nowadays is also paid to cargo access equipment, which has a crucial effect nowadays for quick turn around of ships in ports.
- It is of a vital importance for a Ro-Ro terminal to choose the right type of cargo handling equipment, which could ensure quick and efficient cargo handling operations. The crew on board a Ro-Ro ship should also be well familiar with all steps of Ro-Ro transportation in order not to cause damage to the cargo and raise customers' dissatisfaction.

The commercial research of Ro-Ro shipping line setting-up concludes that Ro-Ro transportation regarding modal competition has brilliant perspectives in the Southern Baltic and mainly points out the steps that should be taken in establishing a new shipping line in this area, which consists of three major types of analysis:

- Analysis of trade between the states and liner shipping activities.
- Ascertainment of shipping line service conditions.
- Calculation of Ro-Ro shipping line optimum scheme.

The role of ports in Ro-Ro shipping line setting-up is more than important. However, today possibilities of changes in legal matters and traditions, customs and other conditions between the ports in the western part of the Southern Baltic on the one hand and between the ports in the eastern part on the other hand are rather similar. Therefore, the main factors influencing the setting-up of a new shipping line are transportation price, time and safety. Research clearly showed that the setting-up of a new Ro-Ro shipping line is rational if its efficiency is at least 15% higher than in the previous one. The deficiencies in the work of Port Authorities, stevedoring companies, customs and border officials are still a very common problem in this area, which should be eliminated in the nearest future, ensuring a sufficient level of co-operation between port operators, highly supported by such computerised systems as TOMaS (Terminal Operating Management System).

Even though it is generally stated that today requirements for a Ro-Ro terminal are minimal, its design, layout and access equipment should be calculated so that it could highly support the Ro-Ro ship operator in cargo handling operations and minimise the vessel's turn around time in the port.

Research into the Ro-Ro market in the Southern Baltic shows us that this area is considered not only as very specific and different from others but also a region of potential growth and need for Ro-Ro transportation in the nearest future. Even though the order book stood at more than 100 vessels world-wide in 1999 and the average speed of Ro-Ro vessels has approached 20 knots, there is still plenty of room

in this area for new comers with different types of ships, which is perfectly illustrated by the anticipated introduction of Superfast ferries next year. There are several major carriers, such as Scandlines AG, Finnlines Group and smaller ones – LISCO, Polferries, TT-Line, Easy Line, etc. in this area that in most cases up to the present time have been facing a fierce competitive struggle between them or from land/based transportation hauliers and fixed links. However, the tendency to acquire competitors or enter with them into conference co-operation is very common nowadays and it is thought that only few players will remain in this market in the nearest future.

Another very interesting alternative – perspectives of Ro-Ro transportation in the east – west direction being incorporated into the intermodal chain - was investigated and recommendations for Ro-Ro operators can be given that suggest instead of choosing a fierce competition with land hauliers, to co-operate for incorporation of Ro-Ro shipping lines into the intermodal transport chain and concentrate their attention towards the quality of the services.

Research of Ro-Ro transportation on a particular route is concluded with the statement that in the Southern Baltic area the tariff factor is much more important than quality and safety factors when choosing the route and, therefore, Ro-Ro operators must be particularly careful when preparing their tariff policy. In the present situation the recommendation is given to shipping companies operating in the east-west direction in this region not to raise the current tariffs, but instead to carry out proper advertisement campaigns because calculations show that there is still a great possibility to attract new Ro-Ro cargo flows that have never used a sea-leg as a part of their transportation chain. Finally, the future for Ro-Ro transportation in the Southern Baltic is seen in offering freight customers a total transportation package by the addition of road transport companies and port cargo handling facilities to their operations and passengers – a variety of travel agency services.

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APPENDIX A

Specific items of Ro-Ro ships design

1. Hull and structure

In choosing a vessel's hull and structure a lot of attention is paid to the requirements presented by the shipowner, who usually looks for a certain speed, deadweight, fuel economy and seakeeping ability. Besides those stated above, there are always a lot of additional requirements and specifically for the Ro-Ro type – large deck areas with the greatest possible width and length, large openings at bow and/or stern with ramps and doors upon them. The main deck is required to be located very close to the waterline. There are also a lot of other more detailed requirements for hull and structure but all of them, as well as the above stated, must comply with perfect ship's manoeuvrability that in ordinary weather conditions will not be assisted by harbour tugs. The latter is well achieved by incorporating in the vessel's hull a sufficient number of bow and stern thrusters and developing of twin-skeg afterbody which guarantees better stability, leads to lower power requirements, reduces tendency to trim by the stern and extent of vibration. According to Fairplay Publications (1985, p.88), vibration of single screw vessels can also be minimised by allowing very generous propeller tip clearances in conjunction with excellent flow to the propellers. Another solution for that problem was found when the highly skewed propeller was specially designed to minimise cavitation and vibration. There is no doubt that the above stated inventions greatly improved a ship's efficiency but also increased cost of new-buildings. Another issue closely related to Ro-Ro ships and worth discussion is the forepart that in most cases is equipped with a bulbous bow. The forebody is usually of U or V shape and, regardless which one is chosen, it can be combined with a bulbous bow. It is already tested and concluded that a U forebody takes priority over the V-shape for high speed Ro-Ro ships. A completely different story arises when additional stability is required – a V formed forebody is used because of its higher initial stability.

Considering the hull form we should admit that naval architects have done their best to meet the shipowners' requirements and sometimes designed the ships with very strange hull forms. In order to increase deck area the ships with the main deck some metres above the draught were built and, according to Fairplay Publication (1985, p.90), at the design draught the hull was canted out to meet the main deck, which also ensures rather stable GM irrespective of draught. Another tendency common for most Ro-Ro ships is a very large bow flare that gives as much cargo or passenger cabin area as possible. The bad side of these ships, as was mentioned before, mostly is much higher new-building cost compared with Lo-Lo ships.

2. Access equipment

It goes without saying that every shipowner of Ro-Ro ships tries to minimise the hours spent in harbour as much as possible. However, that is very dependent on how the ship and terminal are fitted to carry out cargo handling operations. Therefore, this section will be dedicated to the very important parts of the design of Ro-Ro ships – internal and external access equipment.

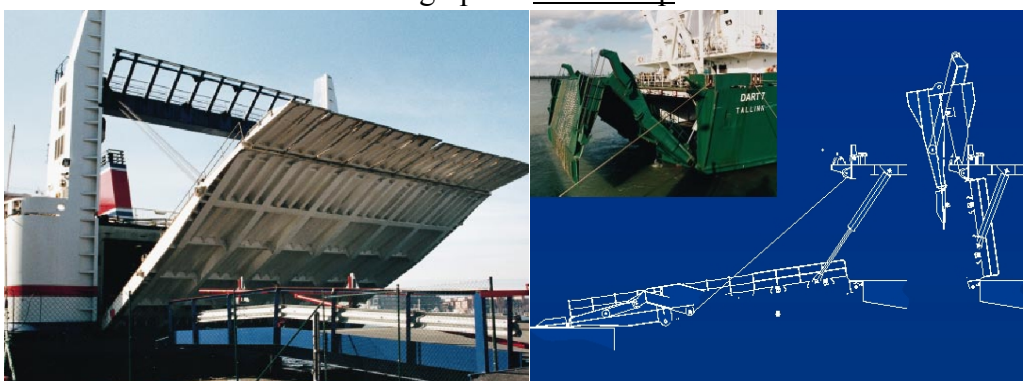
It should be noted that access equipment varies as much as different types of Ro-Ro ships. Those ships can be equipped with ramps or doors either at the bow, stern or side of the ship or have several of them at the same time. The vessel's decks are usually connected with internal fixed and foldable ramps or lifts. Access equipment is also very important because the lack of universality can even limit the area of trading and exclude some ports. The other great problem arising nowadays is the low level of ships' access equipment standardisation. Nevertheless the most common types can be systematised and those are stated below.

Stern ramps

This type of ramp is one of the most common nowadays. Ro-Ro ships can possess ramp access either to the main or upper decks. Michael Grey in Fairplay Publication (1985, p.62) states that in the latter case it is a common thing to divide stern entrance into two halves. The port side leads to a short ramp to the upper deck and the

starboard side to a similar short ramp to the lower main deck. Another issue worth discussing is the length of the stern ramp. Usually its length varies from 8 to 12 metres and tightly depends firstly, on tidal changes and secondly, draught variation of light and loaded Ro-Ro ships (up to 5 metres for very large Ro-Ro vessels but in most cases not more than 2 metres). It is well-known that tidal variations in the Baltic Sea are minimal and therefore there could hardly be any reason to lengthen it up to 20 metres for vessels operating in Baltic. Another very important factor when choosing the ramp is its width. It goes without saying that it must be calculated very wisely paying a lot of attention to the type of vehicle the vessel will carry because that can have a crucial effect on the speed of the cargo handling operations. There are some standards for a single lane ramp width – 5 to 6 metres and for two-way lane – 8 to 10 metres. There is a tendency nowadays to build the widest possible ramps and if the strength problem arises because of that, it is common to split the ramp into two or three sections where each of them is separated by a dividing post. Another way to enlarge the stern entrance of the ship is to equip it with two or even three ramps leading to the different decks. The shipowner should also be aware that building of wide ramps could create such problems as slamming or protecting the cargo from damages because of water entering. When the ramp is in closed position it performs the function of the watertight door. The deployment of such a ramp usually takes from 3 to 25 minutes and is being done by two hydraulic cylinders on either side or by wires and winches. However, a conclusion was made by HarmworthyKSE naval architects that regardless of which type of stern ramp is used, it must be designed with the correct length to meet optimum operational requirements in terms of the vessel's relevant dimensions and range of quay heights it will serve.

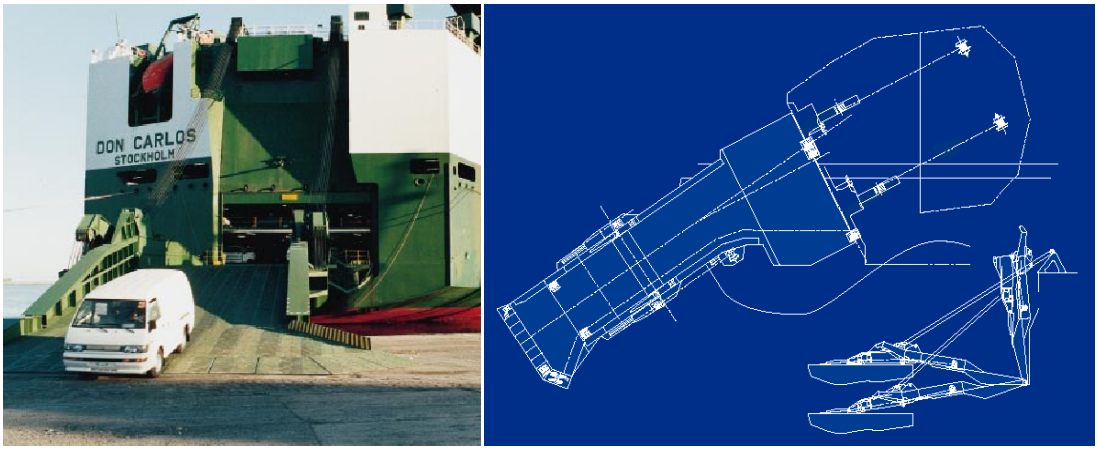
Photograph 9: Stern ramp



The quarter ramp

After this type of ramp was first seen on Japanese coastal car carriers in the late sixties, a lot of Ro-Ro ships, especially in Scandinavia, were equipped with that ramp construction. The main advantage using this structure is that the vessel is able to moor on a simple conventional berth and highly specialised terminal facilities are not required. Usually the quarter ramp consists of the main section, second section and the flap. It is common practice to design those sections in such a way that the slope in normal working conditions wouldn't exceed 1:8 (7.1º). It is worth mentioning that even though the total weight of such a ramp usually exceeds 400 tones, the whole system is designed to absorb most of the weight of the ramp and heavy cargo. Therefore, the load on the quay is usually no greater than 3.5 tons per m^2 and no specifically strengthened berth areas are required. Quarter ramps in closed position also act as a watertight door and deployment of such ramps usually takes more time than stern ramps but generally never exceeds 30 minutes.

Photograph 10: Quarter ramp



Slewing ramp

The deficiencies of the quarter ramp, which lets the vessel moor just on the one side (mostly starboard) highly restricted shipowners' flexibility in choosing the ports and, therefore, tightly tied the vessel to a limited number of ports to be served. The solution for this problem was found when the vessels started being equipped with the slewing ramps, most of them capable to slew to port, starboard or even work stern-to.

Another variation of this ramp offering better flexibility was the development of the semi-slewing ramp. Such vessels were usually equipped with two of those semi-slewing ramps that could work either stern-to or slew 33° to port or starboard. The natural gap, which appeared between them was filled by the spine holding two triangular ramp sections. It is worth mentioning that the development of this type of ramp is a continuing process and other interesting alternatives have already been invented.

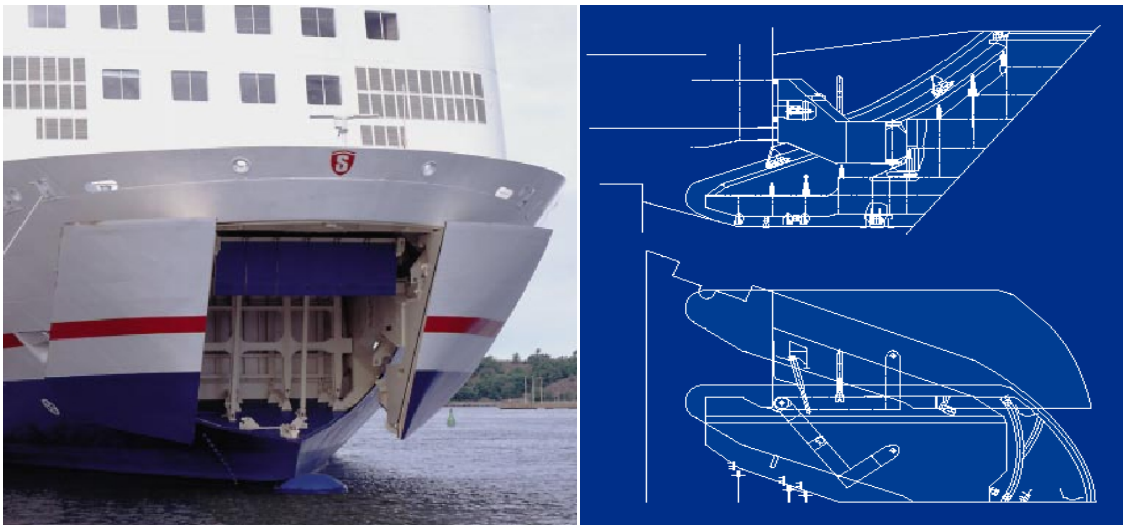
Bow access

Ro-Ro vessels having bow access are in most cases equipped either with clamshell or visor arrangements. Even though the latter is much more popular nowadays both of them have certain advantages and disadvantages against each other. The main advantage of a clamshell arrangement is that it is much less vulnerable to heavy swells damage. However, having this equipment on board a problem of watertightness arises sharply. The solution for that is an additional watertight door – ramp behind the bow combined with cleating arrangements. Another disadvantage of a clamshell arrangement is that the ships with that equipment need much more free space for mooring. It is worth mentioning that a visor arrangement has proved itself well on short-sea routes where the shape of the bow or stern is used as a “wedge” to ensure quick mooring. Therefore, despite the above stated vulnerability to heavy swells, the visor arrangement is much more popular in the Baltic Sea for the vessels having bow access. Another problem related to the bow access is the necessity to extend the ramp beyond the ramp extremity, which divides the ramp into several sections. However, Fairplay Publication (1985, p.70) concludes that in most cases a bow door is the visor type in which a section of the bow is lifted vertically or rotated to reveal the bow ramp or door.

A new invention on clamshell arrangement by HamworthyKSE for which patents are pending, is the side shifting bow door that consists of two box construction steel sections, which open to either side of the door aperture by means of two guide arms

incorporated into the structure of each. The company states that both weather and sea forces act perpendicularly all round the periphery of the door on to the sealing system so that none of the hinges or its bearings are affected by any forces. There are also no manoeuvring devices in this region of the door structure and, therefore, it can be built stronger and in a more effective manner.

Photograph 11: Bow access – clamshell arrangement

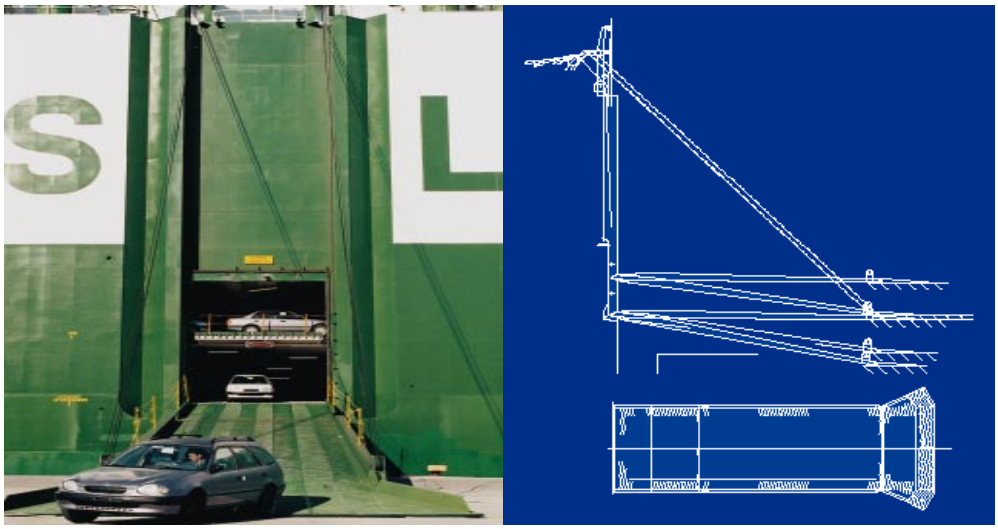


Side ramps

It should be noted that in the Baltic Sea region it is not very common to load/discharge Ro-Ro cargo through side ramps and in most cases it is just used to serve the passenger cars. Despite the fact that there is a number of ferries equipped with such ramps, Fairplay Publication (1985, p.71) categorically states the fact that vehicles entering and leaving a ship at right angles to the longitudinal can encounter serious problems and, therefore, equipping a vessel with side ramps is much more reasonable for huge ocean Ro-Ro carriers. These usually have two starboard or port ramps – one near the bow and another near the stern that can operate at angles up to 10° from the horizontal. Some vessels having the side access can load/discharge Ro-Ro cargo only in conjunction with shore gangways. In view of the above stated it is clear why this type of access is not so popular nowadays in the Baltic sea region and

the main disadvantage of it is certainly that the ship is very tightly tied to particular ports.

Photograph 12: Side ramp



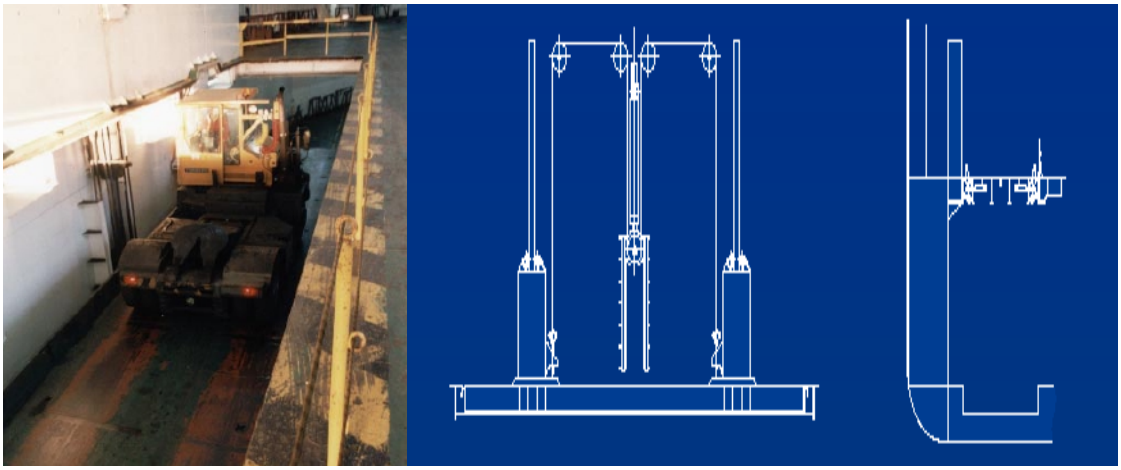
Internal ramps and elevators

Internal access in Ro-Ro vessels is basically provided by fixed or hoistable ramps and elevators. The main purpose they serve is transferring cargo vertically between the decks. Despite the above stated principal methods are used, each of them certainly has a few advantages and disadvantages. Using an elevator, the rate of cargo operations slows down considerably. On the other hand, using internal fixed ramps a lot of space is wasted. Therefore both methods of cargo moving between the decks will be briefly described separately.

There are several types of most commonly used elevators. The first and the oldest one is wire operated. However, it had a lot of deficiencies regarding safety, lifting capacity and working intensity. The second generation of elevators was scissor lifts that had several advantages against wire operated lifts and the main one of them was that this type of lift could be easily operated by hydraulic rams and did not need any guide. The cargo could also be stowed on the lowered lift during the voyage and, consequently, no space was wasted. The third type of elevators is the chain operated

lift. It is rather similar to the wire operated but its construction corresponds much better with the safety regulations. The fourth type of elevators used is the cantilever type that is supported only on one side. That allows Ro-Ro cargo to access the elevator platform in three directions.

Photograph 13: Internal elevator



As was mentioned before, internal ramps can be either fixed or hoistable. However, despite different types of construction both must respond to several requirements of safe and smooth Ro-Ro cargo handling operations. The angle between the deck and ramp usually can vary between 6.5 and 10 degrees and is highly dependent on the type of vehicle the vessel is intended to carry:

Table 17: Angle between the deck and ramp

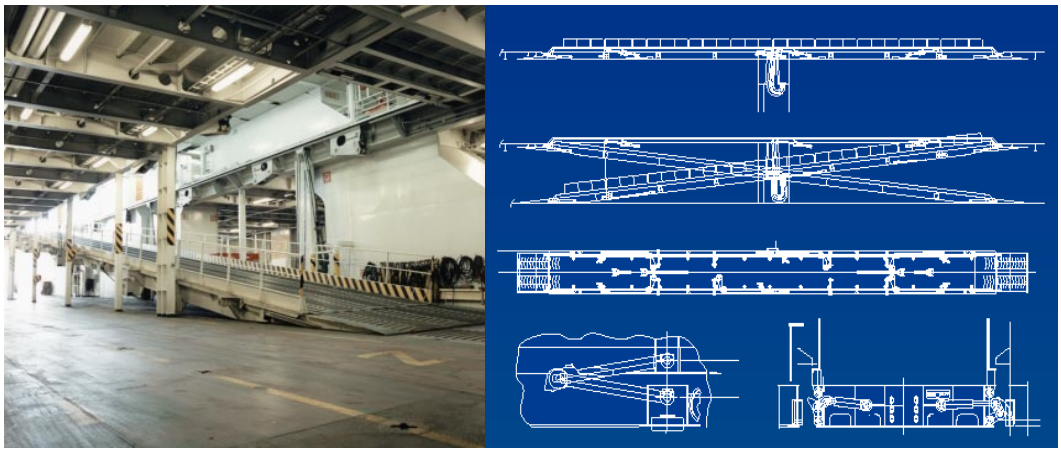
Type of car	Maximum slope
Private car	8.0 – 9.5º (1:6)
Trailer	7.1º (1:8)
Translifter	5.7º (1:10)

Source: HamworthyKSE

Another very important thing is the surface of the ramp that becomes very slippery due to rain or icy weather conditions. The solution for this problem, in most cases, is found by welding a sufficient number of steel bands to the ramp surface. Another way to increase friction between the ramp and vehicle is to stick synthetic plastics to the surface of the ramp. As was mentioned before the main disadvantage of fixed

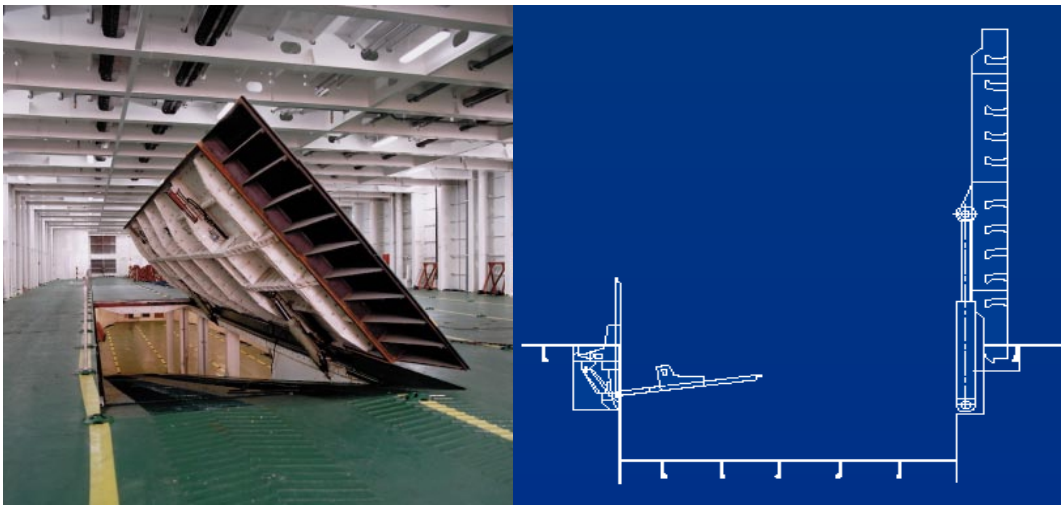
ramps is that too much space is wasted. Therefore, equipping the vessel with hoistable ramps that can carry Ro-Ro cargo upon them during the voyage is an alternative solution. There are also a number of ships having even two internal hoistable ramps between the decks that eliminate the need to turn the vehicles around.

Photograph 14: Hoistable ramp



Another solution eliminating fixed ramp deficiencies are side or end-hinged ramp covers that close the opening above the fixed ramp. It is important to note that these covers, when closed, have the same load-bearing capacity as the deck itself.

Photograph 15: Side-hinged ramp



APPENDIX B

Statistics

Table 18: Ro-Ro trade between the states

Countries	Year	Passengers	Cars	Buses	Trailers	Trips
Denmark domestic	1997	16.613.417	4.964.654	44.268	890.295	151.577
	1998	21.641.542	7.570.903	59.168	905.849	453.259
	1999	24.499.980	9.284.529	63.816	1.064.243	436.192
Denmark - Germany	1997	9.402.854	1.363.758	59.934	300.980	44.037
	1998	9.260.900	1.413.927	57.045	311.367	44.298
	1999	8.088.181	1.369.744	50.972	305.795	44.273
Denmark - Lithuania	1997	-	-	-	-	-
	1998	-	-	-	21.500	-
	1999	-	-	-	15.000	-
Denmark - Poland	1997	94.915	12.364	361	8.351	558
	1998	106.395	13.941	370	7.659	554
	1999	108.981	13.108	426	7.672	532
Estonia domestic	1997	1.080.000	-	-	-	22.100
	1998	1.164.215	382.398	-	-	18.204
	1999	1.266.851	386.274	-	-	15.363
Estonia - Finland	1997	5.333.960	141.057	8.664	69.161	6.332
	1998	5.982.515	184.994	11.630	92.845	7.860
	1999	6.147.564	214.559	12.410	88.702	9.156
Estonia - Sweden	1997	316.772	24.219	872	24.987	868
	1998	377.823	29.623	1.104	29.100	1.547
	1999	436.275	27.695	1.427	32.930	1.359
Finland domestic	1997	-	-	-	-	-
	1998	1.535.251	555.770	1.753	18.744	610
	1999	1.646.734	578.277	1.591	18.811	604
Finland - Germany	1997	209.675	39.033	741	1.396	-
	1998	120.960	23.432	439	40.180	88
	1999	133.834	35.101	464	19.5121	86
Finland - Poland	1997	-	-	-	-	-
	1998	-	-	-	7.478	-
	1999	-	-	-	-	-
Finland - Sweden	1997	9.314.690	743.793	20.255	178.254	13.408
	1998	9.613.701	741.761	19.930	239.990	15.574
	1999	9.385.365	730.109	17.181	240.773	16.048
Germany domestic	1997	5.756.350	466.626	127	33.743	12.751
	1998	6.319.402	757.260	127	55.330	16.730
	1999	6.545.227	742468	-	56.109	18.876

Germany - Latvia	1997	-	4.241	-	8.693	-
	1998	-	3.730	-	9.000	-
	1999	5.737	3.526	2	9.482	202
Germany - Lithuania	1997	39.513	22.211	-	58.981	720
	1998	37.223	18.549	-	43.408	1.085
	1999	39.971	16.152	-	37.771	1.267
Germany – Poland	1997	94.591	-	-	-	918
	1998	82.478	-	-	-	731
	1999	102.115	-	-	-	797
Germany - Sweden	1997	3.078.765	482.047	14.672	509.529	14.530
	1998	3.065.517	498.754	16.457	605.750	14.699
	1999	2.779.783	479.441	13.009	649.389	15.429
Latvia – Sweden	1997	-	-	-	-	-
	1998	52.054	19.321	158	2.289	293
	1999	39.544	2.658	95	1.733	211
Lithuania - Sweden	1997	7.888	1.456	-	10.343	304
	1998	16.556	2.300	77	10.472	580
	1999	20.181	3.150	43	9.106	659
Poland - Sweden	1997	658.164	127.873	2.914	79.780	4.427
	1998	707.932	137.764	2.989	90.973	4.490
	1999	749.012	139.337	5.811	101.426	4.366
Russia - Sweden	1997	4.488	1.401	-	4.704	195
	1998	899	644	7	4.078	119
	1999	1.466	54	1	178	33

Source: Various issues of Shippax Statistics 1998 - 2000

Table 19: Ro-Ro cargo turnover in the Southern Baltic ports

Port	Year	Passengers	Calls	Cars	Trailers	Trade cars
Åhus, SWE	1997	-	152	250	9.200	-
	1998	2.631	189	-	8.684	-
	1999	4189	223	177	7268	-
Aarhus, DEN	1997	1.540.440	4.887	621.325	28.428	-
	1998	1.500.000	5.000	540.000	20.000	-
	1999	-	-	-	-	-
Copenhagen, DEN	1997	3.900.000	5.027	-	42.456	-
	1998	4.202.181	-	-	43.752	27.290
	1999	4.600.000	-	-	-	26516
Frederikshavn, DEN	1997	4.392.436	6.357	733.108	194.205	-
	1998	4.305.264	6.325	723.570	206.414	-
	1999	3.900.919	6.246	714.265	199.666	-
Gdansk, POL	1997	116.719	200	21.849	2.348	-
	1998	114.115	204	21.208	2.626	-
	1999	-	-	-	-	-
Gdynia, POL	1997	183.333	313	67.910	30.411	-
	1998	180.659	318	40.603	23.439	-
	1999	241.287	320	68.139	20.914	-
Grenaa, DEN	1997	718.459	-	155.696	41.800	-
	1998	558.749	1.281	129.573	37.213	-
	1999	365.845	1.481	86.680	23.801	1.084
Halmstad, SWE	1997	367.000	695	88.000	25.100	-
	1998	279.900	623	65.800	23.800	80.000
	1999	-	-	-	-	-
Helsingborg, SWE	1997	13.412.353	47.288	1.997.183	458.272	-
	1998	13.753.739	47.734	2.134.271	508.336	-
	1999	14.340.791	47.052	2.322.029	567.324	-
Helsingör, DEN	1997	13.302.254	-	1.900.228	335.798	-
	1998	13.657.135	-	2.149.582	375.962	-
	1999	13.968.490	-	2.249.826	418.403	-
Helsinki, FIN	1997	8.006.359	3.894	278.346	121.708	-
	1998	8.615.496	5.800	335.127	321.315	25.000
	1999	8.970.000	10.800	437.800	179.000	25.000
Karlskrona, SWE	1997	173.710	285	23.325	10.871	-
	1998	181.858	291	25.672	16.117	-
	1999	239.900	318	30.505	16.720	-
Kiel, GER	1997	1.909.560	-	249.334	125.649	81.682
	1998	1.829.412	2.032	240.947	115.095	73.425
	1999	1.188.057	1.397	176.156	101.651	43.710

Klaipeda, LIT	1997	70.120	-	-	159.300	-
	1998	76.117	-	-	133.137	-
	1999	79.105	-	-	89.600	-
Landskrona, SWE	1997	434.012	5.212	21.708	-	2.579
	1998	393.764	5.291	19.812	-	2.677
	1999	415.078	5.335	22.301	-	2.479
Lübeck, GER	1997	1.030.000	4.700	84.000	-	120.000
	1998	1.299.641	6.963	137.256	-	189.058
	1999	1.360.124	5.965	7117.414	330.471	159.549
Malmö, SWE	1997	5.200.000	22.360	305.000	190.000	7.540
	1998	5.295.881	21.952	354.606	202.709	6.040
	1999	5.183.594	21.789	304.317	199.765	9.235
Nynäshamn, SWE	1997	864.569	927	192.800	20.161	-
	1998	902.413	971	204.430	21.277	-
	1999	996.197	986	232.788	21.516	-
Oxelösund, SWE	1997	43.869	192	8.916	6.082	-
	1998	17.666	51	3.650	831	-
	1999	5.768	20	1.228	313	-
Riga, LAT	1997	-	123	14.850	-	-
	1998	-	-	-	-	-
	1999	44.045	250	6.807	8.070	-
Rostock, GER	1997	1.734.566	5.324	325.877	18.838	117.731
	1998	1.813.450	5.987	337.868	27.456	145.028
	1999	2.039.800	6.605	382.502	35.568	168.830
Ronne, DEN	1997	1.263.313	1.630	205.280	-	-
	1998	1.354.374	1.757	228.846	-	-
	1999	-	-	-	-	-
Sassnitz, GER	1997	97.824	571	32.193	15.265	9.818
	1998	997.230	2.916	176.462	10.804	37.623
	1999	948.851	2.753	169.022	-	-
Tallin, EST	1997	4.174.500	-	163.291	85.359	-
	1998	4.697.100	-	193.192	142.100	-
	1999	5.858.835	6.560	226.954	76.824	58.764
Trelleborg, SWE	1997	2.050.192	5.955	363.125	303.678	-
	1998	2.126.507	5.858	366.633	340.147	-
	1999	2.114.638	6.065	361.564	374.698	-
Varberg, SWE	1997	330.884	689	66.998	16.700	-
	1998	282.100	654	59.358	14.781	-
	1999	360.578	691	79.554	24.796	-
Ystad, SWE	1997	868.054	1.775	151.038	5.026	57.932
	1998	1.221.450	2.005	173.670	4.635	77.189
	1999	979.980	2.252	190.460	3.826	80.627

Source: various issues of Shippax Statistics 1998-2000

Table 20: Freight only Ro-Ro ships on order

Shipyard	Delivery	Owner	GT
J Barreras	04-Oct-00	Odiel Naviera	9.600
Constantza	01-Jul-00	French interests	4.500
Daewoo HI	01-Sep-00	Wilhelmsen Lines	45.000
Daewoo HI	01-Feb-00	Wilhelmsen Lines	45.000
Daewoo HI	01-Jun-00	Wilhelmsen Lines	45.000
Daewoo HI	01-Jun-01	Grimaldi Group Naples	52.000
Daewoo HI	01-Apr-01	Grimaldi Group Naples	52.000
Daewoo HI	01-Dec-00	Leif Hoegh	58.600
Dalian Shipyard	01-Jun-01	Stena Line	20.500
Dalian Shipyard	01-Oct-00	Stena Line	40.000
Dalian Shipyard	01-Nov-00	Stena Line	40.000
Damex Shipbuilding	01-Dec-99	Caribe Emp. Nav.	1.000
Esercizio	01-Jul-99	Builder's account	14.500
Esercizio	01-Dec-99	Builder's account	14.500
Esercizio	01-Apr-99	Builder's account	14.500
Esercizio	01-Sep-99	Builder's account	14.500
Esercizio	01-Jul-99	Builder's account	14.500
Esercizio	01-Sep-99	Stena Line AB	14.500
Fincantieri	01-Mar-00	Grimaldi Group Naples	56.642
Fincantieri	01-Dec-00	Grimaldi Group Naples	56.650
Flender Werft	01-Mar-00	Wagenborg Shipping	18.500
Flender Werft	01-Aug-00	Wagenborg Shipping	18.500
Flensburger	01-Aug-00	Und RoRo Isletmeleri	20.000
Flensburger	01-Nov-00	Und RoRo Isletmeleri	20.000
Flensburger	01-Aug-01	Und RoRo Isletmeleri	25.000
Flensburger	01-May-01	Und RoRo Isletmeleri	25.000
Gdynia Shipyard	01-Mar-01	B&N Nordsjofrakt	16.831
Gdynia Shipyard	01-Jan-01	Palkkiyhtyma	16.831
Gdynia Shipyard	01-Jan-02	Talcar	57.346
Gdynia Shipyard	01-Jun-00	Talcar	57.346
Guangzhou Shipyard	01-Mar-00	Norfolkline	13.000
Halter Moss Point	01-May-00	Foss Maritime (Seattle)	6.000
Hashihama Shipbuilding	01-Jun-00	Kawasaki Kisen (K-Line)	49.300
Hashihama Shipbuilding	01-Sep-00	Moller Singapore	52.200
Hashihama Shipbuilding	01-Dec-00	Ugland Autoliners	58.600
Honda Zosen	01-Feb-00	Kyodo Ferry	2.500
Imabari Zosen	01-Aug-00	Mitsui OSK Lines	55.300
Imabari Zosen	01-Sep-00	Mitsui OSK Lines	55.300
Jinling	01-Jun-01	Finncarriers	12.000
Jinling	01-May-00	Finncarriers	12.000
Jinling	01-Apr-00	Finncarriers	12.000
Jinling	01-Oct-00	Finncarriers	12.000
Jinling	01-Oct-01	Finncarriers	12.000
Jinling	01-Feb-01	Finncarriers	12.000

Kanasashi Zosensho	01-Jul-00	Mitsui OSK Lines	36.700
Kanasashi Zosensho	01-Jun-00	Mitsui OSK Lines	36.700
Mitsubishi HI	01-Jan-01	Toyofuji Shipping Co.	18.000
Mitsubishi HI	01-Aug-01	Toyofuji Shipping Co.	54.300
Mitsubishi HI	01-Nov-01	Toyofuji Shipping Co.	54.300
Miura Shipyard	01-Jun-00	Kyodogumi Kaiun	2.533
Naikai Zosen Corp	01-Feb-01	Feng Li Maritime Corp.	40.000
Naikai Zosen Corp	01-Feb-01	Feng Li Maritime Corp.	40.000
NASSCO	01-Jun-02	TOTE	n/k
NASSCO	01-Dec-02	TOTE	n/k
Peene-Werft	01-Jun-00	Scanscot Shipping Services	8.821
Peene-Werft	01-Jun-00	Scanscot Shipping Services	8.821
Peene-Werft	01-Dec-99	Syrian Nav.Co.	10.300
Peene-Werft	01-Mar-00	Syrian Nav.Co.	10.300
Shin Kurushima	01-Jun-00	Toyofuji Co.	19.000
Shin Kurushima	01-Apr-00	Mitsui OSK Lines	49.000
Shin Kurushima	01-Sep-00	NYK Line	54.500
Shina Shipbuilding	01-Jul-00	Cido Shipping	30.000
JJ Sietas Schiffswerft	01-Mar-01	Ernst Russ	18.400
Sumitomo HI	01-Jul-00	NYK Line	2.000
Sumitomo HI	01-Oct-00	NYK Line	52.000
Szczecinska Shipyard	01-Jul-01	Marsano Armatori	10.500
Szczecinska Shipyard	01-Dec-00	Marsano Armatori	10.500
Szczecinska Shipyard	01-Sep-02	Oskar Wehr	10.500
Szczecinska Shipyard	01-Sep-01	Oskar Wehr	10.500
Szczecinska Shipyard	01-Sep-01	Oskar Wehr	10.500
Szczecinska Shipyard	01-Sep-02	Oskar Wehr	10.500
Tsuneishi Shipbuilding	01-Nov-00	UECC (Norway)	21.200
Tsuneishi Shipbuilding	01-May-00	UECC (Norway)	21.200
Tsuneishi Shipbuilding	01-Mar-01	UECC (Norway)	21.200
Turkish Shipbuilding	01-Jun-99	Peter Dohle	4.000
Turkish Shipbuilding	01-Sep-99	Peter Dohle	4.000
Turkish Shipbuilding	01-Jul-00	Ferrostaal	4.000
Turkish Shipbuilding	01-Jul-00	Ferrostaal	4.000
Uljanik Brodogradiliste	01-Jun-02	Grimaldi Group Naples	37.200
Uljanik Brodogradiliste	01-Feb-02	Grimaldi Group Naples	37.200
Uljanik Brodogradiliste	01-Sep-01	Grimaldi Group Naples	37.200
Uljanik Brodogradiliste	01-Jun-00	Krupp Seeschiffahrt	37.237
Uljanik Brodogradiliste	01-Dec-00	Krupp Seeschiffahrt	45.000
Uljanik Brodogradiliste	01-Sep-00	Krupp Seeschiffahrt	47.000
Union Naval Valencia	01-Dec-00	Transmediterranea	10.500
CN Visentini	01-Oct-99	F Visentini	21.000
Yamanishi Zosen	01-Jul-00	Osaka Kochi Tokkyu Ferry	4.000
Yamanishi Zosen	01-Apr-00	Japanese interests	4.331
Zhonghua Shipyard	01-Dec-01	Dag Engstroem Rederi	22.000
Zhonghua Shipyard	01-Sep-01	Dag Engstroem Rederi	22.000

Source: Fairplay