Market study of the West African container shipping market

Lessons towards NileDutch for 2015

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Preface

This master thesis is written as part of the Master program "Shipping Management" which is part of the Marine Technology track Design, Production, and Operations at the faculty of Mechanical, Maritime and Materials Engineering at the Delft University of Technology in the Netherlands. The research described herein was conducted under the supervisions of Prof. Dr. E. Van de Voorde and Ir. J.W. Frouws on behalf of the Delft University of Technology. It was also in collaboration with NileDutch, Rotterdam. Ir. G. Van IJserloo was the supervisor on behalf of NileDutch, between January 2011 and March 2015.

With this work, I tried to push myself to the limits of my own abilities and pushed them even further to get the best out of myself. Challenges along the way did not hold me back, but empowered the drive for good work. My abilities of persistence and determination were my never abandoning companions. In my experience, nothing worthwhile has ever really been very easy. Nevertheless, it certainly has been worthwhile regardless how difficult it seemed.

To cite Calvin Coolodge: "Nothing in the world can take the place of persistence. Talent will not; nothing is more common than unsuccessful men with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent. The slogan, 'press on' has solved, and always will solve, the problems of the human race."

My personal learning curve along this process had a lot of resemblance with a logarithmic function. It started negativel as you are thrown in the deep, needing to find your way up, but during the steep slope of this learning curve, the acquired knowledge also worked positively for my motivation. The more flat gradient of the logarithmic function represents the urge to push further or try plan A, B, C, ad infinitum, though you will never get what you are looking for. You need to learn to let go. It goes without saying that it nonetheless took some pains to eventually finalise this master thesis.

I would like to take the opportunity to thank those people who spend their time and shared their knowledge for helping me to complete my thesis with the best possible result.

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Abstract

NileDutch's focus on container shipping is very recent. Nevertheless, the company has grown bigger in a short time span in the West African container shipping market. Because of this, their in-house knowledge and methods for doing market research in the container shipping market are limited and therefore subject to improvement.

NileDutch wants to anticipate to changes quickly in the West African container shipping market. Therefore, NileDutch needs to have access to up to date market information. Therefore, NileDutch wants to widen their in-house knowledge about the West African container shipping market. NileDutch also wants to learn more about market research methodologies in the container shipping market for the present and the future. They would like to get to know these market research methodologies and to see them being applied to the West African container shipping market of 2011 and 2015.

Objectives

The main objectives of this research are to identify market research methodologies and to apply them to the West African container shipping market for 2011 together with advice for the fleet of NileDutch in the West African container shipping market for 2015.

More specific objectives for the market research of 2011 are to identify the carriers and operators together with their container liner services, fleet, and strategy. The demand and supply for full TEUs of NileDutch and the entire West African container shipping market will be determined for 2011. The demand and supply for full TEUs by NileDutch for 2015 will be estimated.

Four scenarios estimate the supply of full TEUs by NileDutch for 2015.These four scenarios focus on high net results by minimizing costs and weekly sailing frequencies for which the minimum net freight rate needs to be known. Per scenario the fleet specifications are also given. A statement about the evolution of NileDutch's 2015 net freight rates in comparison with 2011 due to the changes in supply and demand is given.

Description of the methods used

Literature research, agency questionnaire, modelling, computer programs, and calculations are used in this research.

Summary of the market study results

In the West African container shipping market container volumes to West Africa, come from Asia, East Africa, Europe, the Mediterranean, North America, Oceania, South America, and from West Africa itself. Oceania does not trade directly with West Africa as they have second leg services to West Africa.

The West African container shipping market has 45 carriers and 36 operators. The three largest operator groups are Maersk group, CMA CGM Group, and MSC Group, Together they have a market share of 60%, which is more than half the West African container shipping market. MOL and Hamburg Süd complete the top five. The top five is almost three fourth of the West African container shipping market. NileDutch is located at position eight in the operators list with a market share of 3%.

The West African container shipping market of 2011 includes 112 liner services using 488 vessels, which represent 45 carriers. There are container liner services, ConRo liner services, and multipurpose liner services. NileDutch has six container liner services. Only the five largest carriers have more container liner services which are Maersk line, Safmarine, Delmas, MSC, and CMA CGM. The average container vessel in West Africa has a nominal TEU capacity of 2.650TEU, a 14 ton TEU capacity of 2.000 TEU and design speed of 21,1 knots.

Alphaliner (27/07/2011) provided data about the owned container vessels, chartered container vessels, orders and options per operator in the global container shipping market. Maersk Group MSC Group, and CMA CGM group represent the top three with a share of more than 50% in total nominal TEU capacity and amount of container vessels. The remaining operators in the top ten have shares between 3% and 6% in total nominal TEU capacity and amount of container vessels. NileDutch is ranked at position fifteen with a market share of 0,4%. Only the top fifteen operators have orders and options. Hanjin shipping, MOL and Zim have quite large orders. Hanjin and Zim increase their fleet by almost 50% when looking at their total nominal TEU capacity. Hanjin has orders for 32 container vessels and Zim for 13 container vessels. Maersk group has 20 orders and 10 options for the biggest container vessel in the world. These container vessels have a nominal TEU capacity of 18.000TEU.

Alphaliner (29/04/2011 and 02/05/2011) provides data about the liner services and vessels in these liner services. The five largest trades in the West African container shipping market based on the 14 ton TEU capacity shares are the Europe - West Africa trade (35%), the Asia - West Africa trade (25%), the inter West African trade (12%) , the Asia - East Africa - West Africa trade (12%), and the Asia -South America - West Africa trade (7%).

When it comes to strategy; the strategy of the competitors of the West African container shipping market can be subdivided in four groups: very large competitors, large competitors, medium competitors, and small competitors. In each group, the competitors try to achieve costs as low as possible. The larger competitors and especially those in the very large group are very focused on achieving low costs to stay the largest in the container shipping market.

The principal way to try to achieve low costs is to use the costs advantages of applying economies of scale. They used the largest container vessels possible to meet their share in the demand for TEUs in the West African container shipping market per trade. The larger the container vessels, the lower the costs per TEU. Instead of two small container vessels one should use one large container vessel as this results in lower costs per TEU.

Owned container vessels have the cost advantage of having lower long-term costs in comparison with chartered container vessels. Owned container vessels also give more stable cash flows. Chartered container vessels are used to benefit from favorable charter prices in comparison with the capital costs and operational costs of owned container vessels. Time chartered container vessels are also used to meet the demanded TEU capacities quickly in the fluctuating container shipping market. In contrast to NileDutch, each competitor has a more or less 50% - 50% balance between chartered and owned container vessels in terms of total nominal TEU capacity. NileDutch has a 5% share of owned container vessels versus a 95% share of chartered container vessels in terms of total nominal TEU capacity. NileDutch should be able to lower its costs per TEU by owning more container vessels. Due to the low new built prices of 2011 and keeping the long-term lower costs for owned container vessels in mind, the competitors in the large group, very large group, and NileDutch have orders and options for container vessels. The competitors in the two smallest groups did not have the finances to benefit from this.

Vessel sharing agreements or slot agreements also help in lowering costs per TEU or to benefit from opportunities in the container shipping market. Larger competitors have relatively more agreements in comparison with smaller competitors. The larger groups of competitors make agreements to improve the provided container liner services for the customers and to have lower costs per TEU when entering new markets or when a market is growing. Again the larger the container vessels the lower the costs per TEU. In case of a vessels sharing agreement or slot agreements these costs per TEU are lower in comparison with transporting the same amount of TEUs by a single vessels instead of sharing TEU space on a container vessels with another competitor. In general costs per TEU can be kept low by applying economies of scale, a good balance between owned and chartered container vessels, vessels sharing agreements, and slot agreements. Having low costs give a higher net result or can make a company more competitive in case of a price war in the market.

NileDutch solely focusses on the West African container shipping market. The other competitors are active in other regions of the container market, commodity-shipping market or non-commodity shipping market. As NileDutch is solely active in the container shipping market, they cannot spread their risks over other types of shipping or non-shipping markets in case the West African container shipping market is not doing well. Angola is very important to NileDutch as a significantly 57% of NileDutch's handled TEUs come from Angola. NileDutch faces big challenges in case container transport from Angola drops.

The very large competitors are aggressive first movers, the large competitors are first movers or fast followers, the medium size competitors are fast followers and the small size competitors are late movers. In general, one can say NileDutch is a first mover, but also a fast follower.

Being a first mover manifests itself as next. The company is internally organised in such a way that short decision times are possible when wanting to adjust to changes in the market. This is for example the case when chartering container vessels but also when putting up local agencies due to their experience. Their experience about operations and operational costs squeezes the operational cost margins. Their extended network in West Africa helps them arranging changes as their vast knowledge about local cultures, languages, the way of doing business, engagement with local players, personal relations, and meetings with local agencies throughout the year gives them the advantage and opportunity to obtain information and use it to their advantage. Due to these first mover advantages, they are able to anticipate and act ahead of market changes. Being a fast follower manifest itself on the commercial front as they do not have an in-house market research department. Their market information is mainly purchased or outsourced. There are websites which provided market information but these data are not processed and made available to all managers and directors. Their market information comes with a delay in time which prevents fast anticipation to market changes.

The West African container shipping market of 2011 has a supply of about 6.2000.000 full TEUs based on the 14 ton TEU capacities of the container vessels used. The trades with Asia and Europe turn out to have the majority share in the market. Combined they supply 60% of the TEUs in the West African container shipping market. The three biggest operators in the market are Maersk with a market share of 26%, MSC with a market share of 17% and CMA CGM with a market share of 16%. Combined, their share is 60% in the entire market. NileDutch is ranked at position 8 with a market share of 2,6%.

NileDutch's supply for 2011 is about 200.000TEU. For 2015, the supply is increased to about 290.000TEU – 325.000TEU. 51% for scenario 1, 55% for scenario 2, 47% for scenario 3, and 66% for scenario 4. NileDutch's demand for TEUs in the West African container shipping market has increased from about 150.000TEU to 220.000TEU between 2011 and 2015. This is an increase of about 45%. The net freight rate per TEU of 2015 has decreased by about 20% in comparison with 2011. 1.908,51 $/TEU for 2015 and 2.256,08 $/TEU for 2011.

The size of container vessels advised to weekly supply these TEUs to meet the demand are as follows for the first three scenarios: nineteen to twenty 2.000TEU – 2.200TEU container vessels in the FEWA liner service, seventeen 800TEU container vessels in the SWAX liner service, thirteen to fourteen 2.400TEU – 2.600TEU container vessels for the WEWA liner service, nine 1.000TEU container vessels for the ECSA liner service, three 200TEU container vessels in the Feeder 1 liner service, and five 1.000TEU container vessels in the Feeder 2 service.

The fleet advise for the fourth scenario providing weekly sailing are: twenty 2.500TEU container vessels for SWAX liner service, twelve 2.400TEU container vessels for the WEWA liner service, nine 1.000TEU container vessels for the ECSA liner service, Three 200TEU container vessels for the Feeder 1 liner service, four 300TEU container vessels for the Feeder 2 liner service, six 1.000TEU container vessels for the Feeder 3 liner service, and seven 1.000TEU container service for the Feeder 4 liner service.

Main conclusions and recommendations

The market research of the West African container shipping market of 2011 is obtained by applying partly Dynamar's market research approach to data from Alphaliner. In addition to Dynamars approach, data about the vessels used in the West African container shipping market and the strategy of the competitors in the market is added. The strategy of the competitors is determined based on the conceptual model and a portfolio model of Lorange (2005). This makes the knowledge about the vessels in the West African container shipping market and the strategy new to NileDutch.

Knowledge obtained by modelling the supply, demand and fleet for NileDutch for 2015 is new to NileDutch as well. The computer model made to obtain this knowledge is partly based on existing modelling methods, alterations to existing work, and new work. The computer model is positivelly validated. The statement about the supply and demand of NileDutch when comparing 2011 to 2015 is new to NileDutch as well. The forecasts and prediction made for 2015 are also new to NileDutch.

The most important recommendation for NileDutch is to set up a market research department inside NileDutch headquarters in Rotterdam, The Netherlands and to use consultancy firms every two to five years to carry out market research and advice NileDutch on strategy.

This is important for three reasons:

- Firstly, currently NileDutch does not have a market research department which makes their market information come with a delay as they use reports from Dynamar and Alphaliner. In addition, the market information that is available is distributed throughout various departments within NileDutch and each person interprets and processes this information for his own opportune reasons. It is not clear which person has which information and if, in case data are processed, reliable methodologies are used.
- Secondly, NileDutch in general is a first mover, but a fast follower when it comes to its commercial department. To become a first mover commercially fast access to data about changes in the market is required. Having an in-house market research department, this market information can be provided more quickly.
- Thirdly, even though consultancy companies are pricey, their experience, methodologies about market research, advice on strategy, and access to sources to which NileDutch does not have access outweigh the costs. Their work provides insights, which would not become clear in market research done by an in-house market research department. They are also good advisors when a company is in the process of determining or altering its company's future strategy. Consultancy firms might also ask thought-provoking questions the company had not considered previously.

For these three reasons, it is advisable for NileDutch to set up a market research department inside NileDutch headquarters in Rotterdam, The Netherlands and to use consultancy firms every two to five years to carry out market research and advice NileDutch on strategy.

Recommendations are also made to improve and expand NileDutch's knowledge about the West African container shipping market when doing more research and by improving the quality of the research and the computer model.

Other recommendations involve alterations and improvements of the computer models and the tool which generates the container vessels in the computer model. These are both technical improvements, data improvements, and modelling NileDutch's container transport chain more precisely.

1 Introduction

1.1 Background

NileDutch, founded in 1980, originally started as an agent to book vehicles on ConRo liner services between the Netherlands and Egypt. Their first ConRo vessel, chartered in 1984, transported vehicles from Rotterdam to Ghana and Nigeria. During the next twenty-five years, more ports were added to the ConRo liner service and more ConRo vessels were added to the fleet. In 2003, the first container liner service was introduced in West Africa. In 2004, the container liner service named ECSA (East Coast South America) on the South America - West Africa trade was introduced. In 2006 the FEWA (Far East - West Africa) container liner service on the Asia - West Africa trade was introduced. The Asian market increased rapidly so in 2009 the SWAX container liner service (South West Africa Express) was introduced in a consortium with NYK. Because of high exploitation costs and a changing market in 2009 it was decided to sell the five ConRo vessels in 2009 and 2010. From then on, their liner services were solely container liner services and in the Europe – West African trade the container liner service WEWA (West Europe – West Africa) was introduced. In January 2011, NileDutch accepted the request to join the Asian West Africa Trade Agreement (AWATA). In July 2011 they have three vessels of their own, one 1.300TEU container vessel and two 418 TEU feeders, three 2.500TEU vessels are used in a consortium with NYK, two 1.700TEU vessels are used in a consortium with Delmas (CMA CGM), fifteen container vessels with an average capacity of 2.000TEU are time chartered with an average short-term[1] time charter of about eight months for fourteen container vessels and a short-term time charter of three months for two container vessels. Four 3.500TEU Africa-Max container vessels are ordered at the Shanghai Shipyard in China. These are expected to be delivered in 2014 and 2015. When looking and NileDutch’s history it becomes clear that the focus on container shipping is only very recent and that the company has grown larger in a short time span. Therefore, their in-house knowledge and methods for doing market research in the container shipping market is limited and subject to improvement.

NileDutch wants to widen their in-house knowledge about the West African container shipping market. NileDutch also wants to learn more about market research methodologies in the container shipping market. Both for the present and the future. They would like to get to know these market research methodologies and see them applied.

NileDutch wants to anticipate quickly to changes in the West African container shipping market. Therefore NileDutch needs to have access to up to date market information. Because of this NileDutch wants to widen their in-house knowledge about the West African container shipping market. NileDutch also wants to learn more about market research methodologies in the container shipping market. Both for the present and the future. They would like to get to know these market research methodologies and to see them applied to the West African container shipping market of 2011 and 2015.

[1] Short-term shorter than a year

The aim of this master's thesis is to present market research methodologies and the results of these methodologies applied to market research of the West African container shipping market of 2011 together with advice for the fleet of NileDutch in the West African container shipping market for 2015.

This research is done by the use of literature research, an agency questionnaire, modelling computer programs, and calculations.

Chapter 1 contains the background of the problem that is researched in this thesis, the objective and the scope. Chapter 2 contains the results of the market research of the West African container shipping market of 2011. Chapter 3 describes how the computer model is obtained and how it works. Chapter 4 deals with the verification and validation of the computer model. Chapter 5 contains the results of the computer model, and chapter six contains the sensitivity analysis.

1.2 Objectives

The main objectives are to carry out a market research of the West African container shipping market for 2011 together with advice for the fleet of NileDutch in the West African container shipping market for 2015.

More specific market research objectives are to identify the carriers and operators together with their container liner services, fleet, and strategy. The demand and supply for full TEUs of NileDutch and the entire West African container shipping market will be determined for 2011. The demand and supply for full TEUs by NileDutch for 2015 will be estimated.

Four scenarios estimate the supply of full TEUs by NileDutch for 2015.These four scenarios focus on high net results by minimizing costs and weekly sailing frequencies for which the minimum net freight rate needs to be known. Per scenario the fleet specifications are also given. A statement about the evolution of NileDutch's 2015 net freight rates in comparison with 2011 due to the changes in supply and demand is given.

1.3 Scope

The market research will consist of information about the carriers and operators, which are active in the West African container shipping market of 2011. It will identify their carriers and operators as well as the group in which they take part. It will describe their container liner services in terms of port rotation schedules of the first leg ports, transshipment ports, and second leg ports for container trade with West Africa in 2011. It will describe their owned fleet, chartered fleet, new building projects, and options in the world container market of 2011. The type of vessels active in West Africa in 2011 taken from the carriers and operators' container liner services as well as what they look like will be described. A conceptual model and a portfolio model describe the strategy of each operator. The agreements between these operators and carriers will also be determined for the West African container shipping market of 2011.

A trip matrix expressed in full TEUs describes the demand for container shipping in West Africa for NileDutch in 2011 and 2015. The 2015 situation needs to be estimated by the use of ARIMA forecasting models and Monte Carlo Simulations with Weibull probability density distribution for the prediction intervals. Input values for the forecast are time series with monthly data from 2007 to 2011 of the Asia – West Africa: West and East bound, Europe – West Africa West and East bound, South America – West Africa East bound, and inter West Africa will be used. Next, the annual situation of NileDutch for 2011 and 2015 together with the estimation results obtained from a questionnaire sent to agencies will be compared with each other to discuss the findings.

The questionnaire was newly put together and sent to NileDutch's agencies in 2011 focusses on the year 2015. Firstly and most importantly, the questionnaire was sent to find out how the agencies estimate the full TEU volumes of NileDutch's container liner services to change by 2015 and which strategy the competition applies. Secondly, the questionnaire focuses on the important ports of loading and final ports of discharge in the future and its consequences on the number of full TEU volumes transported between these ports and the port of loading or final port of discharge. Other items the questionnaire covers, are the importance of price rates, frequency of departure, transit times, reliability of schedules, capacity availability, directs calls, and exchange rates by their customers. A question about the wishes and more specifically a wish for the door-to-door concept by the customers was added. Finally, the agencies were asked about protectionism in their country, the competitors they have to deal with in their country, how they see the freight rates of this competitors change by 2015, and if the competition is investing in new offices and new personnel.

The supply of container shipping will be expressed in full TEU capacities. The TEU capacities NileDutch deployed in the West African container shipping market in 2011 are based on the nominal and 14 ton TEU capacities of the used container vessels. The TEU capacities other operators deployed in the West African container shipping market in 2011 are based on the nominal and 14 ton TEU capacities of the used container vessels. The TEU capacities NileDutch needs to use in the West African container shipping market in 2015 will be based on the output of a computer model.

The objective of the model is to determine a fleet and by consequence the supply for the four different scenarios for 2015 with an as high as possible net result by minimizing the costs.

This computer model estimates the supply for TEUs for four different scenarios for 2015. The nominal TEU and 14 ton TEU capacities of the container vessels used to transport these TEU capacities will be specified as well as the vessel speed, average costs, and minimum required freight rate for transportation per trade and in NileDutch's West African container shipping market.

The statement about the evolution of NileDutch's 2015 net freight rates in comparison with 2011 will be done based on changes in supply and demand. The computer model mentioned above will only take into account the part of NileDutch's container transport chain between the terminals of the ports of loading and the terminals of the final ports of discharge for the full TEU flows. Input values for the computer model are cost and time data based on 2011 data. Another input are estimates of the full TEU volumes per trade and trade lane[2], net freight rate per trade and trade lane, the time charter rates, and bunker prices for 2015. These estimations are obtained by the use of ARIMA forecasting models and Monte Carlo Simulations with Weibull probability density distribution for the prediction intervals. The empty TEUs will be relocated to the ports where they are required to avoid leasing containers. The TEU flows are Asia – West Africa East and West bound, Europe – West Africa North and South bound, South America - West Africa East bound, and inter West Africa, so six TEU flows in total. In each scenario, container vessels are active in container liner services where they have to transport the amount of full TEUs of NileDutch's 2015 trip matrix. These container vessels are obtained out of a tool. This tool designs a container vessel in the preliminary stages of container vessels design due to the technical aspect of the master thesis. Per container liner service, there is a weekly sailing per port. The amount of container vessels, their size, and the container vessel's speed can be varied. The port rotation schedules of each container liner service are fixed. The aim is to transport all the full TEUs from NileDutch's 2015 trip matrix with the objective of having a high net result by minimalizing costs. The costs calculations are done in United States dollar. The computer model will take into account the congestion behaviour per port, average stuffing time per port, average striping time per port, and container handling times. In case of offshore bunkering, the additional time will be taken into account. The reference point will be the ports, fleet, the costs, and port rotation schedules of 2011. The Ports of Lagos Tincan and Lagos Apapa are located so close to each other that they are considered to be one port with the name of Lagos.

The first scenario in the computer model uses the forecasted full TEU flows of 2015 per trade and trade lane and divides these full TEUs volumes over the ports of loading and final ports of discharge in the same proportion as this was done in 2011. Therefore, the market shares stay

[2] Explenation trade and trade lane: a trade indicates between which region container shipping takes place. For example Asia – West Africa or Europe – West Africa. The trade lane indicates the direction of the container shipping such as north bound, east bound, south bound, and west bound. The combination of trade and trade lane result in Asia – West Africa, East bound, Asia – West Africa West bound, Europe – West Africa North bound, and Europe – West Africa South bound.

equal. The same turnaround schedules for NileDutch are used, as this was the case in 2011. In addition, the bunker places in the container liner services stay the same.

The second scenario is based on the first scenario but the port of Abidjan in Ivory Coast is added to the WEWA container liner service and the port of Xiamen in China is added to the FEWA container liner service. These ports are added to these two container services as NileDutch operations department expects container volumes going to these ports. To the port of Abidjan NileDutch operations department expects full TEU volumes will come from the port of Antwerp and the port of Le Havre. Between the port of Antwerp and the port of Abidjan NileDutch operations department expects there will go 1.000 full TEUs South bound and 1.400 full TEUs North bound in 2015. Between the port of Le Havre and the port of Abidjan NileDutch operations department expects there will go 1.000 full TEUs South bound for and 1.400 full TEUs North bound in 2015. From the port of Xiamen NileDutch operations department expects full TEUs to the port of Luanda. For 2015, NileDutch operations department expects there will be 500 full TEUs East bound and 3.000 full TEUs West bound. The bunker places in the container liner services stay the same, as this was the case for NileDutch in 2011.

The third scenario uses the forecasted TEU flows of 2015 for the import and export per region and divides these container volumes over the ports of loading and final ports of discharge in the same proportion as this was done in 2011. Therefore, the market shares stay equal. The same turnaround schedules for NileDutch are used, as this was the case in 2011. In addition, the bunker places in the container liner services stay the same.

The fourth scenario is based on the second scenario but adjustments are made in Asia and the feeder container liner services are different. There will only be one container liner service on the Asia – West Africa trade. The port rotation schedule will be Shanghai, Shekou, Port Kelang, Lagos, Tema, Luanda, and Shanghai. Bunkers will be taken in Port Kelang. There will be four West Africa feeder container liner services. Their port rotation schedules will be West Africa feeder 1 container liner service (WAF1 container liner service): Lagos, Cotonou, Tema, and Lomé. Bunkering will take place in Tema. West Africa feeder 2 container liner service (WAF2 container liner service): Lagos, Douala, Libreville, Pointe Noire, and Lagos. Bunkering will take place in Offshore Pointe Noire. West Africa feeder 3 container liner service (WAF3 container liner service): Luanda, Soyo, Matadi, Boma, Cabinda, and Luanda. Bunkering will take place in Offshore Luanda. West Africa feeder 4 container liner service (WAF4 container liner service): Luanda, Lobito, Namibe, Cape Town, Durban, and Luanda. Bunkering will take place in Offshore Luanda

In Lagos, there will be two feeder container liner services. One will go to the port of Cotonou and the port of Lomé. The other one will go to the port of Pointe Noire. In Luanda, there will be a feeder container liner service to the port of Lobito and the port of Namibe.

Earlier a tool was mentioned to obtain container vessels for the computer model. These container vessels are designed in the early stages of container vessel design based on the container vessel’s required nominal and 14 ton TEU capacity. The tool estimates a container vessel's main dimensions, design speed, weight ship and machinery, resistance, required power, and capital costs. Per trade, the average full and empty container weights per TEU will be used to determine the required nominal and 14 ton TEU capacity of the container vessels per container liner service when a weekly sailing frequency is required. Each container vessel will be designed based on its design speed at a sea margin[3] of 15%, fully loaded condition, and a block coefficient (C_b) of 0,65. The added resistance of the container vessels is 10% in service condition. Each container vessels has a minimum speed of 11 knots due to engine restrictions. Each container vessels has ship cranes. The admiralty coefficient is used to determine the container vessels break powers when a vessels speed and loading condition are known. Knowing the container vessels break power the fuel consumption[4] and fuel consumption costs per voyage can be calculated. The container vessels in the computer model will not be limited in their draft and/or length on order to call port. Tropical draft, summer draft and winter draft will not be taken into account during sailing. All container vessels have ships cranes for flexible deploy ability.

The time data about 2011 as mentioned before involve transit times, congestion, the bunker times in case of offshore bunkering, and the time required for container handlings based on the average container moves per hour and per port are used to calculate the voyage duration.

The costs data about 2011 as mentioned before are to calculate the voyage costs and cargo costs, the vessel's hire, the vessel's capital costs bunker costs, port costs, general vessel expenses, stevedoring, commissions, container costs, transshipment, and general expenses are used. The container costs will be based on capital costs per day of an owned container, the long or short-term lease price per day in case of a long-term or short-term leased container. These costs will be multiplied by the amount of days the customer has the container in its possession. This includes the average stuffing time per port, the two days the container is on the terminal waiting to be loaded, the transit time, the transshipment time in case of transshipment, and the average stripping time per port. The time chartered vessels and owned vessels balance is fifty-fifty. Their division over the container liner services is also fifty-fifty. In case an odd number of container vessels is required in a container liner service, the cheapest type of container vessel is extra used.

[3] Sea margin: A powering margin defined as the margin which should be added to the estimation of the speed-power relationship for a newly built ship in ideal weather conditions to allow for the operation of the ship in realistic conditions.

[4] Fuel consumption depends on the the mass flow rate of fuel per time interval the engine is running. The mass flow rate of fuel is engine specific as each engine has its own specific fuel consumption (*sfc*) but the mass flow rate of fuel also depends on the vessel's speed, the added resistance on the vessel and the vessels displacement weight. The displacement weight of a vessels depends on it's loading condition.

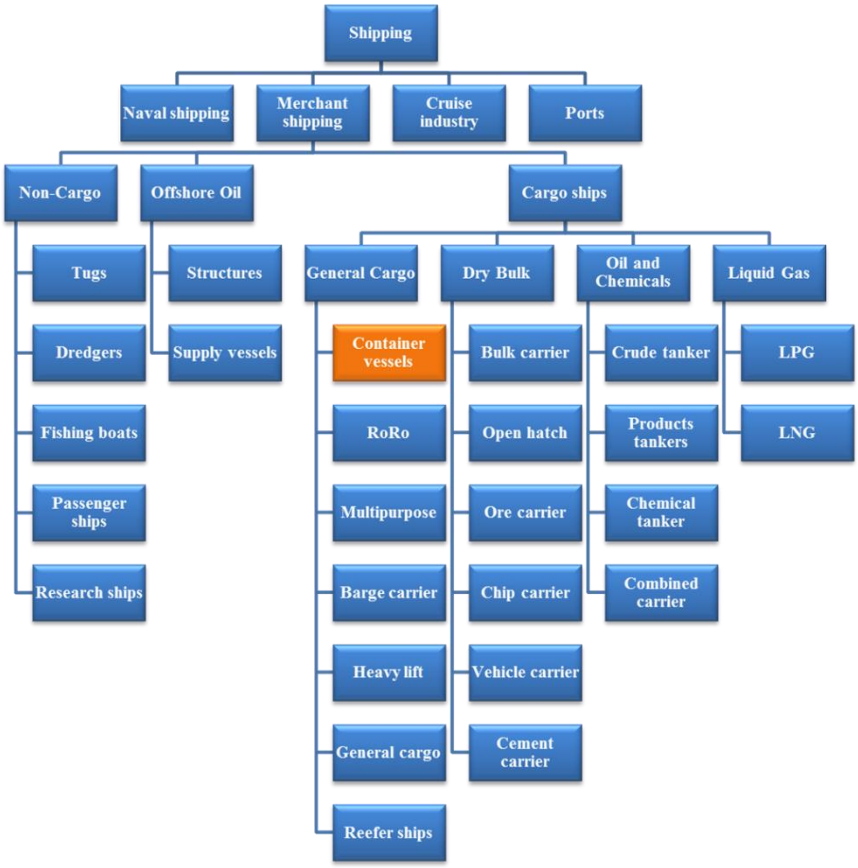
2 Container shipping market

In this chapter, the general container shipping market, the West African container shipping market as well as the strategies of the carriers and operators active in the West African container shipping market is described. By describing the general container shipping market, the share in which West Africa takes part can be compared with the entire container shipping market.

2.1 General

The shipping market consists of different segments and sub segments. Figure 1 obtained by Clarkson (2007) gives a schematic overview of these segments. The first distinction is based on segments in which the vessels serve. Naval vessels serve the governments, merchant ships the commercial industry, cruise ships serve tourism, and ports are required for vessel's operations. Container vessels are part of merchant vessels as they sail for transportation companies. Next, the vessels are split up further into non-cargo, offshore oil, and cargo vessels. The non-cargo segment involves vessels, which can perform certain tasks at sea or transport passengers. Offshore and oil involves structures or supply vessels which support the offshore and supply industry. The cargo vessels transport commodities. A container vessel also transports commodities and therefore they are part of the cargo ships. When looking more into detail at which type of commodity a container vessel transport, a container vessel ends up in the general cargo group.

Figure 1: Commercial shipping fleet classified by group, sector, and ship type.



Source: Clarkson (2007)

2.2 Container shipping market

The world container trade routes can be subdivided in three groups: East - West trade routes, north - South trade routes, and interregional trade routes. The East - West trade routes involve trades between Asia, Europe, and North America. The North – South trades involves trades between the regions of the Northern hemisphere and the Southern hemisphere. The interregional trade routes involve container liner services within the region. Table 1 shows the amount of full TEUs that are transported in the world and highlights the twenty largest container trades routes in the world as obtained by the World Shipping Council (2010). The East – West routes in the table represent more than half the transported containers in 2010, the North – West routes represents almost 11% of the total volumes transported, the interregional trade routes in the table represent 16% of the total volumes transported. When looking at the trades in which West Africa is involved, namely the Middle East and Africa, this represents almost 10% of the world trade. Therefore, West Africa represents less than 10% of the world trade.

Table 1: Top 20 trade routes of the world container shipping market

Trade Route	TEU(Millions)
Greater China - United States	8.5
Greater China - European Union	6.9
Greater China - Other Asia	5.3
Other Asia - Other Asia	5.0
European Union - Middle East and Africa	3.4
United States - Greater China	3.4
Greater China - Middle East and Africa	3.3
Other Asia - European Union	3.1
European Union - Greater China	3.1
European Union - Other Asia	2.9
Greater China - Greater China	2.9
Other Asia - Greater China	2.8
Other Asia - Middle East and Africa	2.7
Other Asia - United States	2.6
Latin America - United States	2.4
Greater China - Japan	2.4
Greater China - Other Europe	2.3
European Union - United States	2.1
Greater China - Latin America	2.0
Middle East and Africa - European Union	1.9
Rest of World	45.3
World Total	114.3

Source: World shipping council (2010)

The TEUs are based on full containers

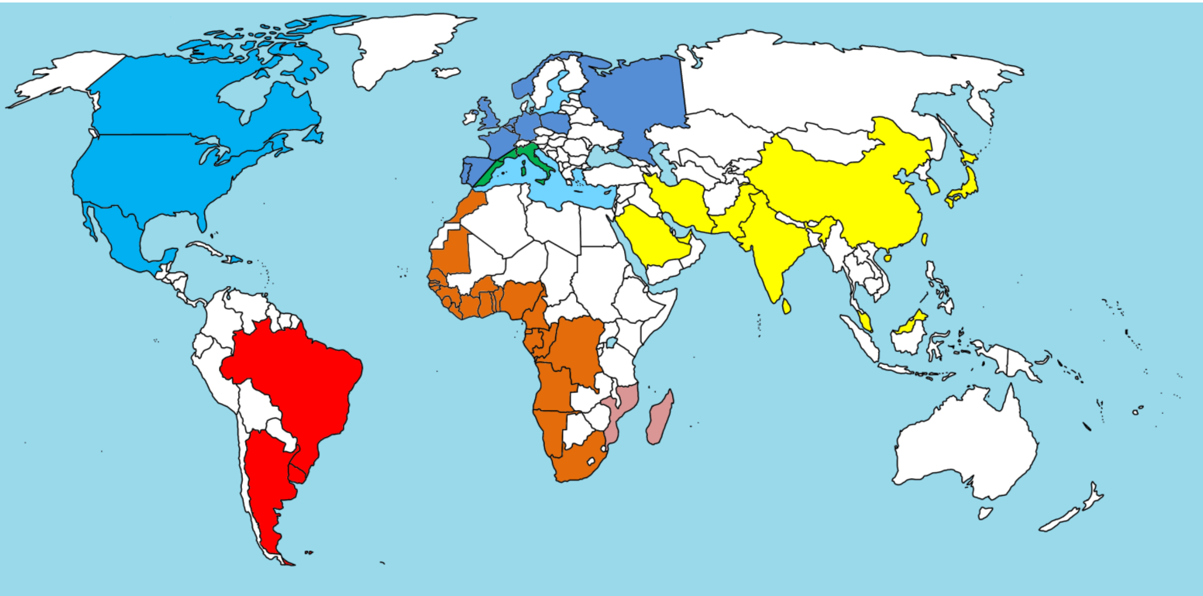
2.3 West African container shipping market

Container shipping transport from and to West Africa is typically imbalanced. This means that there are more full containers going to West Africa than full containers leave West Africa. The West African container shipping market is described geographically, by giving an overview of the markets carriers and the groups to which some of them belong. Per carrier the market shares, the liner services, the fleet, and the strategies are described. Finally, the supply and demand for 2011 and 2015 are specified, or described for NileDutch and the entire West African container shipping market. When talking about a liner service one means a container, ConRo, or multipurpose liner service of an operator and/or carrier on which a customers can book a container. Operators transport the containers booked by their clients via their owned and/or chartered vessels of their liner services to West Africa. Carriers use a thirth party via for example a vessels sharing agreement or slot agreement to transport the containers booked by their clients via a liner service to West Africa. In other words, a carrier does not operate a vessel as they do not have an owned or charter vessel active in their liner service on that trade. Within that container liner service, the customer's container are assigned to a vessel, and this vessel sails according to its container liner service's port rotation schedule.

2.3.1 Geographically

The West African container shipping market involves trades to West Africa coming from Asia, East Africa, Europe, the Mediterranean, North America, and South America. In Figure 2 an overview of the countries involved in trade with West Africa can be found. The countries per region are specified in Appendix A.

Figure 2: Countries involved in the West African container shipping market



Source: Alphaliner (29/04/2011 and 02/05/2011)

Colour code: : Asia, : West Africa, : South America, : East Africa, : North America, : Europe, : The Mediterranean

According to Alphaliner (2011) container trades from and to West Africa come from Asia, East Africa, Europe, the Mediterranean, North America, South America, and West Africa itself. The trades and trade lanes with West Africa can be found in Table 2.

Table 2: Trades and trade lanes West African container shipping market

Trade	Trade lane
Asia - East Africa - West Africa	East bound
Asia - East Africa - West Africa	West bound
Asia - South America - West Africa	East bound
Asia - South America - West Africa	West bound
Asia - West Africa	West bound
Asia - West Africa	East bound
Europe - West Africa	South bound
Europe - West Africa	North bound
Europe - West Africa - South America	South bound
Europe - West Africa - South America	North bound
Inter West Africa	
Mediterranean - West Africa	South bound
Mediterranean - West Africa	North bound
North America - West Africa	East bound
North America - West Africa	West bound
North America - South America - West Africa	East bound
North America - South America - West Africa	West bound
South America - West Africa	East bound
South America - West Africa	West bound

Source: Alphaliner (29/04/2011 and 02/05/2011)

● **: Trades and trade lanes in which NileDutch is active**

2.3.2 Players in the market

The players in the market are operators and carriers. Operators transport the containers booked by their clients via their owned and/or chartered vessels active in their liner services to West Africa. Carriers transport the containers booked by their clients via their owned and/or chartered vessels active in their liner services to West Africa or they use a thirth party via for example a vessels sharing agreement or slot agreement to transport the containers booked by their clients via a liner service to West Africa. Thus an operator is a carrier but a carrier is not always an operator.

Table 3 shows the carriers, which are part of a group in 2011. A group and its carriers are comparable to a the parent company and its subsidiaries. There are eight groups in total. The table also indicates if the carrier belonging to the group is also a carrier in the West Africa container shipping market.

Table 3: Carrier groups active in the West African container shipping market in 2011

Groups	Carrier	Carrier in the West African market
CMA CGM Group	ANL	
	CNC Line	
	CMA CGM	X
	CoMaNav	X
	Delmas	X
	Mac Andrews	
	US Lines	
CSAV Group	CSAV	X
	CSAV-Norasia	
	Libra Brasil	
	Libra Uruguay	
Grimaldi (Napoli) Group	ACL	X
	Atlantica	
	Finnlines	
	Grimaldi (Napoli)	X
	Grimaldi & Suardiaz Lines	
	Inarme	X
	Minoan Lines	
	MMS	
Hamburg Süd Group	Aliança	
	Hamburg Süd	X
Maersk Group	Maersk Line	X
	MCC	
	Mercosul Line	
	OACL	X
	Safmarine	X
	Seago Line	
MSC Group	MSC	X
	WEC Lines	
PIL Group	Advance Container Line	
	Malaysia Shg Corp.	
	PDL	
	PEL	
	PIL	X
Zim Group	Gold Star Line	X
	Laurel Navigation	
	Zim	X

Source: Alphaliner (27/07/2011)

The market has 36 operators divided over 31 groups in 2011. According to Alphaliner (2011) Maersk group, CMA CGM Group, and MSC Group are the lead operators in the West African container shipping market in 2011 when it comes to their annual TEU capacity. Table 4 shows the operators groups active in the West African container shipping market ranked according to their 2011 TEU capacity share within this market. It shows NileDutch at position eight in the operators list with a market share of 3.47%. Maersk group has the largest market share of 32.43%. Together with MSC Group and CMA CGM Group, they have a market share of 60,06% which is more than half the West African container shipping market. Adding up the shares of MOL, Hamburg Süd, PIL Group, and CSAV Group gives a market share of 83.53%. The top 10 even represents 91,19% of the market share leaving only 8,81% market share for the remaining 21 operators. Paragraph 2.3.5 shows information about the supplied TEUs and container vessels of each operator to obtain these market shares.

Table 4: Operators West African container shipping market per group in 2011

Nr.	Operator	Market Share	Nr.	Operator	Market Share
1	Maersk Group	32,43%	17	Hapag-Lloyd	0,56%
2	MSC Group	15,46%	18	DAL	0,42%
3	CMA CGM Group	12,17%	19	EuroAfrica	0,35%
4	MOL	7,31%	20	Portline	0,28%
5	Hamburg Süd	6,34%	21	UASC	0,23%
6	PIL Group	4,95%	22	CSAL	0,21%
7	CSAV Group	4,87%	23	Hanjin Shipping	0,20%
8	NileDutch	3,47%	24	Bacoliner	0,18%
9	Grimaldi (Napoli) Group	2,25%	25	Nordana Lines	0,11%
10	Zim Group	1,94%	26	OPDR	0,09%
11	K Line	1,89%	27	Boluda Lines	0,08%
12	CSCL	1,24%	28	IMTC	0,06%
13	NYK Line	0,75%	29	Clipper Shipping Line	0,06%
14	UAL	0,75%	30	Transinsular	0,04%
15	MACS	0,68%	31	Angola South Line	0,02%
16	Lin Lines	0,59%			

Source: Alphaliner (29/04/2011 and 02/05/2011)

45 carriers are active in the West African container shipping market in 2011. Table 5 shows the carriers active in the market ranked according to their amount of container liner services in the West African container shipping market of 2011. Here are 107 liner services in the West African container shipping market of 2011. As multiple carriers can be active in one liner service one can also say there are 184 liner services in total. NileDutch appears in the table having six liner services, which is quite a lot as only the five largest carriers have more liner services. Maersk line and Safmarine have about the same amount of liner services. 31 and 28 liner services respectively. However, Maersk Line and Safmarine are both part of Maersk group so they have 59 liner services. Delmas and MSC also have about the same amount of liner services. Seventeen and fourteen respectively. CMA CGM has nine liner services, but is has to

be noted that Delmas and CoMaNav are part of the CMA CGM Group so they have 32 liner services in total.

Table 5: Carriers West African container shipping market

Nr.	Carrier	# Liner services	Nr.	Carrier	# Liner services
1	Maersk Line	31	23	Hanjin Shipping	2
2	Safmarine	28	24	Angola South Line	1
3	Delmas	17	25	Bacoliner	1
4	MSC	14	26	Boluda Lines	1
5	CMA CGM	9	27	Clipper Shipping Line	1
6	CoMaNav	6	28	DAL	1
7	Grimaldi (Napoli)	6	29	Dannebrog	1
8	NileDutch	6	30	EuroAfrica	1
9	PIL	6	31	Laurel Navigation	1
10	Hapag-Lloyd	5	32	Lin Lines	1
11	MOL	5	33	Stinnes Linien	1
12	ACL	3	34	MACS	1
13	CSAV	3	35	Marfret	1
14	Hamburg Süd	3	36	Mozline	1
15	IMTC	3	37	Nordana Line	1
16	UAL	3	38	NYK Line	1
17	Zim	3	39	OACL	1
18	Arkas	2	40	OPDR	1
19	CSCL	2	41	SOL	1
20	Gold Star Line	2	42	Transinsular	1
21	K Line	2	43	UASC	1
22	Portline	2	44	VACS	1

Source: Alphaliner (29/04/2011 and 02/05/2011)

Figure 3 and Figure 4 give an overview of the vessel sharing agreements, vessels agreements, and slot agreements between operators and carriers per container liner service and per trade. The table shows that many agreements are made within a group, but most importantly among large container carriers. Maersk Group and CMA CGM Group turn out to have a lot of agreements.

Figure 3: Agreements between operators and carriers (1)

Trade	Operators / Carriers	Inter group agreement	Vessel sharing agreement	Vessel agreement	Slot agreement	Liner service
Asia - South America - West Africa	Hamburg Süd / Maersk Line / Safmarine	No	Hamburg Süd / Maersk Line (11:1)		Safmarine	ASAS 1 / NGX 1
	MOL / Hamburg Süd	No			Hamburg Süd	CWS
Asia - East Africa - West Africa	CMA CGM / Delmas	Yes (CMA CGM Group)			Delmas	WAX II
	Maersk Line Line / Safmarine	Yes (Maersk Group)			Safmarine	Safari Loop 3
	Hamburg Süd / Maersk Line Line / Safmarine	No / Yes (Maersk Group)			Hamburg Süd / Safmarine	Safari Loop 1
Asia - West Africa	CSCL / Hapag -Lloys / K Line	No	CSCL / Hapag -Lloyd / K Line (5:1:2)			WAX / WSX
	Gold Star Line / Zim	Yes (Zim Group)			Zim	FAX
	Gold Star Line / Laurel / PIL / Zim	No / Yes (Zim Group)	Gold Star Line / Zim (3:3)		Lauren / PIL	AMI
	Hanjin Shipping / K Line / PIL	No	K Line / PIL (4:2)		Hanjin Shipping	ASA
	CMA CGM / Delmas	Yes (CMA CGM Group)	CMA CGM / Delmas (8:1)			AFEX
	CMA CGM / Delmas	Yes (CMA CGM Group)	CMA CGM / Delmas (7:1)			MIDAS
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	FEW 1
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	FEW 3
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	MESA
	Maersk Line / Safmarine	Yes (Maersk Group)	Safmarine / Maersk Line (1:8)			FEW 2
	NileDutch / NYK Line	No	NileDutch / NYK (3:3)			SWAX
	Maersk Line / Safmarine	Yes (Maersk Group)			Maersk Line	CWABS
Europe - West Africa	CMA CGM / Delmas / Marfret	No / Yes (CMA CGM Group)			Delmas / Marfret (Operator: CMA CGM)	EAS
	CMA CGM / Delmas	Yes (CMA CGM Group)			Delmas (Operator: CMA CGM)	Battuta Express
	CMA CGM / Delmas	Yes (CMA CGM Group)			Delmas (Operator: CMA CGM)	EURAF
	CMA CGM / Delmas	Yes (CMA CGM Group)		Delmas (Operator: CMA CGM) (5, 6 in total)	Delmas	NIGEX
	IMTC / CMA CGM / CoMaNav / OPDR / VACS	No / Yes (CMA CGM Group)	CMA CGM / OPDR (1:1)		CoMaNav / OPDR / VACS	CES
	DAL / Maersk Line / Safmarine / MOL / SOL	No / Yes (Maersk Group)	DAL / Safmarine / Maersk Line / MOL (1:1:2:3)		SOL	SAECS
	ACL / Grimaldi (Naples)	Yes (Grimaldi (Naples) Group)			ACL	Central Express loop
	ACL / Grimaldi (Naples)	Yes (Grimaldi (Naples) Group)			ACL	Southern Exxpress Loop
	Hanjin Shipping / Hapag - Lloyd / MOL / UASC	No	Hanjin Shipping / MOL / UASC (1:2:1)		Hapag-Lloyd	(WAF) (HL:MWX)
	Hapag-Lloyd / MOL / Zim	No	Hapag-Lloyd / MOL / Zim (2:3:1)			ARN / WAX / NAF
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	WAF1
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	WAF3
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	WAF5
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	WAF7
	Maersk Line / Safmarine	Yes (Maersk Group)	Safmarine / Maersk Line (2:2)			Angola Loop
	Maersk Line / Safmarine	Yes (Maersk Group)	Safmarine / Maersk Line (3:3)			WAF2
	Maersk Line / Safmarine	Yes (Maersk Group)	Safmarine / Maersk Line (4:2)			WAF6
	Maersk Line / Safmarine	Yes (Maersk Group)	Safmarine / Maersk Line (2:2)			WAF8
	Hapag-Lloyd / MSC / Stiness Linien	No			Hapag-Lloyd / Stiness Linien	ESAS
	Maersk Line / Safmarine	Yes (Maersk Group)			Maersk Line	ACE
	Maersk Line / Safmarine	Yes (Maersk Group)			Maersk Line	OPEX
	Maersk Line / Safmarine	Yes (Maersk Group)			Maersk Line	WAF9
	Maersk Line / Safmarine	Yes (Maersk Group)			Maersk Line	WAS
	MSC / Portline / Transinsular	No			Portline / MSC	Africa expresso

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers between parentheses in the vessel sharing agreement column indicate the number of vessels each operator uses in the agreement. The orders of the numbers correspond to the order of operators before the parentheses.

Figure 4: Agreements between operators and carriers (2)

Trade	Operators / Carriers	Inter group agreement	Vessel sharing agreement	Vessel agreement	Slot agreement	Liner service
Inter West Africa	Bolunda Lines / Delmas	No			Delmas	CWAS
	CMA CGM / Delmas	Yes (CMA CGM Group)			Delmas (Operator: CMA CGM)	WAF1
	CMA CGM / Delmas	Yes (CMA CGM Group)			Delmas (Operator: CMA CGM)	WAF2
	CMA CGM / Delmas	Yes (CMA CGM Group)			Delmas (Operator: CMA CGM)	WAF3DO
	CMA CGM / Delmas	Yes (CMA CGM Group)			Delmas (Operator: CMA CGM)	WAMFL
	CMA CGM / MSC	No		MSC (2)		Sango
	CMA CGM / CoMaNav / Delmas	Yes (CMA CGM Group)		Delmas (Operator: CMA CGM (2) / CoMaNav (1))		WAF4
	CMA CGM / CoMaNav	Yes (CMA CGM Group)			CMA CGM	IMS
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	WAF1SM
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	WAF2SM
	Maersk Line / Mozline / OACL / Safmarine	No / Yes (Maersk Group)			Maersk Line / Safmarine / Mozline	West Coast
	Maersk Line / Safmarine	Yes (Maersk Group)			Maersk Line	SAWACS
Mediterranean - West Africa	Arkas / CMA CGM / CoMaNav	No / Yes (Maersk Group)			CoMaNav / Arkas	PVMSM
	Arkas / CMA CGM / CoMaNav	No / Yes (Maersk Group)			CoMaNav / Arkas	WMMS
	CMA CGM / Delmas	Yes (CMA CGM Group)		Delmas (Operator: CMA CGM) (4, 5 in total)		DIAMS
	IMTC / CMA CGM / CoMaNav	No / Yes (CMA CGM Group)	CMA CGM / CoMaNav (1:1)		IMTC	RORO Med Line
	CoMaNav / IMTC	No			CoMaNav	C-C
North America - West Africa	CSCL / Hapag-Lloyd	Yes (CMA CGM Group)			Hapag-Lloyd	USSAMS
	Grimaldi (Naples) / ACL	Yes (Grimaldi (Naples) Group)			ACL	USWARS
	MACS / Danneburg	No			Danneburg	GAL
	Maersk Line / Safmarine	Yes (Maersk Group)			Safmarine	Corex
	Maersk Line / MSC / Safmarine	Yes (Maersk Group & MSC Group)	Maersk Line / MSC / Safmarine (3:4:1)			AMEX
	Maersk Line / Safmarine	Yes (Maersk Group)			Maersk Line	Angorex
South America - West Africa	Clipper Shipping Line / Nigerbras / Nigeria America Line	No			Nigerbras / Nigeria America Line	SATWACS
	Delmas / NileDutch	Yes (CMA CGM Group)	Delmas (operator: CMA CGM) / NileDutch (2:1)			ECSA

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers between parentheses in the vessel sharing agreement column indicate the number of vessels each operator uses in the agreement. The order of the numbers corresponds to the order of operators before the parentheses.

Each carrier and operator is active on one or more trades. Table 6 and Table 7 show in which trades these carriers and operators are active. Maersk Line, MSC, and CMA CGM turn out to be active on most of the trades. The top ten operators show to be active in two or more trades and NileDutch is active on four trades.

Table 6: Trades in which each carrier is active in the West African container shipping market

Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Trade / Carrier	ACL	Angola South Line	Arkas	Bacoliner	Bolunda Lines	Clipper Shipping Line	CMA CGM	CoMaNav	CSAV	CSCL	DAL	Danneburg	Delmas	EuroAfrica	Gold Star Line	Grimaldi (Napoli)	Hamburg Süd	Hanjin Shipping	Hapag-Lloyd	IMTC	K Line	Laurel	Lin Lines	MACS	Maersk Line	Marfret	MOL	Mozline	MSC	NileDutch	Nordana Line	NYK Line	OACL	OPDR	OTAL	PIL	Portline	Safmarine	SOL	Stiness Linien	Transinsular	UAL	UASC	VACS	Zim
Asia - East Africa - West Africa							X										X								X				X							X									
Asia - South America - West Africa																	X								X		X											X							
Asia - West Africa							X		X	X			X		X		X	X	X		X	X			X				X	X		X				X		X							X
Europe - West Africa	X			X			X	X			X		X	X		X		X	X	X			X		X	X	X		X	X				X	X		X	X	X	X	X	X	X	X	X
Europe - West Africa - South America																X																													
Inter West Africa		X			X		X	X	X				X												X		X	X	X	X			X		X			X				X			
Mediterranean - West Africa			X				X	X					X			X				X						X			X																
North America - South America - West Africa																															X														
North America - West Africa	X									X		X				X			X					X	X				X									X				X			
South America - West Africa						X							X																	X															

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch is active on this trade

Table 7: Trades in which each operator is active in the West African container shipping market

Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Trade / Operator	Angola South Line	Bacoliner	Bolunda Lines	Clipper Shipping Line	CMA CGM	CoMaNav	CSAL	CSAV	CSCL	DAL	Delmas	EuroAfrica	Gold Star Line	Grimaldi (Napoli)	Hamburg Süd	Hanjin Shipping	Hapag-Lloyd	IMTC	K Line	Lin Lines	MACS	Maersk Line	MOL	MSC	NileDutch	Nordana Line	NYK Line	OACL	OPDR	PIL	Portline	Safmarine	Transinsular	UAL	UASC	Zim
Asia - East Africa - West Africa					X										X							X		X						X						
Asia - South America - West Africa															X							X	X													
Asia - West Africa					X			X	X		X		X				X		X			X		X	X		X			X		X				
Europe - West Africa		X			X					X	X	X		X		X	X			X		X	X	X	X				X		X	X	X	X	X	X
Europe - West Africa - South America														X																						
Inter West Africa	X		X		X	X		X														X	X	X	X			X				X		X		
Mediterranean - West Africa					X	X					X			X				X						X												
North America - South America - West Africa																										X										
North America - West Africa							X							X							X	X		X								X		X		
South America - West Africa				X	X																				X											

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch is active on this trade

2.3.3 Liner services

Alphaliner (2011) provides the data for the liner services active in the West African container shipping market. These data give the port rotation schedules per liner service and order of rotation (first leg), the transshipment ports per liner service, and the ports in the liner service that picks up the container in the transshipment port and carries it to its next destination (second leg). These data are insufficient for the duration of rotation and frequency of thirteen container liner services. Therefore, the people from NileDutch's operational department together with the program Netpas Distance calculated the durations of rotation and frequency (25/05/2012). These results can be found in Appendix B.The information about NileDutch container liner services is adjusted by the data from the 31/04/2011 sailings schedules

2.3.3.1 Global overview

Globally the countries where ports are called by the liner services active in the West African container shipping market are situated in Asia, East Africa, Europe, The Mediterranean, North America, South America, and West Africa. The overview of the countries of the ports of call globally for the first leg can be found in Figure 5.

Asian, European, North American, South America, and African countries are most active in the firt leg. Oceanian countries are remarkable absent in the first leg ports. Figure 6 shows the countries where the transshipment ports are located and the countries of the second leg can be found in

Figure 7. The transshipments ports are located at the edges of the West African countries or typically in a country before a transit is made over an ocean. Oceanian countries do appear in the second leg figure.

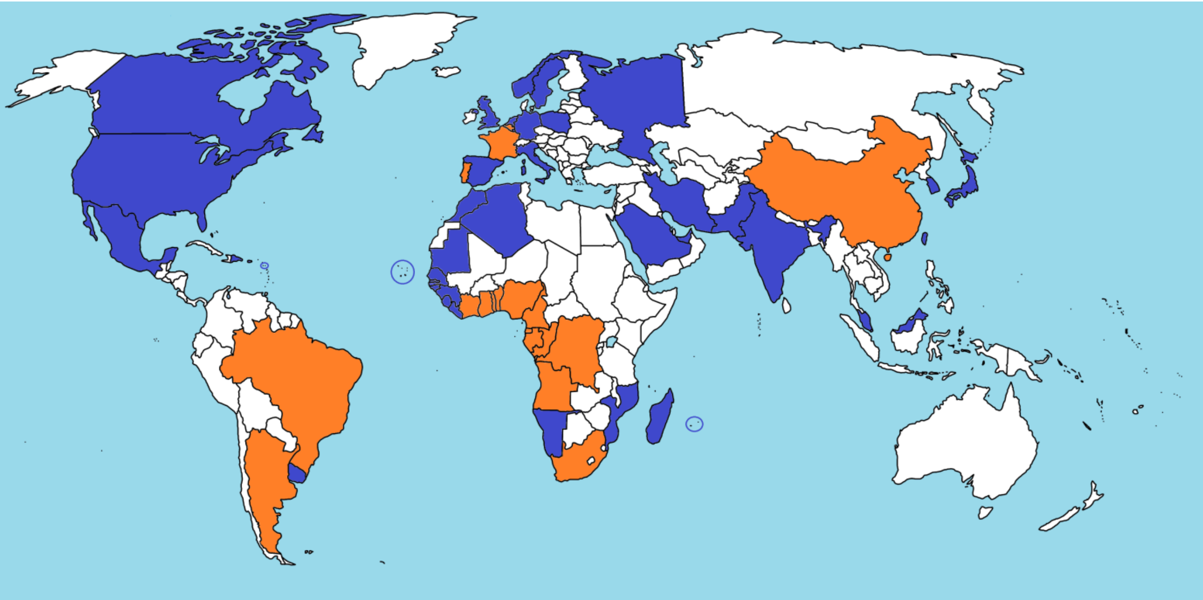
These figures show activities of other players on more trades and in more countries per region in comparison with NileDutch. NileDutch does not transport containers from North America or the Middle east. Within Europe and the Mediterranean more countries appart from Belgium, Fance and Portugal transport container to West Africa.

Figure 7 shows regions and countries wich can transport container to West Africa by the use of two liner services.

Figure 7 gives information about which regions are likely to heve direct liner serviced to West Africa in the future. East African, Oceanian, and South Asian countries appear in this figure. This is value information for NileDutch strategy. Strategy is discussed in paragraph 2.3.6 on page 47.

The port rotation schedules per liner service, per trade, and service type of the first leg ports as well as the transshipment ports and the second leg ports are displayed in Table 80 to Table 115 in Appendix C. This information is also used in the strategy paragraph on page 47.

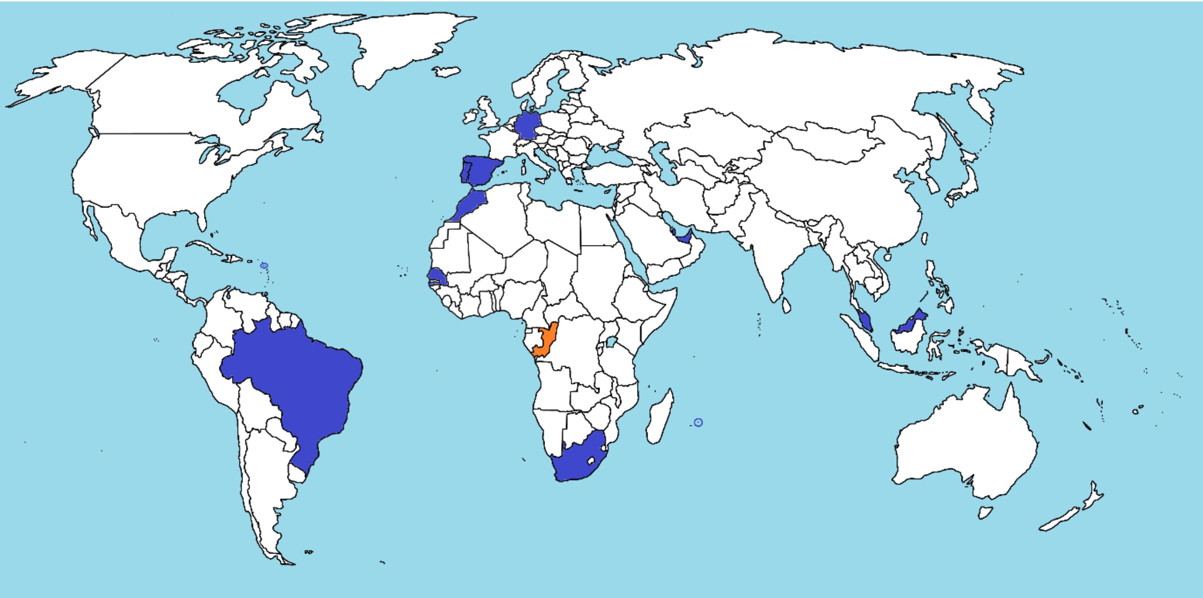
Figure 5: First leg West African container shipping market of 2011



Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch and other carriers if applicable ●: Carriers other than NileDutch

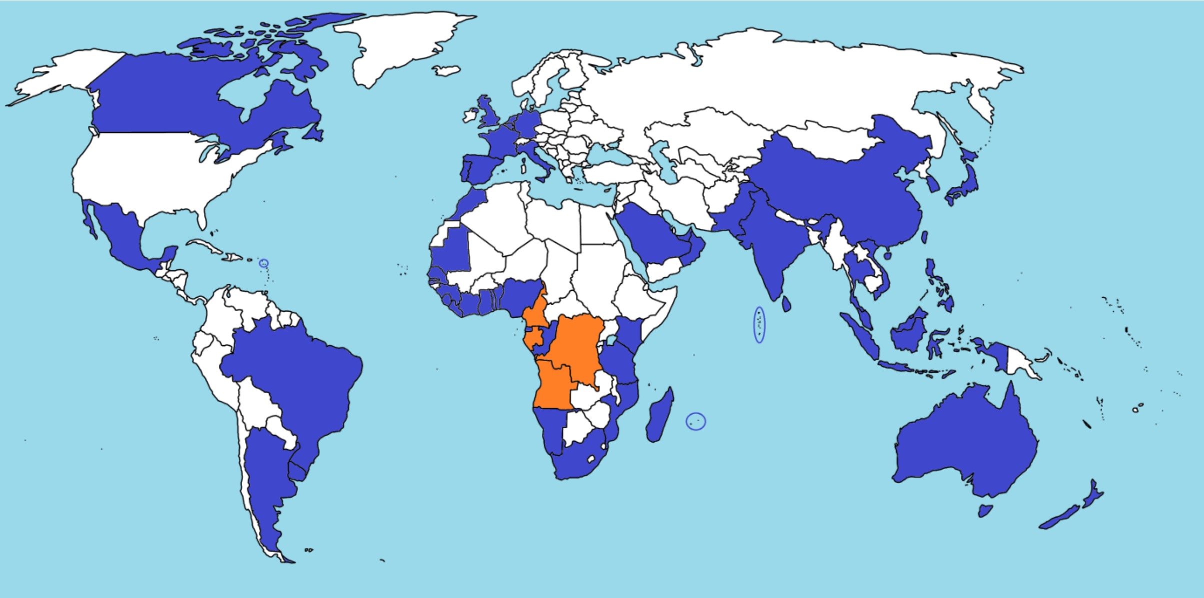
Figure 6: Transshipment places West African container shipping market of 2011.



Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch and other carriers if applicable ●: Carriers other than NileDutch

Figure 7: Second leg West African container shipping market of 2011.



Source: Alphaliner (29/04/2011 and 02/05/2011)

: NileDutch and other carriers if applicable

: Carriers other than NileDutch

In total, there are 107 liner services in the West African container shipping market of 2011. The liner services include container, ConRo, and multipurpose liner services. Because five liner services include a combination of for example container vessels and ConRo vessels, one can say that there are 112 liner services if these five liner services are split up into a container liner service and a ConRo liner service. There are 78 container liner services, 11 ConRo liner services, and 23 multipurpose services in total. An overview of the liner services per trade and service type can be found in Table 8.

Table 8: Amount of container liner services per trade and service type of 2011

Trade	Liner service type	# Liner services
Asia - East Africa - West Africa	Container	5
	Total	5
Asia - South America - West Africa	Container	2
	Total	2
Asia - West Africa	Container	19
	Multipurpose	2
	Total	21
Europe - West Africa	Container	28
	ConRo	4
	Multipurpose	4
	Total	36
Europe - West Africa - South America	ConRo	1
	Total	1
Inter West Africa	Container	16
	ConRo	1
	Multipurpose	11
	Total	27
Mediterranean - West Africa	Container	5
	ConRo	3
	Total	8
North America - South America - West Africa	ConRo	1
	Total	1
North America - West Africa	Container	2
	ConRo	1
	Multipurpose	5
	Total	8
South America - West Africa	Container	1
	Multipurpose	1
	Total	2
	Grand Total	112

Source: Alphaliner (29/04/2011 and 02/05/2011)

: Trades where NileDutch is active

2.3.3.2 Operator's fleet

Per operator active in the West African container shipping market the fleet is obtained from Alphaliner – Top 100 (2011). The fleet is subdivided into the owned fleet and the chartered fleet. To these data, data are added about the orders and the options per operator group. The overview can be found in Table 9. Maersk Group, MSC Group, and CMA CGM group represent the top three. They keep up this ranking in owned container vessels, chartered container vessels, orders, and options. They have a share of 55% of the owned and chartered container vessels in terms of nominal TEU capacity. The remaining operator in the top 10 have shares between 3% and 6%. NileDutch is ranked in position 15 with a mrket share of 0,4%. When looking at the balance between owned and charter container vessels NileDutch and Grimaldi (Napoli) Group stand out. NileDutch stand out due to only a 5% share of owned container vessels in their fleet and Grimaldi (Napoli) Group stand out as there are only 4% chartered vessels in the fleet. Only the top 15 operators have order and options. Hanjin shipping, MOL and Zim have quite large orders. Hanjin and Zim increase their fleet size by almost 50% each when lokking at the total nominal TEU capcity. MOL increased it with almost 30%. Maersk group has orders and options for the largest container vessel up to now. The container vessels have a nominal TEU capacity of 18.000TEU.

Table 9: Fleet specifications for the owned, chartered ordered container vessels as well as the options per shipping company active in the West African container shipping market

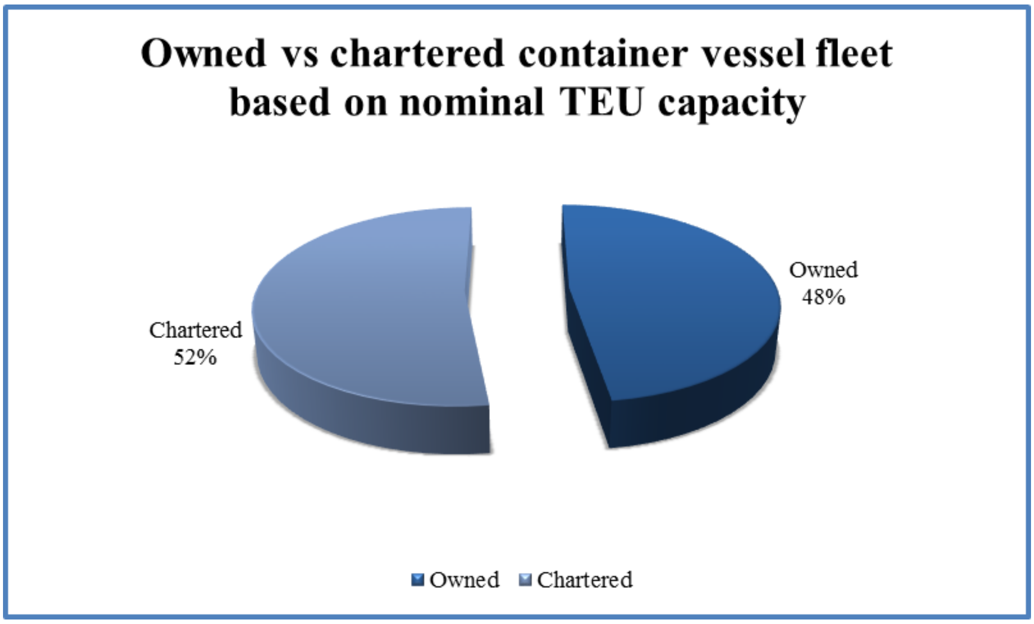
		Owned				Chartered				Total existing fleet					
Rank	Operator	Nominal capacity (TEU)	# vessels	% volume	% vessels	Nominal capacity (TEU)	# vessels	% volume	% vessels	Nominal capacity (TEU)	# vessels	% volume	% vessels	% volume owned	% volume chartered
1	Maersk Group	1.138.098	210	47,1%	33,0%	1.275.769	426	52,9%	67,0%	2.413.867	636	23,1%	21,9%	47,1%	52,9%
2	MSC Group	1.010.805	213	50,4%	45,1%	993.482	259	49,6%	54,9%	2.004.287	472	19,1%	16,3%	50,4%	49,6%
3	CMA CGM Group	506.799	95	39,3%	24,4%	783.467	295	60,7%	75,6%	1.290.266	390	12,3%	13,4%	39,3%	60,7%
4	Hapag-Lloyd	267.259	56	42,9%	39,2%	355.540	87	57,1%	60,8%	622.799	143	5,9%	4,9%	42,9%	57,1%
5	Hanjin Shipping	240.860	40	47,0%	37,0%	271.919	68	53,0%	63,0%	512.779	108	4,9%	3,7%	47,0%	53,0%
6	CSAV Group	45.632	10	8,6%	7,6%	482.615	121	91,4%	92,4%	528.247	131	5,0%	4,5%	8,6%	91,4%
7	CSCL	315.864	76	61,8%	53,5%	195.094	66	38,2%	46,5%	510.958	142	4,9%	4,9%	61,8%	38,2%
8	MOL	214.984	36	50,7%	35,3%	208.776	66	49,3%	64,7%	423.760	102	4,0%	3,5%	50,7%	49,3%
9	Zim	158.129	34	47,0%	34,0%	178.270	66	53,0%	66,0%	336.399	100	3,2%	3,4%	47,0%	53,0%
10	NYK Line	300.391	58	75,3%	56,9%	98.276	44	24,7%	43,1%	398.667	102	3,8%	3,5%	75,3%	24,7%
11	Hamburg Süd Group	184.356	44	47,9%	38,3%	200.770	71	52,1%	61,7%	385.126	115	3,7%	4,0%	47,9%	52,1%
12	K Line	221.618	39	66,4%	50,0%	112.193	39	33,6%	50,0%	333.811	78	3,2%	2,7%	66,4%	33,6%
13	PIL Group	161.819	93	60,9%	66,9%	104.100	46	39,1%	33,1%	265.919	139	2,5%	4,8%	60,9%	39,1%
14	UASC	126.696	28	54,0%	50,0%	108.119	28	46,0%	50,0%	234.815	56	2,2%	1,9%	54,0%	46,0%
15	NileDutch	2.137	3	5,0%	13,0%	40.477	20	95,0%	87,0%	42.614	23	0,4%	0,8%	5,0%	95,0%
16	Grimaldi (Napoli) Group	46.295	39	96,0%	90,7%	1.931	4	4,0%	9,3%	48.226	43	0,5%	1,5%	96,0%	4,0%
17	Arkas Line	17.959	13	68,2%	59,1%	8.374	9	63,1%	40,9%	26.333	22	0,3%	0,8%	68,2%	31,8%
18	MACS	6.828	4	32,3%	26,7%	14.342	11	67,7%	73,3%	21.170	15	0,2%	0,5%	32,3%	67,7%
19	DAL	4.500	1	36,5%	12,5%	7.831	7	63,5%	87,5%	12.331	8	0,1%	0,3%	36,5%	63,5%
20	Marfret	8.442	7	83,0%	87,5%	1.732	1	100,0%	12,5%	10.174	8	0,1%	0,3%	83,0%	17,0%
21	OPDR	4.490	7	58,0%	58,3%	3.253	5	42,0%	41,7%	7.743	12	0,1%	0,4%	58,0%	42,0%
22	Boluda Lines	5.159	6	73,6%	75,0%	1.848	2	26,4%	25,0%	7.007	8	0,1%	0,3%	73,6%	26,4%
23	UAL					5.433	11	100,0%	100,0%	5.433	11	0,1%	0,4%	0,0%	100,0%
24	Lin Lines					4.602	2	100,0%	100,0%	4.602	2	0,0%	0,1%	0,0%	100,0%
25	Nordana Line	1.800	3	44,3%	60,0%	2.266	2	55,7%	40,0%	4.066	5	0,0%	0,2%	44,3%	55,7%
26	Euroafrica	3.948	7	100,0%	100,0%					3.948	7	0,0%	0,2%	100,0%	0,0%
27	Portline	655	1	17,9%	33,3%	3.000	2	82,1%	66,7%	3.655	3	0,0%	0,1%	17,9%	82,1%
28	Clipper Shipping Line	2.708	7	100,0%	100,0%					2.708	7	0,0%	0,2%	100,0%	0,0%
29	Transinsular	2.667	5	100,0%	100,0%					2.667	5	0,0%	0,2%	100,0%	0,0%
30	CSAL	2.184	3	100,0%	100,0%					2.184	3	0,0%	0,1%	100,0%	0,0%
31	Bacoliner	1.950	3	100,0%	100,0%					1.950	3	0,0%	0,1%	100,0%	0,0%
32	IMTC	640	2	100,0%	100,0%					640	2	0,0%	0,1%	100,0%	0,0%
33	Angola South Line					639	2	100,0%	100,0%	639	2	0,0%	0,1%	0,0%	100,0%
	Total	5.005.672	1.143			5.464.118	1.760			10.469.790	2.903			47,8%	52,2%

		Orderbook				Total future fleet (orders)		Options				Total future fleet (orders+options)			
Rank	Operator	Nominal capacity (TEU)	# vessels	% volume increase	% vessels increase	Nominal capacity (TEU)	# vessels	Nominal capacity (TEU)	# vessels	% volume increase	% vessels increase	Nominal capacity (TEU)	# vessels	% volume increase	% vessels increase
1	Maersk Group	534.026	54	22,1%	8,5%	2.947.893	690	180.000	10	6,1%	1,4%	3.127.893	700	29,6%	10,1%
2	MSC Group	503.348	47	25,1%	10,0%	2.507.635	519	36.000	4	7,2%	1,9%	2.543.635	523	26,9%	10,8%
3	CMA CGM Group	189.328	17	14,7%	4,4%	1.479.594	407					1.479.594	407	14,7%	4,4%
4	Hapag-Lloyd	132.758	11	21,3%	7,7%	755.557	154					755.557	154	21,3%	7,7%
5	Hanjin Shipping	253.495	32	49,4%	29,6%	766.274	140					766.274	140	49,4%	29,6%
6	CSAV Group	98.589	12	18,7%	9,2%	626.836	143	68.000	8	10,8%	5,6%	694.836	151	31,5%	15,3%
7	CSCL	93.896	12	18,4%	8,5%	604.854	154					604.854	154	18,4%	8,5%
8	MOL	120.830	13	28,5%	12,7%	544.590	115					544.590	115	28,5%	12,7%
9	Zim	153.216	13	45,5%	13,0%	489.615	113					489.615	113	45,5%	13,0%
10	NYK Line	61.476	6	15,4%	5,9%	460.143	108					460.143	108	15,4%	5,9%
11	Hamburg Süd Group					385.126	115					385.126	115		
12	K Line	49.720	6	14,9%	7,7%	383.531	84					383.531	84	14,9%	7,7%
13	PIL Group	65.400	20	24,6%	14,4%	331.319	159	5.600	2	1,7%	1,3%	336.919	161	26,7%	15,8%
14	UASC					234.815	56					234.815	56		
15	NileDutch	14.000	4	32,9%	17,4%	56.614	27					56.614	27	32,9%	17,4%
16	Grimaldi (Napoli) Group					48.226	43					48.226	43		
17	Arkas Line					26.333	22					26.333	22		
18	MACS					21.170	15					21.170	15		
19	DAL					12.331	8					12.331	8		
20	Marfret					10.174	8					10.174	8		
21	OPDR					7.743	12					7.743	12		
22	Boluda Lines					7.007	8					7.007	8		
23	UAL					5.433	11					5.433	11		
24	Lin Lines					4.602	2					4.602	2		
25	Nordana Line					4.066	5					4.066	5		
26	Euroafrica					3.948	7					3.948	7		
27	Portline					3.655	3					3.655	3		
28	Clipper Shipping Line					2.708	7					2.708	7		
29	Transinsular					2.667	5					2.667	5		
30	CSAL					2.184	3					2.184	3		
31	Bacoliner					1.950	3					1.950	3		
32	IMTC					640	2					640	2		
33	Angola South Line					639	2					639	2		
	Total	2.270.082	247	21,7%	8,5%	12.739.872	3.150	289.600	24	2,3%	0,8%	13.029.472	3.174	80,4%	91,5%

Source: Alphaliner's top 100 and order book (27/07/2011)

When the owned fleet is compared with the chartered fleet of all the container carriers active in the West African container shipping market it shows that the container vessel fleet consists of slightly more owned vessels than chartered vessels. The division can be viewed in Figure 8.

Figure 8: Owned versus chartered container vessel fleet



Source: Alphaliner's top 100 (27/07/2011)

2.3.3.3 Vessels West African container shipping market

Alphaliner (29/04/2011 and 02/05/2011) provided data about the vessels that can transport containers in the West African container shipping market. The data are collected in a database and show per vessel the operator that operates her, the owner, the container liner service in which she sails, The amount of vessels in that container liner service, the trade in which she is in, the vessel's name, IMO number, TEU capacity, nominal TEU capacity, the amount of reefer plugs, the deadweight tonnage (dwt), the type of vessel, the flag state, the maximum vessel speed, length over all (L_{oa}), length between perpendiculars (L_{pp}), beam (B), draft (T), if there are cargo cranes present and what type of gears, the type of engine, and the maximum continuous rating engine power ($P_{B,Max}$).

When looking at the vessels active in the West African container shipping market according to Alphaliner (29/04/2011 and 02/05/2011) there are 376 container vessels, 38 ConRo vessels, 66 multipurpose vessels, and for three vessel their type is unknown. A more detailed overview can be found in Table 10. The numbers of vessels per trade in West Africa per type of vessel are indicated in Table 11.

Table 10: Types of vessels active in the West African container shipping market

Type	Description	Type class	# Vessels
bg	Barge - Container Carrier	Container	3
cb	ConBulker	Multipurpose	4
cc	Container Carrier	Container	325
cc/h	Container Carrier / Cellular (semi - hatchless)	Container	6
cc/o	Container Carrier Overpanamax - 17 rows	Container	38
cc/v	Container Carrier / Cellular (Sub-Panamax VLCS - 17 rows)	Container	4
cr	Container RoRo vessel (ConRo) - one cellular hold fwd	ConRo	1
gr	Multipurpose / Conventional (RoRo auxiliary access)	Multipurpose	3
mp	Multipurpose Box	Multipurpose	57
mr	Multipurpose Box - RoRo access to main deck only - cargo hatches on upper deck - no lower hold	Multipurpose	2
ro	RoRo Cargo vessel - hatchless	ConRo	31
vc	Vehicle Carrier	ConRo	6
nk	Not known	Not Known	3
	Total		**483**

Source: Alphaliner (28/04/2011 and 02/05/2011)

Table 11: Division of the vessels over the trades in West Africa and the type of vessel

Trade	Vessel type	# Vessels
Asia - East Africa - West Africa	Container	32
	Total	32
Asia - South America - West Africa	Container	24
	Total	24
Asia - West Africa	Container	145
	Multipurpose	5
	Total	182
Europe - West Africa	Container	114
	ConRo	20
	Multipurpose	21
	Not Known	2
	Total	157
Europe - West Africa - South America	ConRo	8
	Total	8
Inter West Africa	Container	29
	ConRo	1
	Multipurpose	17
	Not Known	1
	Total	48
Mediterranean - West Africa	Container	19
	ConRo	5
	Total	24
North America - South America - West Africa	ConRo	1
	Total	1
North America - West Africa	Container	10
	ConRo	3
	Multipurpose	22
	Total	35
South America - West Africa	Container	3
	Multipurpose	1
	Total	4
	Grand Total	491

Source: Alphaliner (28/04/2011 and 02/05/2011)

●: Trades where NileDutch is active

The average container vessel looks as indicated in Table 12. The average container vessels active in the West African container shipping marketin 2011 has a nominal TEU capacity of 2.650TEU and a design speed of 21,1 knots. The alterations and calculations that had to be made to the database can be found in Appendix D. The ranges of the container vessels specifications can be found in Figure 125 to Figure 134 in Appendix E.

Table 12: Average container vessel on the West African container shipping market.

Average container vessel	Value
Nominal TEU	2.650 TEU
14 ton TEU	1.968 14 ton TEU
Reefer Plugs	373 Plugs
dwt	35.425 t
W_{sm}	13.932 t
∇	49.357 t
v_s	21,1 knots
L_{oa}	205,9 m
L_{pp}	194,3 m
B	29,9 m
T	11,3 m
C_b	0,69
$P_{B,Max}$	22.186 kW

Source: Alphaliner (28/04/2011 and 02/05/2011)

More into detail per trade the minimum, maximum, and average values of the nominal TEU capacity, 14 ton TEU capacity, amount of reefer plugs, length over all (L_{oa}), and Draft (T) are calculated as well as the percentage of vessels per trade that is geared. The data of the 480 vessels of which all data are given by Alphaliner (29/04/2011 and 02/05/2011) is used. Table 13 shows the result per trade and vessel type.

Table 13: Minimum, maximum and average properties of vessels active on the trades with West Africa.

Trade	Type of vessel	Min Nominal TEU	Max Nominal TEU	Average Nominal TEU	Min 14 ton TEU	Max 14 ton TEU	Average 14 ton TEU	Min Reefer Plugs	Max Reefer Plugs	Average Reefer Plugs	Min Speed (knots)	Max Speed (knots)	Average Speed (knots)	Min LOA (m)	Max LOA (m)	Average LOA (m)	Min T (m)	Max T (m)	Average T (m)	% geared
Asia - East Africa - West Africa	Container	1.302	8.204	4.454	1.010	6.370	3.372	50	1.120	446	18,0	32,2	22,8	166,4	334,1	249,0	9,5	14,5	12,6	37,5%
Asia - South America - West Africa	Container	4.250	7.450	5.465	2.805	5.668	3.943	360	1.700	944	22,2	24,5	23,6	260,0	299,9	276,4	12,5	14,0	13,1	0,0%
Asia - West Africa	Container	1.080	4.228	2.422	890	2.810	1.797	60	1.900	362	17,5	24,0	21,3	159,5	276,5	205,0	9,2	21,0	11,4	73,1%
	Multipurpose	965	1.052	987	644	844	684	45	150	71	16,0	17,0	16,2	154,9	160,5	156,0	10,1	17,0	11,5	100,0%
Europe - West Africa	Container	375	8.400	2.317	264	6.680	1.731	78	1.150	317	14,5	25,6	20,6	100,6	334,1	197,3	6,3	14,5	10,7	75,4%
	ConRo	800	1.790	1.008	574	1.479	737	25	100	60	15,0	21,5	19,6	182,5	216,0	205,8	9,2	12,0	9,9	95,0%
	Multipurpose	287	766	615	201	536	414	20	138	102	13,5	17,0	15,2	113,1	149,5	129,4	6,4	9,7	8,3	100,0%
Europe - West Africa - South America	ConRo	850	850	850	611	611	611	75	75	75	18,5	20,0	18,9	206,0	214,0	212,0	9,2	9,2	9,2	75,0%
Inter West Africa	Container	474	2.546	1.121	270	1.905	780	30	536	180	14,0	22,0	18,1	113,0	208,5	151,3	6,2	15,0	9,0	96,6%
	ConRo	394	394	394	278	278	278	25	25	25	15,0	15,0	15,0	121,5	121,5	121,5	5,3	5,3	5,3	0,0%
	Multipurpose	256	965	550	169	644	355	20	60	44	12,0	16,5	14,6	88,6	154,9	119,8	4,6	10,1	7,3	100,0%
Mediterranean - West Africa	Container	862	3.005	1.851	595	2.480	1.405	100	825	237	17,0	21,5	19,6	134,4	237,0	184,5	7,7	21,0	11,2	57,9%
	ConRo	200	1.068	461	139	772	328	/	/	/	15,0	21,0	17,9	105,6	216,0	157,2	5,0	9,4	6,9	20,0%
North America - South America - West Africa	ConRo	1.218	1.218	1.218	884	884	884	/	/	/	17,0	17,0	17,0	187,8	187,8	187,8	10,9	10,9	10,9	100,0%
North America - West Africa	Container	1.572	3.430	2.230	1.060	2.481	1.729	110	800	280	13,0	23,5	19,9	168,0	248,1	197,7	10,7	12,8	11,5	40,0%
	ConRo	800	800	800	574	574	574	/	/	/	20,9	20,9	20,9	210,9	210,9	210,9	9,8	9,8	9,8	100,0%
	Multipurpose	348	1.104	772	245	799	545	20	104	46	13,0	17,0	15,2	100,5	184,5	154,5	7,1	11,5	9,4	100,0%
South America - West Africa	Container	1.730	1.740	1.737	1.124	1.330	1.261	250	300	282	19,5	20,5	20,2	175,5	184,0	178,3	9,9	10,9	10,6	100,0%
	Multipurpose	639	639	639	360	360	360	60	60	60	15,0	15,0	15,0	124,2	124,2	124,2	6,6	6,6	6,6	100,0%
Entire West African container shipping market		**200**	**8.400**	**2.205**	**139**	**6.680**	**1.630**	**20**	**1.900**	**331**	**12,0**	**32,2**	**20,0**	**88,6**	**334,1**	**195,5**	**4,6**	**21,0**	**10,7**	**71,6%**

Source: Alphaliner (28/04/2011 and 02/05/2011)

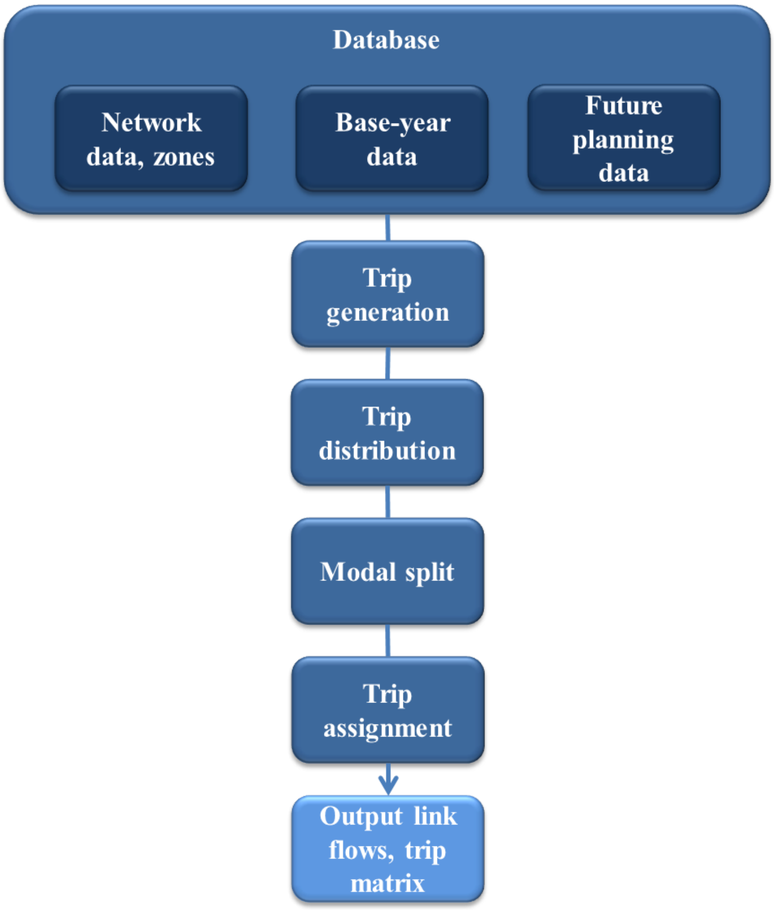
: Trades where NileDutch is active

2.3.4 Demand

The demand for shipping services is a derived demand for goods, which need to be transported by sea. The demands for this type of goods correlate with the demand for TEUs, which on their part correlate with the demand for TEU capacity. How this supplied TEU capacity is divided over the container vessels depends on the market shares per container carrier on each trade, how the market is likely to change, the container carriers strategy, and the wishes of the customer.

The demand of NileDutch in 2011 and 2015 needs to be described in TEU volume flows from port of loading (POL) to final port of discharge (FPOD). Blauwens et al. (2010) and Mathew and Krishna Rao (2007) use travel demand modelling to accomplish these objectives. The way to do this, according to Blauwens et al. (2010), Mathew, and Krishna Rao (2007), is by the use of the four-stage model (FSM) which results in a trip matrix. The four different stages are trip generation, trip distribution, modal split, and trip assignment. Figure 9 shows the general form of the four-stage model. The outcome of the trip generation and trip distribution is a trip matrix or Origin-Destination matrix as shown in Table 14.

Figure 9: General form of the four-stage model (FSM)



Source: Mathew and Krishna Rao (2007)

Table 14: Outlook trip matrix

Origen / Destination	1	2	3	…	J	Total traffic departing
1	x_{11}	x_{12}	x_{13}	…	x_{1j}	R_1
2	x_{21}	x_{22}	x_{23}	…	x_{2j}	R_2
3	x_{31}	x_{32}	x_{33}	…	x_{3j}	R_3
…	…	…	…	…	…	…
I	x_{i1}	x_{i2}	x_{i3}	…	x_{ij}	R_i
Total traffic arriving	K_1	K_2	K_3	…	K_j	X

In the trip matrix x_{ij} represents the numbers of TEUs from zone i to zone j. R_i represents the Export, K_j represents the import, and X represent the total.

X is the grand total and represents the total amount of TEUs transported in the indicated area. This number should be the sum of the totals departing traffic or the sum of the total traffic arriving.

The trip matrix makes it possible to look at four different stages of demand separately.

Trip generation: The calculation of X, R_i and K_j

Trip distribution: The distribution of K_j and R_i over separate flows x_{ij} between zones

Modal split: The determination of the share of each of the modes in the traffic flows x_{ij} .

As mentioned before the trip matrix is filled out in two stages. The first stage aims to obtain column totals for import (K_j), the row totals for export (R_i), and the grand total for export and import together (X). If no data are available for these totals, regression analysis can be executed.

The second stage aim is to obtain the x_{ij} values in the matrix. This can be done by the use of growth factors or via synthetic methods. Another way is by the use of equal staying market shares. Examples of growth factor methods are the uniform growth factor method, average growth factor method, Fratar growth method, Furness growth method, and Detroit growth factor method. Examples of synthetic methods are the gravity model, Tanner model, intervening opportunities model, and competing opportunities model.

2.3.4.1 Demand NileDutch 2011

The NileDutch 2011 trip matrix is obtained from data of NileDutch's Shipnet Agency Liner System (SNALS) (2011) database and Soft Ship Line (2011) database. The data ranges from 1 January 2007 to 31 December 2011. Table 15 shows NileDutch trip Matrix of 2011 per region. Table 118 in Appendix G shows NileDutch's trip matrix of 2011 per port. Table 15 shows a total demand for TEUs of 153.491. This trips matrix shows the imbalance of NileDutch's trade with West Africa. Clearly more full TEUs are transported to West Africa and only modest amounts are transported to Asia, Europe, and South America. There are many cells empty as NileDutch's trades are all linked to West Africa, The 88 full TEUs transported within Asia, the four full TEUs within Europe, and the three TEUS from West Africa to South America are very rare events. Paragraph 5.7 on page 191 uses this information when comparing the changes in demand and supply between 2008 and 2014.

Table 15: NileDutch 2011 full TEU trip matrix per region

Origen / Destination	Asia	Europe	South America	West Africa	Total TEU original	
Asia	88			59.913	**60.001**	**Export**
Europe		4		54.797	**54.801**	
South America				16.339	**16.339**	
West Africa	6.054	2.889	3	13.404	**22.350**	
Total TEU original	**6.142**	**2.893**	**3**	**144.453**	**153.491**	
	Import					

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011Demand NileDutch 2015

2.3.4.2 Demand NileDutch 2015

To estimate the NileDutch 2015 trip matrix econometric ARIMA models[5] are used for the forecasting and the Monte Carlo Simulation with Weibull probability density distribution are used for the prediction as described in Appendix R. The results for NileDutch's trip matrix can be seen in paragraph 3.6.2.1.2 on page 153. NileDutch's trip matrix for 2015 is obtained in two ways.

One is the forecast by the use of the trade and trade lane time series. Next, these forecasted values per trade and trade lane are further distributed over the ports in the same proportion as this was done in 2011. Therefore, the market share stay the same. As import is more important

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[5] The Univariate AutoRegressive Integrated Moving Averages ( ) models, also known by the name Box-Jenkins models, are used to forecast equally spaced univariate time series data econometrically. The model predicts one value based on a linear combination of the historical data and errors. A minimum of 50 data sets in the time series is required. Monetary time series need to be adjusted for inflation before they can be used as input values. A stationary time series is needed as an input time series. In case the original time series is not stationary, the time series is integrated or its log transformation is used is case it is stationary. In case of missing values in the time series, the conditional least squares algorithm fills in missing values by forecasting ahead from the non-missing past values as far as required with the use of the structure of the missing values. ARIMA models need to pass several tests. These tests involve the augmented Dickey-Fuller unit root test, t value test, conditional least squares estimation test, correlations of parameters test, and the autocorrelation of residuals (white noise) test. The forecasted values of a monetary time series are deflated values. The time series needs to be adjusted for inflation to obtain realistic results.

than export in West Africa. The distribution over the port is done by keeping the import share the same. Table 16 and Table 119 in Appendix G show these results. Table 16 shows a total demand for TEUs of 224.636 TEU.

The second way is the forecast by the use of the import and export time series per region. Next, these values are distributed over the trades and trade lanes in the same proportion, as this was the case in 2011. Further distribution over the ports is also done in the same proportion as this was the case in 2011. This means equal staying market shares. As import is more important than export in West Africa. The distribution over the port is done by keeping the import share the same. Table 17 and Table 120 in Appendix G show these results. Table 17 shows a total demand for TEUs of 218.248 TEU. Paragraph 5.7 on page 191 uses this information when comparing the changes in demand and supply between 2008 and 2014.

Table 16: Forecasted NileDutch 2015 trip matrix per region based on forecasts per trade and trade lane

Origen / Destination	Asia	Europe	South America	West Africa	Total TEU original	
Asia				91.690	**91.690**	**Export**
Europe				83.860	**83.860**	
South America				25.005	**25.005**	
West Africa		3.572		20.513	**24.085**	
Total TEU original	**0**	**3.572**	**0**	**221.068**	**224.639**	
	Import					

Table 17: Forecasted NileDutch 2015 trip matrix per region based on forecast of import and export totals

Origen / Destination	Asia	Europe	South America	West Africa	Total TEU original	
Asia				89.282	**89.282**	**Export**
Europe				81.658	**81.658**	
South America				24.348	**24.348**	
West Africa	2.043	975		19.975	**22.960**	
Total TEU original	**2.043**	**975**	**0**	**215.262**	**218.248**	
	Import					

2.3.4.3 Comparison demand NileDutch 2011 and 2015

Table 18 and Table 19 show the percentage change in demand for TEUs when comparing the demand for TEUs from 2011 to the two forecasted scenarios of 2015.

Table 18: Percentage change between demand for TEUs in 2011 and 2015 based on the 2015 forecasts per trade and trade lane

Origen / Destination	Asia	Europe	South America	West Africa	Total TEU original	
Asia	a			53,0%	52,8%	Export
Europe		a		53,0%	53,0%	
South America				53,0%	53,0%	
West Africa	b	23,6%	a	53,0%	7,8%	
Total TEU original	b	23,5%	a	53,0%	46,4%	
	Import					

a: No value as these data are considered negligible

b:The forecasted value resulted in an negative value, which indicated no transports of TEUs

When comparing the demand for TEUs of 2011 to the 2015 forecast based on the trade and trade lane time series it shows no transport of TEUs on the Asia - West Africa East bound trade lane. All other trades and trade lanes except the inter West Africa trade have increasing container volumes. The Asia – West Africa West bound trade lane increases by 53%. The Europe – West Africa South bound trade lane increases by 53% and the North bound trade lane by 23,6%. The South America – West Africa East bound trade lane increases by 53%. The inter West African trade decreases by 53%. Overall the TEU volumes increase by 46,4% according to this forecast.

Table 19: Percentage change between demand for TEUs in 2011 and 2015 based on the 2015 forecast of import and export totals

Origen / Destination	Asia	Europe	South America	West Africa	Total TEU original	
Asia	a			49,0%	48,8%	Export
Europe		a		49,0%	49,0%	
South America				49,0%	49,0%	
West Africa	-66,3%	-66,3%	a	49,0%	2,7%	
Total TEU original	-66,7%	-66,3%	a	49,0%	42,2%	
	Import					

a: No value as these data are considered negligible

When comparing the demand for TEUs of 2011 to the 2015 forecast based on the import and export, time series it shows decreasing TEU volumes on the outbound trade lanes and decreasing TEU volumes on the inbound trade lanes. Meaning that the import is increasing and the export is decreasing of West Africa. The Asia – West Africa West bound trade lane increases by 49%, the East bound trade lane decreases by 66,3%. The Europe – West Africa South bound trade lane increases by 49% and the North bound trade lane decreases by 66,3%.

These decreases are explained by a drop in demand. NileDutch calculations department (11/02/2015) showed a demand of 764TEU for Europe – West Africa North bound for 2014. For Asia – West Africa East bound they showed decreases to 4.900 TEU for 2012, 5.100TEU for 2013 and 6.100TEU for 2014. Thus a decrease and equal situation was noticeable between 2011 and 2014. The South America – West Africa East bound trade lane increases by 49%. The inter West African trade increases by 49,0%. Overall the TEU volumes increase by 42,2% according to this forecast. Overall the TEU volumes increase by 42,2% according to this forecast.

2.3.5 Supply

The capacity of the West African container shipping market is expressed in TEU and 14 ton TEU based on the nominal and 14 ton TEU capacities of the container vessels active in the West African container shipping market. A list is obtained with container vessels and their specifications including the nominal TEU and 14 ton TEU capacities. This way the TEU and 14 ton TEU capacities of the entire West African container shipping market and NileDutch are obtained for 2011. It is more important to look at the 14 ton TEU capacities, as this capacity approximates the full TEUs capacities that are supplied. The TEU capacities on the other hand indicate the supply provided by the nominal TEU capacity of the container vessels for the available slots on board. As there are deadweight and stability restrictions per container vessels, these slots cannot be filled with full TEUs in reality. In reality, they are filled with both full and empty TEUs.

For 2015, a fleet advice is given to NileDutch for four different scenarios. Per scenario the TEU and 14 ton TEU capacities of the fleet is displayed based on the nominal TEU and 14 ton TEU capacities of the container vessels. This advice is based on a computer model of which the modelling is described in chapter 3 on page 74. The Verification and validation of the computer model can be found in chapter 4 on page 176. The results per scenario can be found in chapter 5 on page 178. The sensitivity analysis can be found in chapter 6 on page 194.

2.3.5.1 Supply West African container shipping market 2011

The 2011 West African container shipping market information is very limited. Dynamar (2008, 2010, and 2011) estimated the demand and the supply side for the West African container shipping trades with Asia, Europe/The Mediterranean, and the Americas for 2010. The Dynamar lists the ports in the world where the West African trades are situated. The report also contains information about each liner service active in the West African container shipping market. This information includes the container carrier, the type of liner service, the liner service's name, the port rotation schedule, the sailing frequency, the number of sailings per year, the number and type of vessels active in the liner service, the average nominal TEU capacity of the container vessels active in the container liner services, the total nominal TEU capacity per container liner service, the total nominal TEU trade capacity and the capacity share per trade for the West African container shipping market for each container carrier. Another source of information is the Alphaliner website. Compared with the Dynamar reports the website contains more detailed information about the liner services in Africa and especially about the ships deployed. The port rotation schedules contain more transshipment information than the Dynamar reports. This makes it possible to make a more detailed and extensive overview of all the ports involved in the market, where exactly the containers come from, or from which ports in the world containers to Africa are likely to come from. Contrarily to the Dynamar report, the Alphaliner website contains the specifications of each container vessel active in each container liner service at that time. More precise nominal TEU capacities of the container vessels can be obtained by collecting and processing these data. By consequence, more precise data about the total TEU capacity per liner service, per operator, per carrier, per trade, and entire West African container shipping market is obtained. The Alphaliner website, contrarily to the Dynamar report, also provides information about the total fleet per container carrier, the part of the fleet per container carrier active in the West African container shipping market, and the orders per container carrier. Both Alphaliner and Dynamar take at random samples from the market to obtain their data. Alphaliner takes more often samples than Dynamar. As the Dynamar report contains calculation mistakes at the summation and works with strong round offs, it is better to work with the data of the Alphaliner website, which are more precise. However, a critical note must be made for the Alphaliner website, as taking samples at random does not mean the information is accurate and up-to-date. Another critical note is that the information shown on the website is a snapshot of the situation around that particular point in time in. Therefore, the information only is an indication of reality.

Per liner service in the West African container shipping market Alphaliner (2011) provided data about the carriers, operators, amount of vessels, sailing frequency, duration of rotation, port rotation, transshipment ports, ports to where transshipment goes to, and the trade. Alphaliner (2011) also provided the vessels, which are active in each liner service. These data involve: the name of the vessel, the IMO number, nominal TEU capacity, 14 ton TEU capacity, reefer plugs, deadweight, vessel's type, flag, speed, length over all, beam, draft, building year, type of gears, main engine, power at maximum continuous rating (MCR), and the vessel's operator. However, the data for the duration of the rotation were incomplete for fourteen liner services. In 74 cases the 14 ton TEU capacity of the container vessels was not given. For three vessels, there were no data available at all except for an approximation of the TEU capacity. The IMO number of these three vessels was also not known.

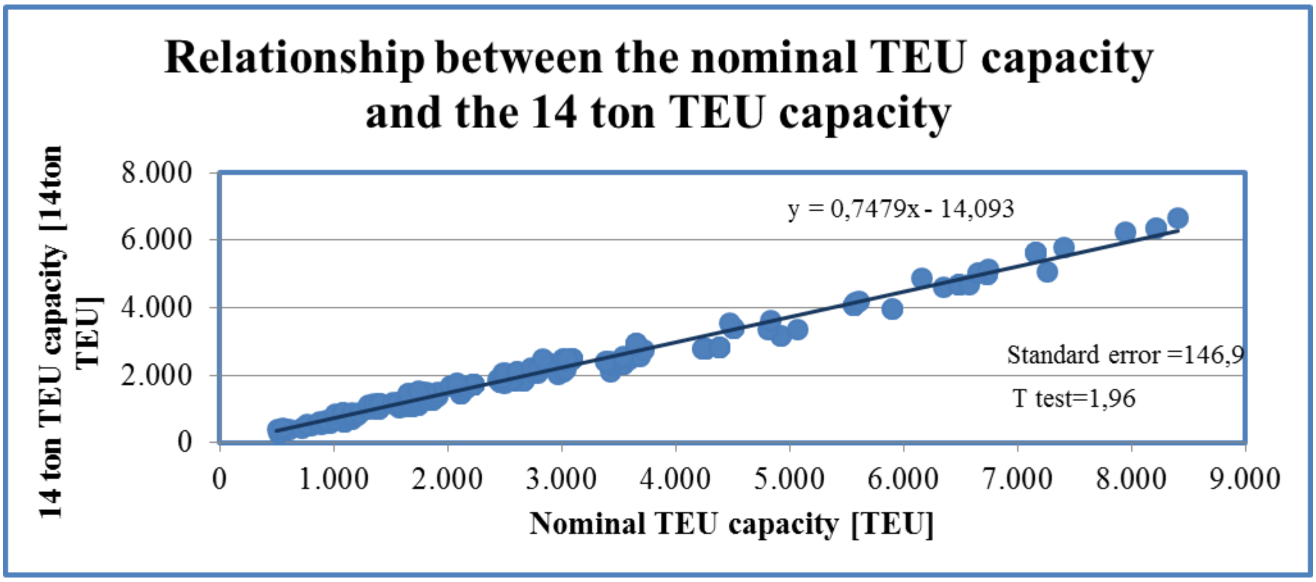
The problem with the lack of data for the duration of the rotation for fourteen liner services is solved by the use of Netpas Distance and the experience of the operations department. The result of calculations of the duration of rotation for those fourteen liner services can be found in Appendix B in Table 67 to Table 79.

The problem with the lack of information about the 14 ton TEU capacity of 74 vessels is solved by the use of regression analysis with the estimation method of least squares[6] for a linear function. In this way, the relationship between the nominal TEU capacity and the 14 ton TEU capacity of a container vessel could be determined. The regression analysis with the estimation method of least squares for a linear function is explained in Appendix I 362 vessels out of 487 are container vessels for which the nominal and the 14 ton TEU capacities are given by Alphaliner (2011). These data are subsequently used to determine the function of the 14 ton TEU capacity based on the nominal TEU capacity of a container vessel. The results are found below and in Figure 10. The standard error value is 146,9 and the t test value 1,96.

$$y = 0,7479 \cdot x - 14,093 \qquad 1$$

- x : Nominal TEU capacity of the container vessel
- y : 14 ton TEU capacity of the container vessel

Figure 10: Relationship between nominal TEU capacity and 14 ton TEU capacities of a container vessel.



Source: Alphaliner (29/04/2011 and 02/05/2011)

Note:Newly wide beam designed container vessels are not included in this data. Due to their higher stability a higher 14 ton TEU capacity is achieved in relation to the nominal TEU capacity.

[6] There are several estimation methods such are the methods of least squares and the maximum likelihood method. The method of least squares is however most often used.

Because the information provided by Alphaliner is an indication, the data of NileDutch are replaced by data from NileDutch itself. The data used for the sailing frequency and duration of rotation come from NileDutch's sailing schedules 2011. The sailing frequency and the durations of rotation are average values of the roundtrips that had a departure in 2011. The amount of vessels and the port rotation schedules come from the February 2011 sailing schedule.

The yearly TEU capacity and 14 ton TEU capacity come from NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

Further on there are two container liner services from NileDutch that have an agreement with another carrier. The agreement on the SWAX container liner service is a vessel sharing agreement between NileDutch and NYK Line. In the agreement, NileDutch can use maximum 952 slots per vessel. So the Nominal TEU and 14 ton TEU capacities are 952 (applied to data from 01/01/2011-29/08/2011) After this date the agreement became a slot agreement of the consortium of the SWAX container liner service between NileDutch and NYK Line. In the agreement, NileDutch can use maximum 100 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 100TEU (applied to data from 30/08/2011-31/12/2011). The agreement on the ECSA container liner service is a vessel sharing agreement between Delmas and NileDutch. In the agreement, the nominal TEU capacity is 970 and the 14 ton TEU capacity is 700TEU.

The database made with all these vessel and liner service information of West African container shipping market makes it possible to show information about the amount of liner services, the sailing frequency, duration of rotation, sailings per year, number of vessels, average vessel's nominal TEU capacity and 14 ton TEU capacity, total ships capacity for nominal TEU capacity and 14 ton TEU capacity, yearly trade capacity for nominal and 14 ton TEU container capacities and the share of the trade in the West African container shipping market.

For 2011 the TEU capacity, yearly TEU capacity, 14 ton TEU capacity, and yearly 14 ton TEU capacity per trade can be seen in Table 20. Table 20 shows a total nominal TEU capacity of 1.065.067 TEU, a total yearly nominal TEU capacity of 8.500.194, a total 14 ton TEU capacity of 787.450, and a total yearly 14 ton TEU capacity of 6.197.810. The percentage spreads over the trade can be seen in Figure 11 to Figure 14. The trades with Asia and Europe show to have the largest shares. About 60% combined.

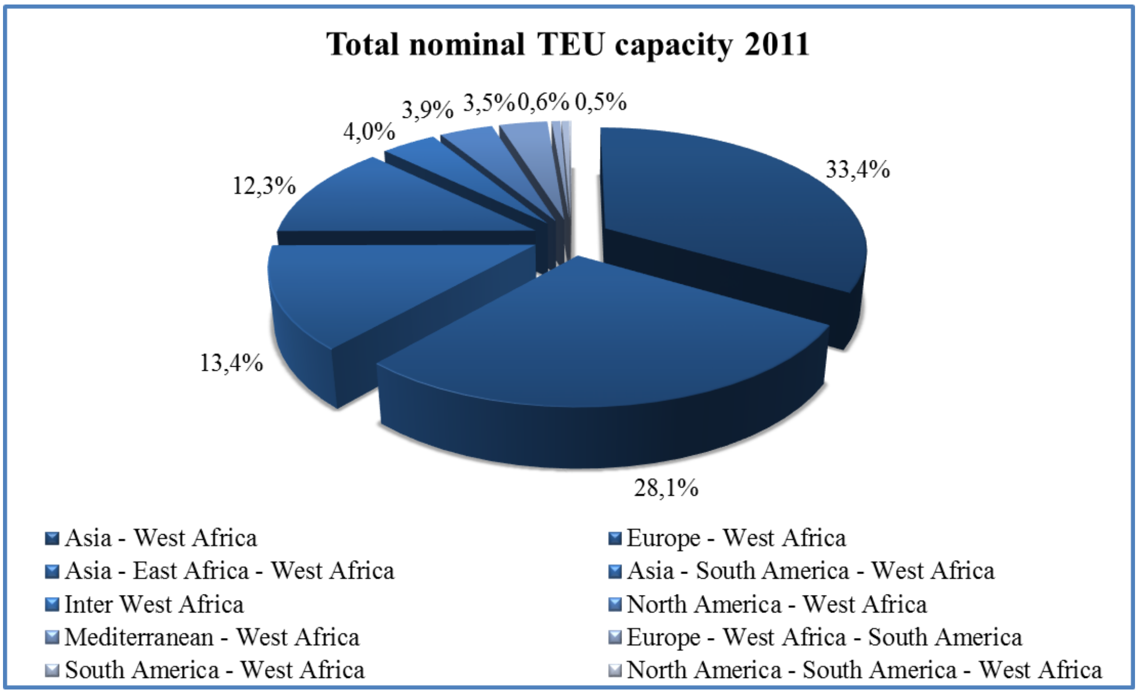
Table 20: TEU capacity and yearly TEU capacity per trade

Trade	Total nominal TEU capacity	Total yearly nominal TEU capacity	Total 14 ton TEU capacity	Total yearly 14 ton TEU capacity
Asia - East Africa - West Africa	142.526	947.395	107.913	715.917
Asia - South America - West Africa	131.153	569.891	94.625	411.168
Asia - West Africa	356.187	2.069.320	264.029	1.538.765
Europe - West Africa	299.431	2.953.943	222.347	2.184.645
Europe - West Africa - South America	6.800	39.397	4.889	28.323
Inter West Africa	42.757	1.113.148	29.275	730.042
Mediterranean - West Africa	37.470	508.486	28.330	368.953
North America - South America - West Africa	1.218	6.351	884	4.608
North America - West Africa	41.676	229.201	31.014	170.804
South America - West Africa	5.849	63.061	4.144	44.585
Total	**1.065.067**	**8.500.194**	**787.450**	**6.197.810**

Source: Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

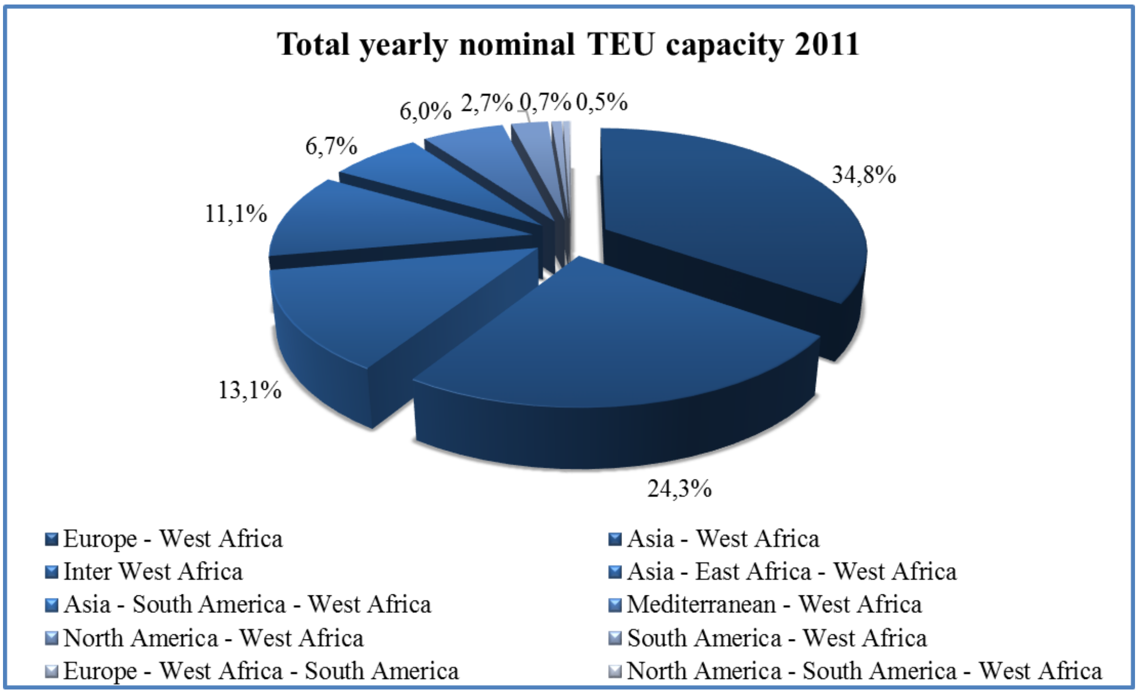
●: Trades where NileDutch is active

Figure 11: Total nominal TEU capacity per trade for 2011



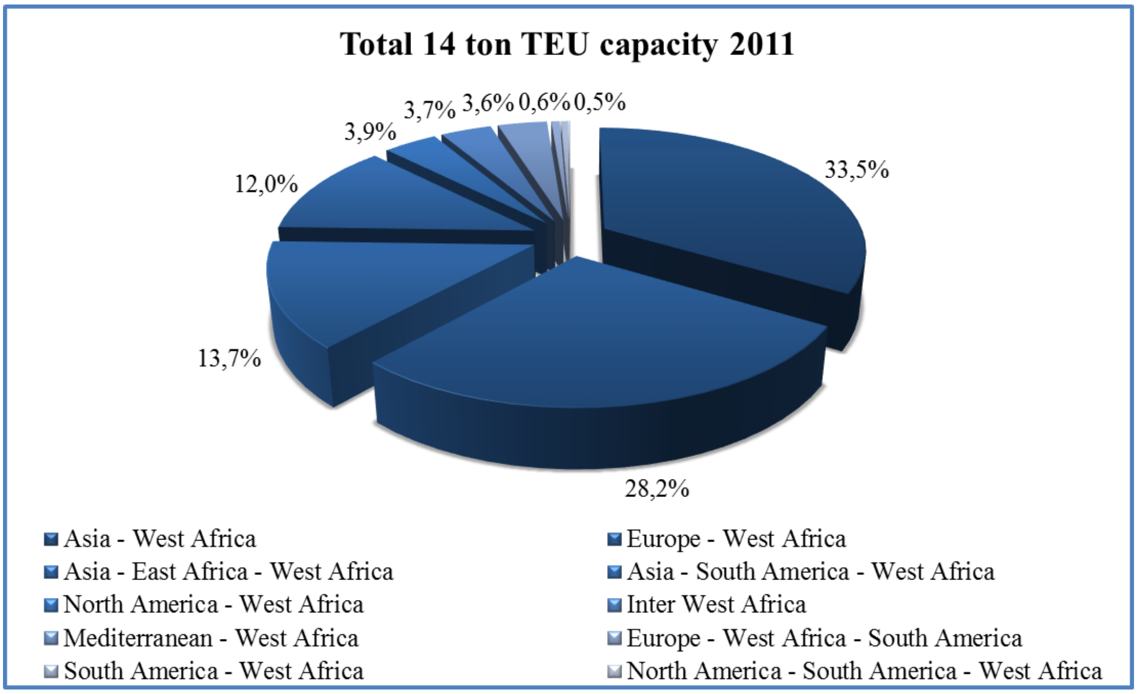
Source: Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

Figure 12: Total yearly nominal TEU capacity per trade for 2011



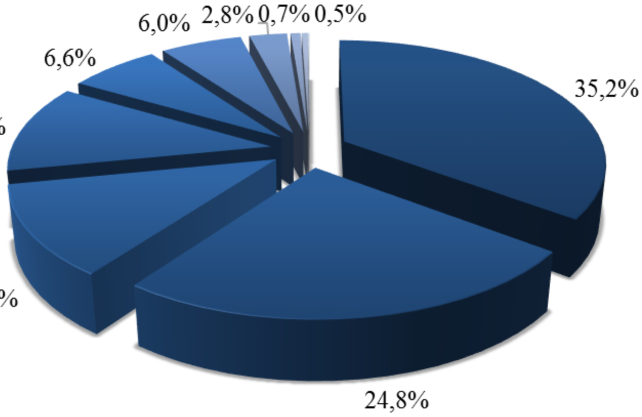
Source: Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

Figure 13: Total 14 ton TEU capacity per trade for 2011



Source: Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

Figure 14: Total yearly 14 ton TEU capacity for 2011



Source: Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

Per trade and service type in those trades totals, averages per vessel, and averages per liner service are obtained. Per liner service, the frequency of sailing is also provided. This make it possible to determine the supply for full TEUs expressed in 14 ton TEU capacity. Table 21 shows this overview per trade and vessel type. The five largest trades in the West African container shipping market based on the 14 ton TEU capacity shares are the Europe - West Africa trade (34,7%), the Asia - West Africa trade (25,1%), the inter West African trade (11,8%) , the Asia - East Africa – West Africa trade (11,7%), and the Asia –South America – West Africa trade (6,7%). Table 128 to Table 136 shows this information per liner service and Table 137 shows this information for the entire market in Appendix F. From the point of view of the operators in the market Table 22 shows the overview of each operator group in the entire market, while Table 138 to Table 146 gives this information per trade and service type and Table 147 gives the entire market overview in Appendix F. Last Table 23 shows these numbers per operator. The West African container shipping market has 45 carriers and 36 operators. The operators are divided over 31 groups. Maersk group, CMA CGM Group, and MSC Group are the lead operators of the West African container shipping market in 2011 when it comes to their annual TEU capacity. NileDutch is located at position eight in the operators list with a market share of 3.47%. Maersk group has the largest market share of 32.43%. Together with MSC Group and CMA CGM Group, they have a market share of 60%, which is more than half the West African container shipping market. Adding up the shares of MOL, Hamburg Süd, PIL Group, and CSAV Group gives a market share of 83.53%. The top 10 even represents 91,19% of the market share leaving only 8,81% market share for the remaining 21 operators.

2.3.5.1.1 General supply overview per trade

Table 21: West African trades

Trade	Liner service type	Total liner services	Average of sailing frequency per liner service (days)	Average of sailings per year per liner service	Average of sailing per year per vessel	Sailings per year per vessel	Average duration of rotation per vessel (days)	Total vessels	Average nominal TEU capacity per vessel (TEU)	Average 14 ton TEU capacity per vessel (14 ton TEU)	Total TEU capacity (TEU)	Total 14 ton TEU capacity (14 ton TEU)	Average yealry TEU capacity per vessel (TEU)	Average of yearly 14 ton TEU capacity per vessel (14 ton TEU)	Total yealry TEU capacity (TEU)	Total yearly 14 ton TEU capacity (14 ton TEU)	Share of yealry TEU capacity (TEU)	Share of yearly 14 ton TEU capacity (14 ton TEU)
Asia - East Africa - West Africa	Container	5	7,9	7,0	1,2	39,4	57,4	32	4.454	3.372	142.526	107.913	29.606	22.372	947.395	715.917	11,3%	11,7%
	Total	5	7,9	7,0	1,2	39,4	57,4	32	4.454	3.372	142.526	107.913	29.606	22.372	947.395	715.917	11,3%	11,7%
Asia - South America - West Africa	Container	2	7,0	4,3	0,4	8,7	84,0	24	5.465	3.943	131.153	94.625	23.745	17.132	569.891	411.168	6,8%	6,7%
	Total	2	7,0	4,3	0,4	8,7	84,0	24	5.465	3.943	131.153	94.625	23.745	17.132	569.891	411.168	6,8%	6,7%
Asia - West Africa	Container	19	8,5	5,7	0,8	110,6	68,1	145	2.422	1.797	351.251	260.609	14.094	10.482	2.043.633	1.519.949	24,3%	24,8%
	Multipurpose	2	27,6	5,1	3,1	15,5	94,0	5	987	684	4.936	3.420	5.137	3.763	25.687	18.816	0,3%	0,3%
	Total	21	9,2	5,7	0,8	126,1	68,9	150	2.375	1.760	356.187	264.029	13.795	10.258	2.069.320	1.538.765	24,6%	25,1%
Europe - West Africa	Container	28	8,1	11,0	2,9	329,5	38,1	114	2.317	1.731	264.173	197.332	22.815	16.963	2.600.897	1.933.826	30,9%	31,5%
	ConRo	4	9,6	8,5	1,8	35,6	43,5	20	1.008	737	20.156	14.733	8.543	6.241	170.853	124.814	2,0%	2,0%
	Multipurpose	4	8,3	8,1	1,5	31,2	48,0	21	615	414	12.922	8.704	4.887	3.257	102.623	68.407	1,2%	1,1%
	Total	36	8,3	10,3	2,6	396,2	40,2	155	1.918	1.424	297.251	220.769	18.544	13.723	2.874.373	2.127.048	34,2%	34,7%
Europe - West Africa - South America	ConRo	1	8,0	5,8	0,7	5,8	63,0	8	850	611	6.800	4.889	4.925	3.540	39.397	28.323	0,5%	0,5%
	Total	1	8,0	5,8	0,7	5,8	63,0	8	850	611	6.800	4.889	4.925	3.540	39.397	28.323	0,5%	0,5%
Inter West Africa	Container	16	9,8	27,8	14,8	428,7	21,9	29	1.121	780	32.509	22.613	26.607	17.950	771.609	520.559	9,2%	8,5%
	ConRo	0	9,0	20,3	10,1	10,1	18,0	1	394	278	394	278	7.989	5.632	7.989	5.632	0,1%	0,1%
	Multipurpose	8	13,3	32,9	17,0	288,2	18,9	17	550	355	9.354	6.030	19.352	11.801	328.987	200.615	3,9%	3,3%
	Total	24	11,0	29,5	15,5	727,0	20,7	47	899	615	42.257	28.920	23.587	15.464	1.108.585	726.806	13,2%	11,8%
Mediterranean - West Africa	Container	5	7,0	14,2	5,0	95,6	33,2	19	1.851	1.405	35.166	26.691	23.181	16.901	440.433	321.122	5,2%	5,2%
	ConRo	3	9,8	44,6	34,5	172,4	18,6	5	461	328	2.304	1.639	13.610	9.566	68.052	47.831	0,8%	0,8%
	Total	8	7,6	20,5	11,2	268,0	30,1	24	1.561	1.180	37.470	28.330	21.187	15.373	508.486	368.953	6,0%	6,0%
North America - South America - West Africa	ConRo	1	35,0	5,2	5,2	5,2	70,0	1	1.218	884	1.218	884	6.351	4.608	6.351	4.608	0,1%	0,1%
	Total	1	35,0	5,2	5,2	5,2	70,0	1	1.218	884	1.218	884	6.351	4.608	6.351	4.608	0,1%	0,1%
North America - West Africa	Container	2	9,6	5,9	0,8	7,7	64,8	10	2.230	1.729	22.297	17.292	13.590	10.438	135.899	104.379	1,6%	1,7%
	ConRo	1	15,0	8,1	2,7	8,1	45,0	3	800	574	2.400	1.723	6.489	4.658	19.467	13.973	0,2%	0,2%
	Multipurpose	4	23,0	4,3	0,9	20,6	88,4	22	772	545	16.979	11.999	3.356	2.384	73.836	52.452	0,9%	0,9%
	Total	7	18,5	5,1	1,0	36,5	77,9	35	1.191	886	41.676	31.014	6.549	4.880	229.201	170.804	2,7%	2,8%
South America - West Africa	Container	1	12,6	8,5	2,8	8,5	42,9	3	1.737	1.261	5.210	3.784	19.077	13.767	57.230	41.300	0,7%	0,7%
	Multipurpose	1	40,0	9,1	9,1	9,1	40,0	1	639	360	639	360	5.831	3.285	5.831	3.285	0,1%	0,1%
	Total	2	19,5	8,7	4,4	17,6	42,2	4	1.462	1.036	5.849	4.144	15.765	11.146	63.061	44.585	0,7%	0,7%
	Grand Total	107	9,6	10,2	3,4	1.630,5	53,3	480	2.213	1.636	1.062.387	785.517	17.533	12.785	8.416.061	6.136.977	100,0%	100,0%

Source: Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

●: **Trades where NileDutch is active**

2.3.5.1.2 Supply overview per operator group

Table 22: Supply overview per operator group

Rank	Operator group	Total vessels	Average sailing frequency per vessel (days)	Average sailings per year per vessel	Total sailing per year	Average nominal TEU capacity per vessel (TEU)	Average 14 ton TEU capacity per vessel (14 ton TEU)	Total TEU capacity (TEU)	Total 14 ton TEU capacity (14 ton TEU)	Average yealry TEU capacity per vessel (TEU)	Average yearly 14 ton TEU capacity per vessel (14 ton TEU)	Total yealry TEU capacity (TEU)	Total yearly 14 ton TEU capacity (14 ton TEU)	Share of yealry TEU capacity (TEU)	Share of yearly 14 ton TEU capacity (14 ton TEU)
1	**Maersk Group**	152	9,3	2,9	445,8	2.273	1.684	345.441	255.932	19.361	14.165	2.942.874	2.153.019	35,0%	35,1%
2	**CMA CGM Group**	76	8,2	5,7	434,8	1.699	1.255	129.133	95.344	18.377	12.924	1.396.618	982.202	16,6%	16,0%
3	**MSC Group**	45	8,5	4,8	218,2	3.611	2.776	162.514	124.914	30.867	23.455	1.388.997	1.055.481	16,5%	17,2%
4	**MOL**	21	7,7	1,4	30,4	3.708	2.504	77.877	52.577	21.347	14.591	448.287	306.405	5,3%	5,0%
5	**CSAV Group**	19	7,0	1,5	28,2	2.728	2.023	51.833	38.434	22.576	16.731	428.945	317.895	5,1%	5,2%
6	**Hamburg Süd**	11	7,0	0,4	4,0	6.140	4.670	67.536	51.372	26.678	20.293	293.460	223.224	3,5%	3,6%
7	**PIL Group**	31	10,8	0,9	28,6	1.700	1.248	52.713	38.685	9.250	6.808	286.751	211.058	3,4%	3,4%
8	**NileDutch**	19	14,0	2,9	55,7	1.947	1.443	36.992	27.426	11.576	8.533	219.941	162.127	2,6%	2,6%
9	**Grimaldi (Napoli) Group**	28	10,4	1,8	51,5	858	617	24.010	17.273	6.755	4.860	189.128	136.077	2,2%	2,2%
10	**K Line**	6	7,7	1,0	6,3	3.359	2.427	20.151	14.563	23.119	16.666	138.714	99.994	1,6%	1,6%
11	**Zim Group**	11	10,5	0,8	8,4	1.881	1.424	20.690	15.669	9.340	7.053	102.744	77.584	1,2%	1,3%
12	**CSCL**	5	9,0	0,7	3,3	2.638	1.942	13.189	9.712	13.754	10.128	68.771	50.641	0,8%	0,8%
13	**UAL**	14	10,7	2,8	39,2	571	372	7.991	5.204	4.487	2.860	62.820	40.046	0,7%	0,7%
14	**NYK Line**	3	11,4	0,7	2,1	2.664	1.860	7.992	5.580	15.692	9.590	47.077	28.771	0,6%	0,5%
15	**Hapag-Lloyd**	3	7,7	1,2	3,5	1.973	1.410	5.918	4.229	14.298	10.130	42.893	30.391	0,5%	0,5%
16	**IMTC**	2	4,0	71,0	141,9	320	225	640	450	21.089	14.736	42.178	29.472	0,5%	0,5%
17	**Lin Line**	3	7,0	2,0	6,1	2.111	1.622	6.334	4.866	13.738	10.439	41.215	31.317	0,5%	0,5%
18	**Portline**	2	15,0	6,1	12,2	1.500	1.068	3.000	2.136	18.250	12.994	36.500	25.988	0,4%	0,4%
19	**DAL**	1	7,0	1,1	1,1	4.500	3.420	4.500	3.420	33.520	25.476	33.520	25.476	0,4%	0,4%
20	**UASC**	1	7,0	3,3	3,3	2.452	1.801	2.452	1.801	31.964	23.477	31.964	23.477	0,4%	0,4%
21	**EuroAfrica**	7	7,0	1,1	7,6	539	373	3.774	2.609	4.108	2.840	28.758	19.879	0,3%	0,3%
22	**Hanjin Shipping**	1	7,0	3,3	3,3	2.078	1.650	2.078	1.650	27.088	21.509	27.088	21.509	0,3%	0,4%
23	**OPDR**	1	7,0	13,0	13,0	1.008	720	1.008	720	26.280	18.771	26.280	18.771	0,3%	0,3%
24	**MACS**	6	20,0	0,6	3,7	1.199	954	7.192	5.721	4.375	3.480	26.251	20.882	0,3%	0,3%
25	**Boluda Lines**	2	9,0	10,1	20,3	404	299	807	598	8.182	6.060	16.364	12.121	0,2%	0,2%
26	**Bacoliner**	3	15,0	2,7	8,1	650	464	1.950	1.392	5.272	3.764	15.817	11.293	0,2%	0,2%
27	**CSAL**	3	27,0	1,5	4,6	728	521	2.184	1.564	3.322	2.378	9.965	7.135	0,1%	0,1%
28	**Nordana Lines**	1	35,0	5,2	5,2	1.218	884	1.218	884	6.351	4.608	6.351	4.608	0,1%	0,1%
29	**Transinsular**	1	22,0	16,6	16,6	375	264	375	264	6.222	4.380	6.222	4.380	0,1%	0,1%
30	**Clipper Shipping Line**	1	40,0	9,1	9,1	639	360	639	360	5.831	3.285	5.831	3.285	0,1%	0,1%
31	**Angola South Line**	1	25,0	14,6	14,6	256	169	256	169	3.738	2.467	3.738	2.467	0,0%	0,0%
	Total	**480**	**9,6**	**3,4**	**1.631**	**2.213**	**1.636**	**1.062.387**	**785.517**	**17.533**	**12.785**	**8.416.061**	**6.136.977**	**100,0%**	**100,0%**

Source: Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

2.3.5.1.3 Supply overview per operator

Table 23: Supply overview per operator

Rank	Operator	Total vessels	Average sailing frequency per vessel (days)	Average sailings per year per vessel	Total sailing per year	Average nominal TEU capacity per vessel (TEU)	Average 14 ton TEU capacity per vessel (14 ton TEU)	Total TEU capacity (TEU)	Total 14 ton TEU capacity (14 ton TEU)	Average yealry TEU capacity per vessel (TEU)	Average yearly 14 ton TEU capacity per vessel (14 ton TEU)	Total yealry TEU capacity (TEU)	Total yearly 14 ton TEU capacity (14 ton TEU)	Share of yealry TEU capacity (TEU)	Share of yearly 14 ton TEU capacity (14 ton TEU)
1	Maersk Line	104	8,4	3,0	312,1	2.547	1.889	264.885	196.407	21.029	15.343	2.186.968	1.595.690	26,0%	26,0%
2	MSC	45	8,5	4,8	218,2	3.611	2.776	162.514	124.914	30.867	23.455	1.388.997	1.055.481	16,5%	17,2%
3	CMA CGM	73	8,3	4,7	345,7	1.752	1.293	127.879	94.410	18.296	12.829	1.335.578	936.550	15,9%	15,3%
4	Safmarine	34	12,3	2,7	90,8	1.717	1.274	58.383	43.316	15.485	11.567	526.506	393.271	6,3%	6,4%
5	MOL	21	7,7	1,4	30,4	3.708	2.504	77.877	52.577	21.347	14.591	448.287	306.405	5,3%	5,0%
6	CSAV	19	7,0	1,5	28,2	2.728	2.023	51.833	38.434	22.576	16.731	428.945	317.895	5,1%	5,2%
7	Hamburg Süd	11	7,0	0,4	4,0	6.140	4.670	67.536	51.372	26.678	20.293	293.460	223.224	3,5%	3,6%
8	PIL	31	10,8	0,9	28,6	1.700	1.248	52.713	38.685	9.250	6.808	286.751	211.058	3,4%	3,4%
9	NileDutch	19	14,0	2,9	55,7	1.947	1.443	36.992	27.426	11.576	8.533	219.941	162.127	2,6%	2,6%
10	Grimaldi (Napoli)	28	10,4	1,8	51,5	858	617	24.010	17.273	6.755	4.860	189.128	136.077	2,2%	2,2%
11	Delmas	11	8,8	1,5	16,8	1.708	1.266	18.793	13.929	12.843	9.510	141.278	104.614	1,7%	1,7%
12	K Line	6	7,7	1,0	6,3	3.359	2.427	20.151	14.563	23.119	16.666	138.714	99.994	1,6%	1,6%
13	OACL	3	7,0	8,7	26,1	1.127	760	3.380	2.280	29.374	19.814	88.121	59.443	1,0%	1,0%
14	Gold Star Line	10	10,9	0,7	7,0	1.901	1.444	19.006	14.438	8.811	6.689	88.109	66.886	1,0%	1,1%
15	CSCL	5	9,0	0,7	3,3	2.638	1.942	13.189	9.712	13.754	10.128	68.771	50.641	0,8%	0,8%
16	UAL	14	10,7	2,8	39,2	571	372	7.991	5.204	4.487	2.860	62.820	40.046	0,7%	0,7%
17	CoMaNav	3	4,7	29,7	89,1	418	311	1.254	934	20.347	15.217	61.041	45.652	0,7%	0,7%
18	NYK Line	3	11,4	0,7	2,1	2.664	1.860	7.992	5.580	15.692	9.590	47.077	28.771	0,6%	0,5%
19	Hapag-Lloyd	3	7,7	1,2	3,5	1.973	1.410	5.918	4.229	14.298	10.130	42.893	30.391	0,5%	0,5%
20	IMTC	2	4,0	71,0	141,9	320	225	640	450	21.089	14.736	42.178	29.472	0,5%	0,5%
21	Lin Line	3	7,0	2,0	6,1	2.111	1.622	6.334	4.866	13.738	10.439	41.215	31.317	0,5%	0,5%
22	Portline	2	15,0	6,1	12,2	1.500	1.068	3.000	2.136	18.250	12.994	36.500	25.988	0,4%	0,4%
23	DAL	1	7,0	1,1	1,1	4.500	3.420	4.500	3.420	33.520	25.476	33.520	25.476	0,4%	0,4%
24	UASC	1	7,0	3,3	3,3	2.452	1.801	2.452	1.801	31.964	23.477	31.964	23.477	0,4%	0,4%
25	EuroAfrica	7	7,0	1,1	7,6	539	373	3.774	2.609	4.108	2.840	28.758	19.879	0,3%	0,3%
26	Hanjin Shipping	1	7,0	3,3	3,3	2.078	1.650	2.078	1.650	27.088	21.509	27.088	21.509	0,3%	0,4%
27	OPDR	1	7,0	13,0	13,0	1.008	720	1.008	720	26.280	18.771	26.280	18.771	0,3%	0,3%
28	MACS	6	20,0	0,6	3,7	1.199	954	7.192	5.721	4.375	3.480	26.251	20.882	0,3%	0,3%
29	Boluda Lines	2	9,0	10,1	20,3	404	299	807	598	8.182	6.060	16.364	12.121	0,2%	0,2%
30	Bacoliner	3	15,0	2,7	8,1	650	464	1.950	1.392	5.272	3.764	15.817	11.293	0,2%	0,2%
31	Zim	1	7,0	1,4	1,4	1.684	1.231	1.684	1.231	14.635	10.698	14.635	10.698	0,2%	0,2%
32	CSAL	3	27,0	1,5	4,6	728	521	2.184	1.564	3.322	2.378	9.965	7.135	0,1%	0,1%
33	Nordana Lines	1	35,0	5,2	5,2	1.218	884	1.218	884	6.351	4.608	6.351	4.608	0,1%	0,1%
34	Transinsular	1	22,0	16,6	16,6	375	264	375	264	6.222	4.380	6.222	4.380	0,1%	0,1%
35	Clipper Shipping Line	1	40,0	9,1	9,1	639	360	639	360	5.831	3.285	5.831	3.285	0,1%	0,1%
36	Angola South Line	1	25,0	14,6	14,6	256	169	256	169	3.738	2.467	3.738	2.467	0,0%	0,0%
	Total	480	9,6	3,4	1.631	2.213	1.636	1.062.387	785.517	17.533	12.785	8.416.061	6.136.977	100,0%	100,0%

Source: Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

2.3.5.2 Supply NileDutch 2011

This paragraph treats the supply of NileDutch per trade and for the entire market. NileDutch's supply for the entire market is already partly known from the supply overview per operator. This supply however does not take the vessels sharing agreements and slot agreements into account as they are grouped per operator of the container vessel. Table 24 shows the supply quantities of NileDutch of 2011 when these agreements are taking into account. The supply of NileDutch from 2011 is obtained from the Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

Looking at the 14 ton TEU capacities in Table 24, the Asia –West Africa trade shows to be the larger trade of NileDutch in 2011 with a market share of 38,9%. The Europe – West African trade is the second largest with a share of 31,0%, the South America – West Africa trade is the smallest with a share of 10,5%. The inter West Africa trade is the third largest with a share of 19,6%.

Table 24 also gives information about the size of container vessels and their sailings. The Asia West Africa trade deploys the largest container vessels (2.554TEU) and the largest amount of container vessels (28). As the voyage in this trade are the longest, these container vessels do not have many sailings per year. The trade with the most sailings per year per container vessel is the inter West African trade. The duration of a voyage is significantly shorter and by consequence, smaller container vessels make more voyages per year. An overview of all the container vessels with their nominal TEU, 14 ton TEU, yearly nominal TEU, and yearly 14 ton TEU capacities can be found per trade in Paragraph H.1 of Appendix H. Paragraph 5.7 on page 191 uses this information when comparing the changes in demand and supply between 2008 and 2014.

Table 24: Supply NileDutch 2011

Trade	Total vessels	Average sailing frequency per vessel (days)	Average sailings per year per vessel	Total sailing per year	Average nominal TEU capacity per vessel (TEU)	Average 14 ton TEU capacity per vessel (14 ton TEU)	Total TEU capacity (TEU)	Total 14 ton TEU capacity (14 ton TEU)	Average yealry TEU capacity per vessel (TEU)	Average yearly 14 ton TEU capacity per vessel (14 ton TEU)	Total yealry TEU capacity (TEU)	Total yearly 14 ton TEU capacity (14 ton TEU)	Share of yealry TEU capacity (TEU)	Share of yearly 14 ton TEU capacity (14 ton TEU)
Asia - West Africa[a/b]	28	8,3	2,0	62	2.554	1.892	79.178	58.658	3.073	2.455	95.261	76.113	36,1%	38,9%
Europe - West Africa	15	9,7	2,5	38	2.284	1.702	34.265	25.529	5.432	4.048	81.485	60.716	30,9%	31,0%
South America - West Africa[c]	7	12,3	4,2	30	1.754	1.260	12.280	8.818	4.088	2.950	28.615	20.650	10,8%	10,5%
Inter West Africa	9	3,8	10,6	95	660	430	5.936	3.869	6.510	4.270	58.594	38.431	22,2%	19,6%
Total	**59**	**1,6**	**3,6**	**225**	**2.124**	**1.562**	**131.659**	**96.874**	**4.257**	**3.160**	**263.955**	**195.910**	**100,0%**	**100,0%**

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

a: Numbers are based on the vessel sharing agreement of the consortium in the SWAX container liner service between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. In the agreement, NileDutch can use maximum 952 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 952 (applied to data from 01/01/2011-29/08/2011)

b: Numbers are based on the slot agreement of the consortium of the SWAX container liner service between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. In the agreement, NileDutch can use maximum 100 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 100 (applied to data from 30/08/2011-31/12/2011)

c: Numbers are based on the vessel sharing agreement between Delmas and NileDutch. In the agreement, the nominal TEU capacity is 970 and the 14 ton TEU capacity is 700.

2.3.5.3 Supply NileDutch 2015

As mentioned before a fleet advice is given to NileDutch for four different scenarios for 2015. Per scenario the TEU and 14 ton TEU capacities of the fleet is displayed based on the nominal TEU and 14 ton TEU capacities of the container vessels. This advice is based on a computer model of which the modelling is described in chapter 3 on page 74. In this chapter, the results are also compared with NileDutch's supply of 2011. The Verification and validation of the computer model can be found in chapter 4 on page 176. The results per scenario can be found in chapter 5 on page 178. The sensitivity analysis can be found in chapter 6 on page 194. Paragraph 5.7 on page 191 also uses this information when comparing the changes in demand and supply between 2008 and 2014.

2.3.6 Strategy

Lorange[7] (2005) and Lorange (2009) describe shipping company strategies. Lorange (2009) splits up the value chain of shipping in four archetypes. Lorange (2005) splits up shipping company strategies in three types: commodity strategy, non-commodity strategy, and portfolio strategy. He also talks about organizational issues and the future. A conceptual model and a portfolio model can describe the strategy of the competition. What he does not include in determining a shipping companies strategy is the evolution of the company's strategy in the past. Nor does he give a profound insight about how departments work inside a shipping company to execute the company's strategy. Because of de Braal's presentation (25/11/2011) about NileDutch's strategy and how it is executed this information is provided for NileDutch.

The strategy of the players in the West African container shipping market is not determined priviously. This report will describe their trategies. Each player active in the West African container shipping market is subdivided in a group based on their total nominal TEU capacity[8]. Per group, the conceptual model is determined for their container shipping segment and the portfolio model is determined. First, the conceptual model for commodity and non-commodity strategies is explained as well as the portfolio strategy. Next, the results of the strategies applied to the four groups and onto NileDutch follow together with the comparison and conclusions.

2.3.6.1 Conceptual model for commodity and non-commodity strategy

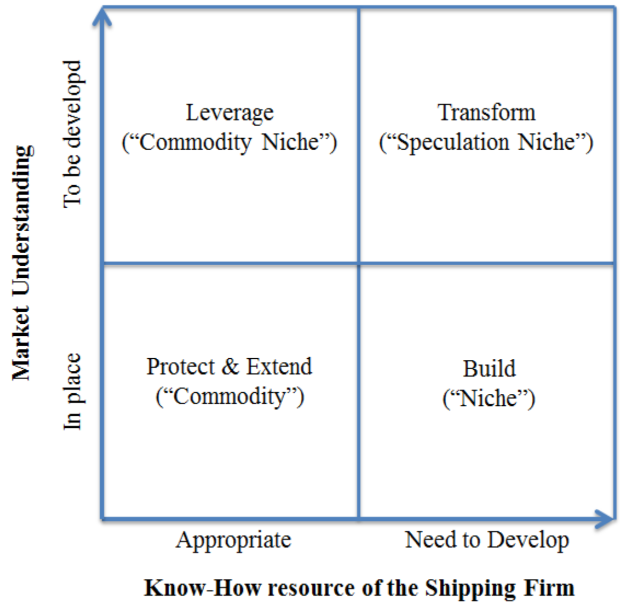
History has taught to optimize the company's strategy. Nowadays companies often strive for professionalism with financial analysis, market knowledge, and consistent right-thinking risk-taking approximations. A well puzzled-out vision and mission are essential together with a good management, which is characterized by the ability to take good thoughts for decisions, a distinct creativity, and being consequent.

When a company is active in the commodity shipping segment there are also non-commodity aspects in their strategy. Commodity strategies require right timing on the spot and long-term market as well as cutting the losses. It is important to keep the winners or copy the actions of the winners. Cost margins should be eliminated or minimized as much as possible and the economical and technological efficiency performance as high as possible. Technological efficiency can be improve by keeping technologies up-to-date and doing research & development. Examples are computer programs and recently built container vessels with better intakes and fuel consumption. For non-commodity strategies it is important to identify the market segments where the competitiveness is low and to acquire loyal customers by using the right unique competences. To get an insight in the generated growth process of industrial corporations Chakravarthy and Lorange (2004) developed a conceptual model for commodity and non-commodity shipping strategies. Next follows how this model works and needs to be interpreted as this is important to understand the results. This model can be viewed in Figure 15.

[7] Lorange has an extensive background in economy, however his knowledge about shipping is restricted. His strategy methods are therefore very much influenced by his economic background.

[8] Companies can also be subdivided based on their profitability or turnover. But in this case there opted for their total nominal TEU capacity.

Figure 15: A conceptual model for shipping strategies



Source: Chakravarthy and Lorange (2004)

The horizontal axis represents the level of specialization. This can be done by (potentially) adding appropriate competences, know-how, and technologies.

The vertical axis represents the level of newly added activities. This can be done by market understanding, close contact with certain shippers, new technologies for loading and discharging, and having knowledge of extremely specialized ship types.

Protect and extend: doing business as usual which is in essence a commodity strategy. There needs to be a good relationship with market contacts and appropriate know-how on the one hand and the shipping firm's ability to deliver on the other hand.

Leverage: accessing new market segments based on the experiences obtained in the Protect and Extend part.

Build: encloses both new technologies and new market segments.

Transform: enclosing new technologies to an already successful strategy developed under Protect and Extend.

The latter three strategies are called niche strategies and are non-commodity strategies. The non- commodity aspects involve entering new markets and using new technologies. The Protect and Extend strategy is a commodity strategy. Applying the niche strategies does not happen that often in reality. Therefore, the focus of the strategy is always on Protect and Extend as this is where the main activities are.

In general a shipping company needs to challenge the established by a constant strive for low/stable costs and good container liner services. This can be done by selecting the most efficient ship for a trade, reducing the financial risk, operations play, hedging, commercial pools, outsourcing, and customer's relations. By squeezing the cost margins, extending existing products, offering new products, and marginally strengthen existing competencies the market position of the company can be marginally improved.

Next, these cost saving methods are described briefly[9].

Efficient ships

Coming back on efficient ships, economy of scale is very important. By using larger size vessels, the costs per transported TEU are lower.

Financial risk

Handling financial risk is also important. Financial risk includes interest rates, exchange rates, and credit risk. Interest rates and exchange rates are important, as they are not included in the freight rates. The interest rate is a big cost in financing a vessel. When the interest rates drop, many costs can be saved and the money can be used for other opportunities in the market. To save on costs interest rates swaps are very often included in ship financing deals.

The effect of the exchange rate is dual: In shipping typically, the United States Dollar (USD) is used for trading, sometimes the EURO is used. Or for example the freight rates are in USD but the costs are in EURO. When these exchange rates increase it becomes interesting for USD/EURO countries to export but for non USD/EURO countries this is not so interesting anymore. Therefore, the increase in the USD/EURO does not necessarily mean freight rates go up as demand increases. When the shipping company is located in a non USD/EURO country the revenue is lower due to lower demand as there is a strong exchange rate between the USD/EURO and the local currency.

Operations play

On the operational side, money can be saved by having an operational department that works efficiently. Mainly minimisation of the costs is hereby very important. Operational costs also depend on the flag under which the vessel sails. Depending on the flag state, the operational costs can be further reduced. The nationalities of the crew can also have a significant influence on the operation costs, this because certain nationalities have lower labour costs. Which nationalities crewmember are allowed to have can be imposed by the flag state.

Hedging

Another way to cut down costs is hedging. Hedging is done by the use of contracts in volatile markets. The purpose is to fix a cost for a certain time span when the costs are expected to keep on going up. Examples of these are medium and long-term charter contracts, bunker contracts, exchange rate contracts, and interest contracts of interest swaps included in contracts. Hedging also reduces risk.

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[9] The scope of this research does not focuss costs saving methods in shipping. Not to much into depth information will be given about saving costs. It is however important that these methods are briefly explained for a better understanding of what methods a company can included in its strategy to keep costs as low as possible.

Commercial Pools

Costs can be reduced by creating commercial pools with other ship owners. In a commercial pool, several ship owners come forward as one. Consequently, the competition becomes less perfect. By working together, the service for the customer is improved. There are high quality vessels, good and timely information, and high availability of vessels. Customers do not have to wait long for the vessels, nor do they need to make adjustments. For the ship owner more data about the market becomes available. When tracking the other vessels in the market a situation is created to get to most out of charter price negotiations and still be able to meet customer requirements. This way they can reduce charter costs. The revenue per ship owner depends on the total revenue which is distributed according to a distribution key. The share of revenue an owner gets depends on their amount of vessels in the pool and on the vessel's revenue days, cargo carrying capacity, the speed, and the fuel consumption. Even an idle vessel can have revenue this way. The back draw of a commercial pool is that it might lead to less fast and less flexible business, as a decision might need to pass by several boards of directors and management levels.

Outsourcing

Outsourcing certain activities can result in lower costs. When for example outsourcing fleet management to several ship management companies, not only they benefit from their know-how and efficientcy, they are also able to benchmark one company to the other, but by keeping safety as a priority, so a better performance can be obtained. Outsourcing leads to getting the same amount of work more efficiently and effectively done. This time and quality advantage saves money.

Customer relation

The strive to constantly improve the service includes customer relations. Although shipping is a global business it is important to have a close relationship with the customer and local agencies are needed. This to know the customer's wishes in a particular region, to communicate more easily with the customer and to observe the developments of the country and its ports more closely. For the customer information technology is important to obtain information quickly, for the shipping company information service is important to have all the tools to carry out their work efficiently and effectively.

Next, the four strategies as described in Lorange (2005:24) is explained more into detail.

Protect and Extend

The protect and extend niche involves a good understanding of the market and timely decisions to be ready to anticipate on turning points in the market cycle. The establishment should constantly be challenged with the aim of always wanting to do better.

Build

The build niche is characterized by adding other businesses to the main business. This can result in growth as well. For a container shipping company this might be warehousing, harbour terminal handling, land transportation by truck or train, ownership or shareholder ship in container terminals.

Another way of applying the build strategy is by using technology. Adding for example cranes to a container vessel can have numerous advantages. When they replace existing cranes, faster container handling times can be obtained in ports. When the vessel's cranes are used together with shore cranes a faster container handling time can be obtained. When a port does not have shore cranes, a container vessel with cranes can still call this port.

Leverage

The leverage niche of the strategy is about using one's knowledge and experience to broaden the business. When for example adding reefer containers to the container fleet, the existing knowledge about containers is used to set up the reefer segment. Another example is using one's knowledge about a market when entering in a new market.

Transform

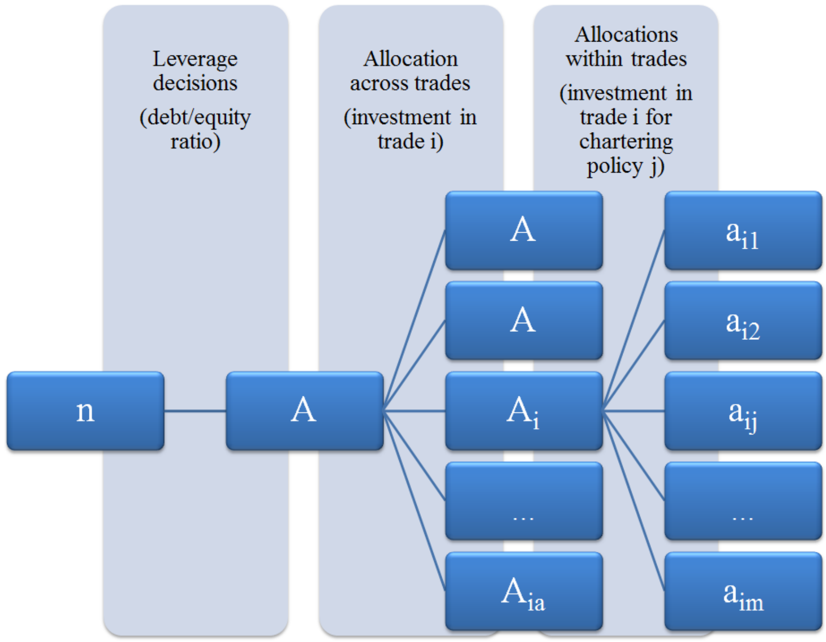
The transform niche combines entering the new markets with new competences and using new technology. However, it is uncommon to immediately move to the transform niche. Often an intermediate stop is made in the leverage or build niche.

2.3.6.2 Portfolio strategy

Portfolio strategy is based on the company's portfolio, the conception models for shipping strategies of each business in which the company is active, and the political stability of the regions in which the company is active.

A shipping company's portfolio can be determined by ways of Lorange and Norman (1973). By the use of a decision tree consisting of three parts, the company's portfolio can be determined. See Figure 16.

Figure 16: The Portfolio Decision in Shipping Companies



Source: Lorange and Norman (1973)

The first part is about leverage. The debt-capital ratio for the vessel's fleet needs to be determined. The second part is the division of the capital over the various trades where the shipping company is active. The third and final part is about chartering strategies within a trade. They can be split up further in different services or in different vessel types.

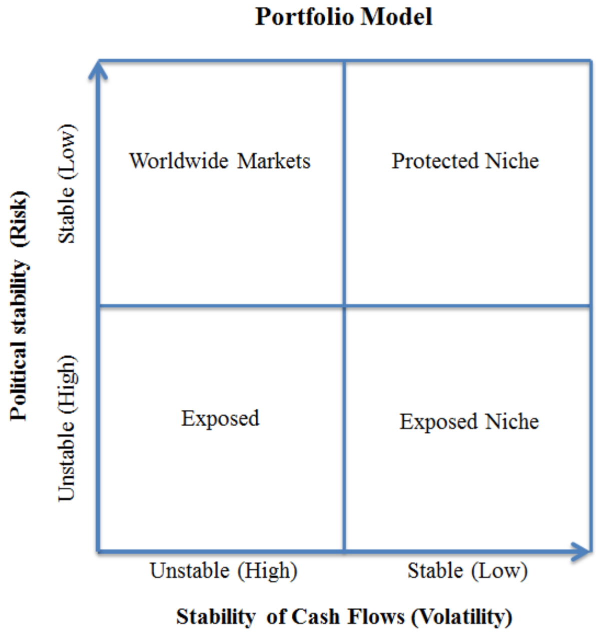
The combination of the amount of leverage and the different types of charter contracts with their corresponding durations has an influence on the stability of the cash flow. The stability of the cash flow depends on different market circumstances. In shipping, spot charters and short-term charters give unstable cash flows. Long-term charters give more stable cash flows due to the hedging advantage (on risk and costs) and owned vessels give the stable cash flow. When a company is active in different market segments, this also adds up to a more stable cash flow.

Political risks have an important role in a shipping company's portfolio model. Countries with a high political risk are unstable and countries with a low political risk are stable.

In the end it all comes down to how much risk exposure the management wants to handle and can handle.

When the portfolio, the conceptual models, and political risk are known, the portfolio model can be created as in Figure 17. Unfortunately, there is too little information available to assemble the portfolio of every competitor and group. The information that is available, however, is used to determine the portfolio strategy.

Figure 17: Portfolio model



Source: Lorange (2005)

On the x-axe and y-axe, the stability of the cash flow and the political stability are represented respectively.

Political stability

The political stability of a country in West Africa depends on its culture, language and political system. In case, a carrier or operator is active in more regions than only West Africa its political situation is considered stable. When the carriers and operators are active worldwide, their political situation is very stable.

Cash flow

When carriers and operators are only active in shipping or various parts of the container transport chain, their business is based on commodity oriented markets, which typically have unstable cash flows. When such a company has only chartered vessels this cash flow is very unstable as the charter prices fluctuate constantly in the market, in case the balance between owned and chartered vessels is fifty-fifty, the cash flow is unstable, and in case all the vessels are owned, the cash flow is slightly unstable. Short-term or spot charters tend to make the cash flow more unstable and long-term charter make it a bit more stable, but at all times the cash flow stays in the unstable region of the portfolio model. In case a company is active in non-commodity oriented markets, next to their shipping market, container market or container transport chain segments, this adds up to the stability of the cash flow. These segments do need to have a significant share in the total business of the company to work their good influence on the cash flow. When the segment is too small in comparison with the commodity markets, the cash flow does not change, but when it over classes these markets, it can even make the cash flows very stable.

2.3.6.3 NileDutch versus the competition

Next NileDutch's strategy is compared with the other type of competitors in the West African container shipping market. These competitors can be subdivided in four categories based on the total nominal TEU capacity of the existing fleet of Alphaliner's top 100 (27/07/2011) as can be seen in paragraph 2.3.3.2 on page 24: the very large competitors having a total nominal TEU capacity larger than 1.000.000TEU. The large competitors have a total nominal TEU capacity ranging from smaller than 1.000.000TEU to 100.000TEU. The medium competitors have a total nominal TEU capacity ranging from 10.000TEU to 100.000TEU and the small competitors having a smaller total nominal TEU capacity than 10.000TEU. Table 25 shows the results when all the carriers of Alphaliner's top 100 (27/07/2011) are grouped.

Table 25: Fleet specifications for the owned, chartered, ordered container vessels as well as the options per shipping company active in the West African container shipping market per competition group

	Owned				Chartered				Total existing fleet						Orderbook				Total future fleet (orders)		Options				Total future fleet (orders+options)			
Competitor's group	Nominal capacity (TEU)	# vessels	% volume	% vessels	Nominal capacity (TEU)	# vessels	% volume	% vessels	Nominal capacity (TEU)	# vessels	% volume	% vessels	% volume owned	% volume chartered	Nominal capacity (TEU)	# vessels	% volume increase	% vessels increase	Nominal capacity (TEU)	# vessels	Nominal capacity (TEU)	# vessels	% volume increase	% vessels increase	Nominal capacity (TEU)	# vessels	% volume increase	% vessels increase
Very large competitors > 1.000.000 total nominal TEU	2.655.702	518	53,1%	45,3%	3.052.718	980	55,9%	55,7%	5.708.420	1.498	54,5%	51,6%	46,5%	53,5%	1.226.702	118	21,5%	7,9%	6.935.122	1.616	216.000	14	3,1%	0,9%	7.151.122	1.630	25,3%	8,8%
Large competitors < 1.000.000 but > 100.000 total nominal TEU	2.237.608	514	44,7%	45,0%	2.315.672	702	42,4%	39,9%	4.553.280	1.216	43,5%	41,9%	49,1%	50,9%	1.029.380	125	22,6%	10,3%	5.582.660	1.341	73.600	10	1,3%	0,7%	5.656.260	1.351	24,2%	11,1%
Medium competitors < 100.000 but > 10.000 total nominal TEU	86.161	67	1,7%	5,9%	74.687	52	1,4%	3,0%	160.848	119	1,5%	4,1%	53,6%	46,4%	14.000	4	8,7%	3,4%	174.848	123	0	0	0,0%	0,0%	174.848	123	8,7%	3,4%
Small competitors < 10.000 Total nominal TEU	26.201	44	0,5%	3,8%	21.041	26	0,4%	1,5%	47.242	70	0,5%	2,4%	55,5%	44,5%	0	0	0,0%	0,0%	47.242	70	0	0	0,0%	0,0%	47.242	70	0,0%	0,0%
Total	5.005.672	1.143			5.464.118	1.760			10.469.790	2.903			47,8%	52,2%	2.270.082	247	21,7%	8,5%	12.739.872	3.150	289.600	24	2,3%	0,8%	13.029.472	3.174	24,4%	9,3%

Source: Alphaliner's top 100 and order book (27/07/2011)

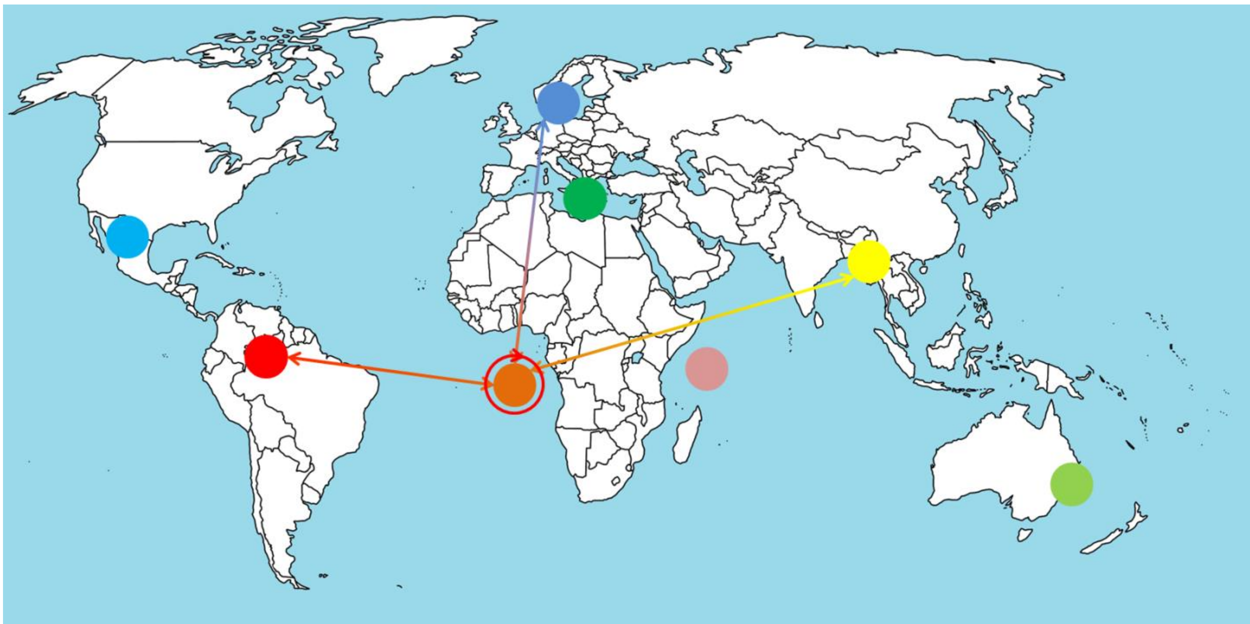
There are, however, three more competitors active in the West African container shipping market: Stiness Linien, VACS, and SOL. However, these three competitors are too small or not suited to be present in Alphaliner's top 100 (27/07/2011). The reasons being that Stiness Linien operates two chartered 1.000TEU multipurpose vessels, VUCS operates one chartered 900TEU container vessel, and SOL does not have owned or chartered container vessels, but has slot agreements with Safmarine, Maersk Line, MOL, and DAL. The names that are used in the strategy part of this thesis may differ from the names used previously as the strategy looks at the entire company and not only the part of the company active in container shipping. So Stiness Linien and VACS are too small to be present in the Alphaliner's top 100 (27/07/2011) and SOL does not have any owned or chartered vessels which can transport containers. These three competitors are added to the group of small competitors.

First the conceptual model and the portfolio model of NileDutch, the very large competitors, the large competitors, the medium competitors, and the small competitors are described. Next, these four strategies are compared with each other and discussed. Appendix J contains the conceptual model and portfolio model of each individual competitors.

NileDutch

NileDutch is a container shipping company, which is active in Asia, Europe, South America, and West Africa. Figure 18 indicates in which trades their container liner services are active. According to their total nominal TEU capacity of 36.992TEU they can be subdivide in the medium size operators group.

Figure 18: Trades NileDutch



Source: NileDutch's operations department (February 2011)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

According to Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011), NileDutch uses 19 container vessels (one container vessel is owned, 18 container vessels are chartered) for these container liner services. Their nominal TEU capacities range from 400TEU to 2.800TEU. They have four vessels on order and have four more options. Among their orders, there are container vessels that have higher nominal TEU capacities than the ones present in their fleet. More details about the orders and options can be found in Table 26. In February 2011, NileDutch has a vessel sharing agreement in the SWAX container liner service between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. In the agreement, NileDutch can use maximum 952 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 952TEU. NileDutch also has a vessel sharing agreement between Delmas and NileDutch. In the agreement, the nominal TEU capacity is 970TEU and the 14 ton TEU capacity is 700TEU.

Table 26: NileDutch: Orders and options

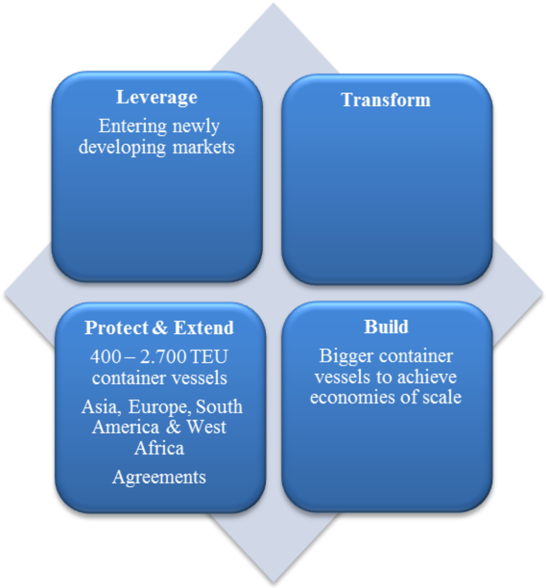
NileDutch	# vessels	TEU	Total TEU
Orders	4	3.500	14.000
Total orders	4		14.000
Options	4	3.500	14.000
Total options	4		14.000
Total	8		28.000

Source: Alphaliner (27/07/2011)

According to the presentation of de Braal (25/11/2011), eight targets have been set by NileDutch for 2015. The first target is to expand their West African container shipping market. The second target is to have more owned offices. The third target is to obtain 270-280 global marketing staff. The fourth target is to obtain 500 million euro annual revenue. A fifth target is to have an annual container volume of 300.000TEU. The sixth target is to have regular weekly container liner services by 2015. The seventh target is that container vessels with nominal capacities of 3.500TEU should become the norm in Asia. Target eight is to have a net profit margin of 5-10% by 2015.

Putting this into practice five different long-term projects should achieve seven different objectives. The first project is to strengthen and expand commerce by 65% more owned agencies that work according to the NileDutch way, have the NileDutch culture, and to get the best out of the employees so they can work more efficiently and get more work done. A second project is to speed-up the realization of global company infrastructure so employees can do their work better. For this, the WOW 2014 project needs to be speeded up. Planning and control needs to be developed and the effectiveness of the employees needs to be improved. The third project is to achieve operational excellence. For this, the operational department needs to become more transparent, more efficient, more reliable, and it needs to unite very well with the commercial department. This way the aim for operational excellence and strict cost control maximize asset utilization and protect profitability. The forth project is to realize performance and profit enhancement. The performance should improve by growing along with the market and strengthening the position in Angola and the Democratic Republic of the Congo. In other West African countries, a growth of 5-10% should be obtained and where possible they need to try to expand their market by adding new ports. There should be one weekly container liner service in Europe and South America and there should be two weekly container liner services in Asia. The South American container liner service and one of the two Asian container liner services use a vessel sharing agreement. Profit enhancement should be obtained by a costs saving program which transports more exports out of Africa so 5-6 million euro can be saved and by a better container utilization which should save 8-10 million euro. The fifth project is to control change agenda and overall human resource management & communication. Control change agenda should be obtained by track and trance possibilities for the customer and by optimizing the website so it becomes more clear what NileDutch is about and what they are doing. Overall, human resource management & communication should stimulate the talent inside the employees and new talented employees need to be recruited.

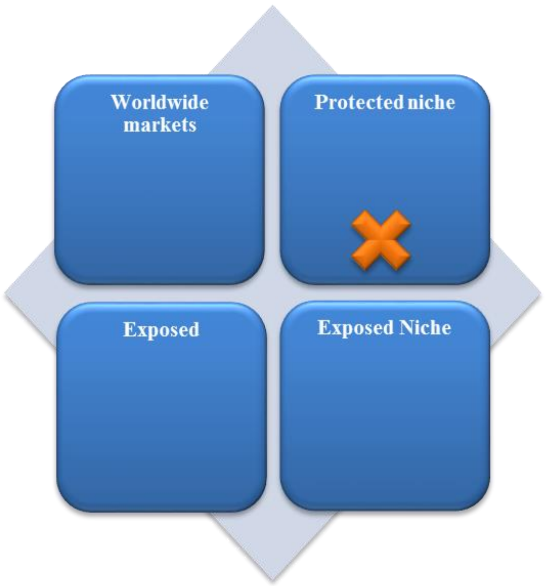
Figure 19: Conceptual model: NileDutch



Their conceptual model can be seen in Figure 19.

Their portfolio model can be seen in Figure 20. This indicates a political situation that is quite stable because all NileDutch's container liner services are active in West Africa. The cash flow is stable due to the facts that NileDutch is active in the commodity oriented container shipping market and except for one container vessel all other container vessels are chartered short-term or long-term. However, the majority of the time chartered vessels are long-term charters.

Figure 20: Portfolio model: NileDutch



Very large competitors

There are only three competitors that are part of the very large competitors group: Maersk group, MSC group, and CMA CGM group. They are active in lots of segments of the container market. Maersk Group is active in logistics and air cargo. MSC Group in logistics. CMA CGM Group is active in logistics, barging, railing trucking, container depots, and warehouses

Door-to-door container transport services are important these very large competitors. NileDutch recognizes the demand for door-to-door container transport. They offer it by the use of third party transporters.

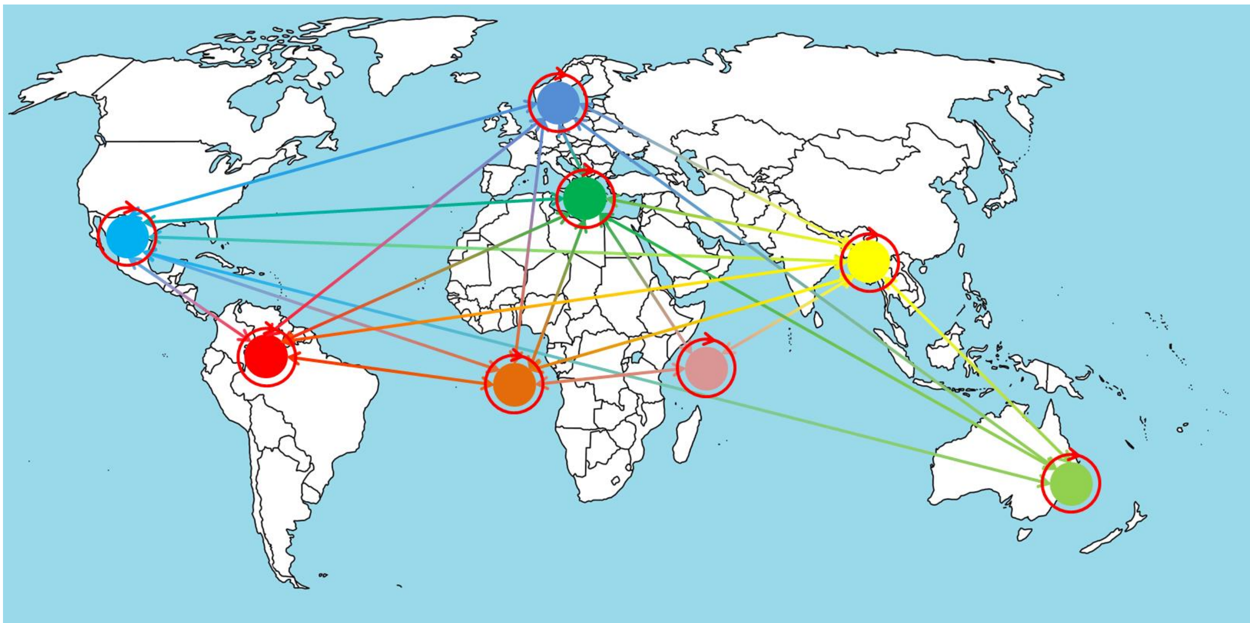
They are also active on other commodity shipping markets or markets related to this one. Maersk Group is active with tankers, FPSO[10] & LNG[11] carriers, RoRo[12] carriers, the oil & gas, and port terminals. This way they can spread their risks in the shipping market but also to be active in different segments that are related to each other in the shipping market.

Other completely different non-commodity markets in which they are present are drilling vessels, supply service vessels, towage & salvage, retail and banking for Maersk Group. MSC Group is active with cruise lines. CMA CGM Group is active in insurance brokerage, container vessel cruising, yacht cruising, and tour operating. This is also done to spread their risks or in case of interrelationships with other markets.

They have often purchased other container line companies or have merged with them to obtain world coverage with their container liner services. By purchasing or merging with companies which have experience and knowledge of a new market segment they were able to expand their coverage to world coverage and obtain more experience and knowledge about certain markets. In the future, these companies purchase and merge to obtain experience and knowledge are likely to continue as they stay on the lookout to enter newly developing container shipping markets and to become present in those markets as fast as possible. In which trades they are active can be seen in Figure 21.

[10] FPSO: Floating Production Storage and Offloading unit.
[11] Liquefied Natural Gas
[12] RORO: Roll-On Roll-Off, transportation of vehicles

Figure 21: Trades very large competitors



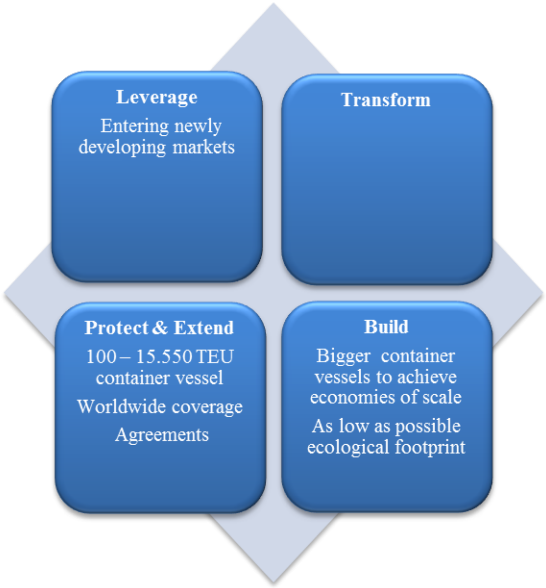
Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

According to Alphaliner's top 100 and order book (27/07/2011) their fleet consists of 1.498 container vessels (518 owned and 980 chartered) representing a total nominal TEU capacity of 5.708.420TEU. The nominal TEU capacities range from 100TEU to 15.550TEU. They own about 54.5% of the total nominal TEU capacity of the carriers active in West Africa from Alphaliner's top 100 (27/07/2011). They have orders for 118 container vessels representing a total nominal TEU capacity of 1.226.702TEU. Among their orders, there are container vessels that exceed the size of container vessels present in their fleet. The largest one is namely 18.000TEU. They have options for 14 container vessels representing a total nominal TEU capacity of 216.000TEU. They also have vessels sharing agreements and slot agreements with other operators or carriers. This indicates that they fast want to be present in newly developing markets and they want to use as much market supply capacity as possible.

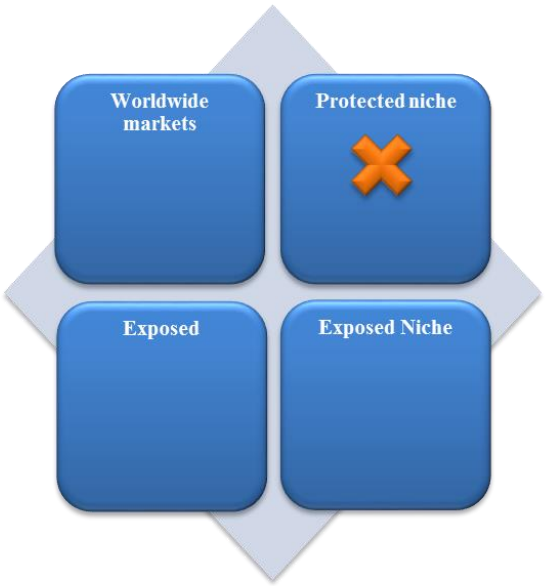
Figure 22: Conceptual model very large competitors



Economies of scale are very important for their strive for market leadership and to stay highly competitive in the market. They own the largest container vessels in the world. Examples are the container vessel Marco Polo that has a nominal TEU capacity of 16.020TEU and is operated by CMA CGM since 6/11/2012. They ordered three such container vessels in total. Maersk line owns the largest container vessels for the moment. The most well known one is named Maersk Mc-Kinney Møller, which put into service on 02/07/2013. It has a nominal TEU capacity of 18.270TEU. Maersk Line ordered 20 such container vessels in total. Operating as large as possible container vessels to meet demand also means that ports need to be ready to cope with these big size container vessels.

To defend their market position, they accept relatively modest freight rates at times. They have the possibility to do this, as they are active on trades worldwide. Therefore, they can compensate their losses elsewhere if necessary. They also strive to have an as low as possible ecological footprint per transported container. Large size container vessels contribute to this, but also container vessels with cleaner engines or a better-shaped hull, which consumes less fuel. Their conceptual model can be seen in Figure 22.

Figure 23: Portfolio model very large competitors



When looking at all the segments in which these very large competitors are active, taking into account their share and the duration of their agreements and projects it becomes clear that they are active in commodity and non-commodity markets which are spread all over the world. Because they are active in the entire world, they can easily move away from political risks if they are exposed to them. This results in a portfolio strategy with a very stable political situation. When knowing that commodity oriented markets have typically unstable cash flows, the fact that about 50% of the container vessels are chartered, which provides stable cash flows due to the hedged charter prices. Because they are also active in many and quite large non-commodity oriented markets, their cash flow is stable.

Large competitors

There are eleven competitors in the large competitors group: Hapag-Lloyd, Hanjin Shipping, CSAV Group, CSCL, MOL, Zim, NYK Line, Hamburg Süd Group, K Line, PIL Group, and UACS. They are present in a lot of container shipping markets. Besides being active in the container shipping market, they are active in the following segments of the container market. Hapag-Lloyd, Hanjin Shipping, CSAV Group, MOL, Zim, Hamburg Süd Group, PIL Group, and UACS are active in logistics. CSCL is active in logistics, air cargo, railing, trucking, container terminals, and warehouses. NYK Line is active in logistics, air cargo, and trucking. K Line is active in logistics, air cargo, and land transport. Door-to-door container transport services are important for the large competitors as well.

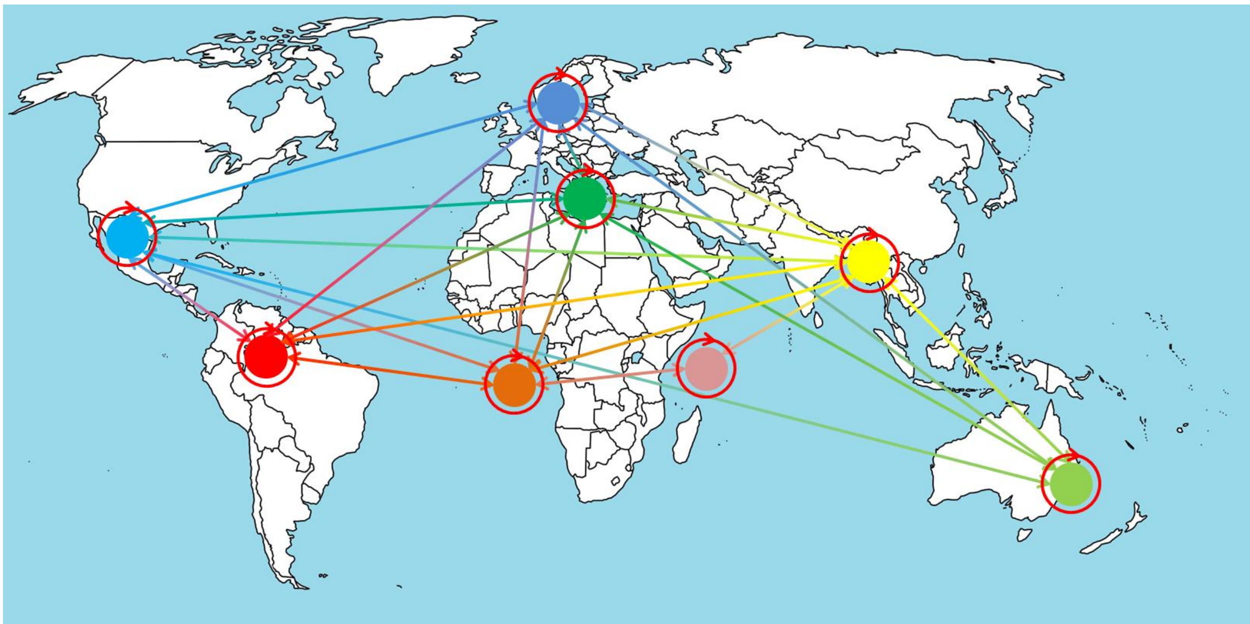
They are also active on other commodity shipping markets or related markets. Hanjin Shipping is active with bulk carriers and port terminals. CSAV Group is active with bulk carrier and RoRo[13] vessels. MOL is active with bulk carriers, tankers, LNG[14] carriers, car carriers, and port terminals. NYK Line is active with bulk carriers, tankers, LNG carriers, car carriers, ore carriers, wood chip carriers, and port terminals. Hamburg Süd Group is active with bulk carriers and tankers. K Line is active with car carriers, CNG[15] carriers, drill ships, dry bulk carriers, heavy lift ships, LNG carriers, LNG FPSOs[16], LPG carriers, product tankers, port terminals, and warehousing. They do this to spread their risks in the shipping market but also to be active in different segments that are related to each other in the shipping market.

Other completely different non-commodity markets in which they work are a ship repair yard for Hanjin Shipping. Mol is active with cruise vessels, ferries, and coastal liners. NYK Line is active with cruise vessels and real estate. Hamburg Süd Group is active in travel & event management and ship management. This is done to spread their risks or in case of interrelationships with other markets.

They often have purchased other container line companies or have merged with them to obtain world coverage with their container liner services. By purchasing or merging with companies which have experience and knowledge of a new market segments they were able to expand their coverage to world coverage and obtain more experience and knowledge about certain markets. In the future, these companies purchase and merge to obtain experience and knowledge are likely to continue as they stay on the lookout to enter newly developing container shipping markets and to become present in those markets as fast as possible. In which trades they are active can be seen in Figure 24.

[13] RoRo: Roll On/Roll Off
[14] LNG: Liquefied Natural Gas
[15] CNG: Compressed Natural Gas
[16] LNG FPSO: Liquefied natural gas Floating Production, Storage and Offloading unit

Figure 24: Trades large competitors

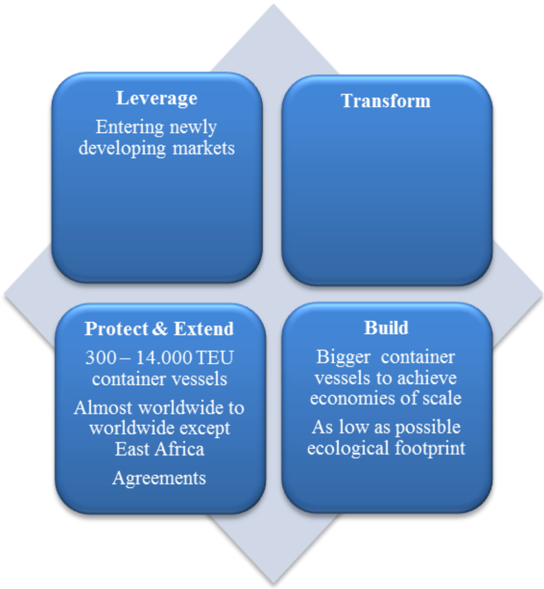


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

Figure 25: Conceptual model large competitors



According to Alphaliner's top 100 and order book (27/07/2011) their fleet consists of 1.216 container vessels (514 owned and 702 chartered) representing a total nominal TEU capacity of 4.553.280TEU. Their nominal TEU capacities range from 300TEU to 14.000TEU. They owe about 43.5% of the total nominal TEU capacity of the carriers active in West Africa from Alphaliner's top 100 (27/07/2011). They have orders for 125 container vessels representing a total nominal TEU capacity of 1.226.702TEU. They have options for 10 container vessels representing a total nominal TEU capacity of 73.000TEU. They also have vessels sharing agreements and slot agreements with other operators or carriers. This indicates they very fast want to be present in newly developing markets and that they want to use as much market supply capacity as possible. Their conceptual model can be seen in Figure 25.

Figure 26: Portfolio model large competitors

When looking at all the segments in which these very large competitors are active, taking into account their share and the duration of their agreements and projects it becomes clear that they are active in commodity and non-commodity markets. These markets are spread practically all over the world to all over the world. Because they are active in these regions, they can quite easily move away from political risks if they are exposed to them. This results in a portfolio strategy with a very stable political situation. When knowing that commodity oriented markets have typically unstable cash flows, the fact that about 50% of the container vessels are chartered which provide very stable cash flows due to the hedging of charter prices. Because some of these competitors are also active in non-commodity oriented markets, their cash flow is stable.

Medium competitors

There are five competitors in the medium competitors group: Grimaldi (Napoli) Group, Arkas Line, MACS, DAL, and Marfret.

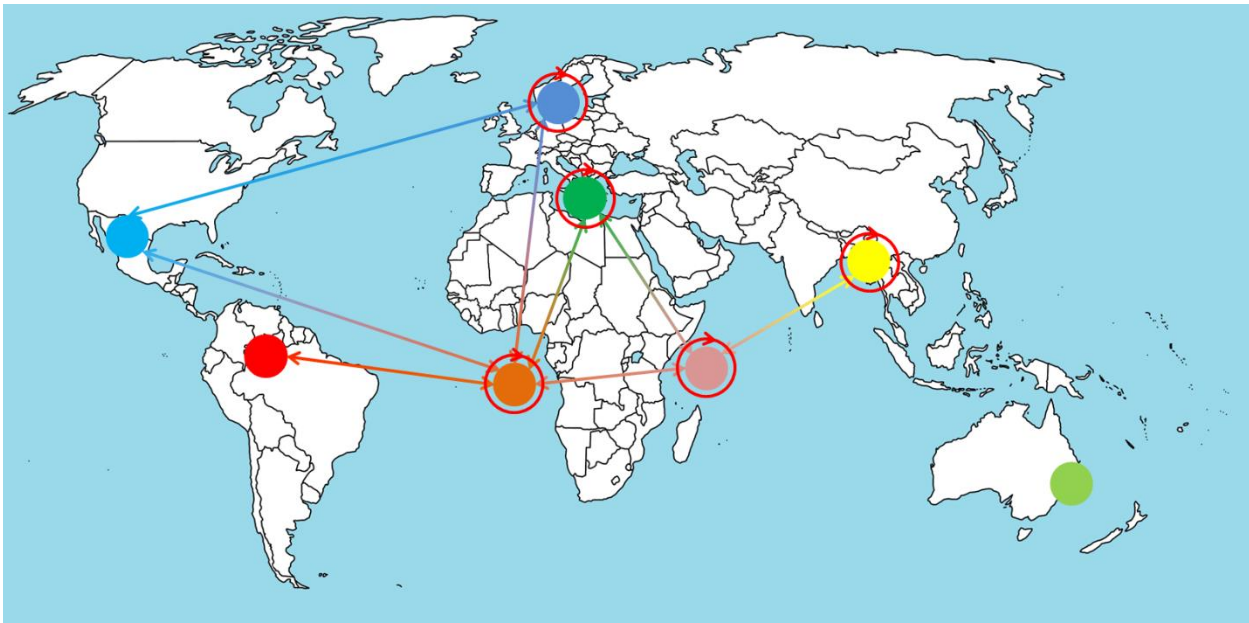
Besides being active in the container shipping market, they are active in other segments of the container market. Grimaldi (Napoli) Group is active in logistics and container terminals. Arkas Line is active in logistics, air cargo, railing, trucking, port terminals, and warehousing. MACS is active in logistics. Marfret is active in logistics, stevedoring, and warehouses. Providing Door-to-door container transport services are important for these competitors.

They are also active on other commodity shipping markets or related markets. Grimaldi (Napoli) Group is active with RoRo vessels, RoPax vessels[17], RoRo-Multipurpose car carriers, ConRo[18], and port terminals. MACS is active with multipurpose vessels for project cargoes, RoRo, heavy lifts, general cargo, dry and liquid bulk. DAL is active in the tanker and bulk segment. They do this to spread their risks in the shipping market but also to be active in different segments that are related to each other in the shipping market.

Other completely different non-commodity markets in which they work are cruise ferries and RoPax vessels for the Grimaldi (Napoli) Group Arkas Line is active in bunkering, insurances, and tourism. DAL is active in ship management and travel agency. Marfret is active in ship brokerage. These competitors do this to spread their risks or in case of interrelationships with other markets.Figure 27 shows in which trades they are active.

[17] RoPax vessel: Roll On/Roll Off and Passenger vessel
[18] ConRo vessel: Container - Roll On/Roll Off vessel

Figure 27: Trades medium competitors

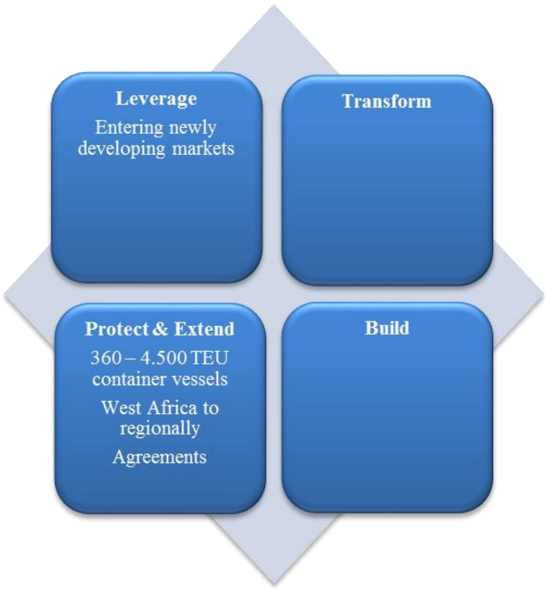


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

Figure 28: Conceptual model medium competitors



According to Alphaliner's top 100 and order book (27/07/2011) their fleet consists of 119 container vessels (67 owned and 52 chartered) representing a total nominal TEU capacity of 160.848TEU. The nominal TEU capacities range from 360TEU to 4.500TEU. Their share in the total nominal TEU capacity of the carriers active in West Africa from Alphaliner's top 100 (27/07/2011) is 1,5%.They have no orders and no options. They also have vessels sharing agreements and slot agreements with other operators or carriers. This indicates that they want to be present in newly developing markets very fast and they want to use as much market supply capacity as possible. Figure 28 shows their conceptual model.

Figure 29: Portfolio model medium competitors

When looking at all the segments in which these very large competitors are active, taking into account their share and the duration of their agreements and projects it becomes clear that they are active in commodity and non-commodity markets, which are situated in West Africa or very regionally. Because they are active in these regions, they can quite easily move away from political risks if they are exposed to them. This results in a portfolio strategy with a quite stable political situation. When knowing that commodity oriented markets have typically unstable cash flows, the fact that about 50% of the container vessels are chartered, which provides stable cash flows due to the hedged charter prices, makes the situation stable. The positive influence of the activities in the non-commodity markets does have enough positive effect on the cash flow to become more stable.

Small competitors

There are sixteen competitors in the small competitor group: OPDR, Bolunda Lines, UAL, Lin Lines, Nordana Line, EuroAfrica, Portline, Clipper Shipping Line, Traninsular, CSAL, Bacoliner, IMTC, Angola South Line, Stinnes Linien, VACS, and SOL.

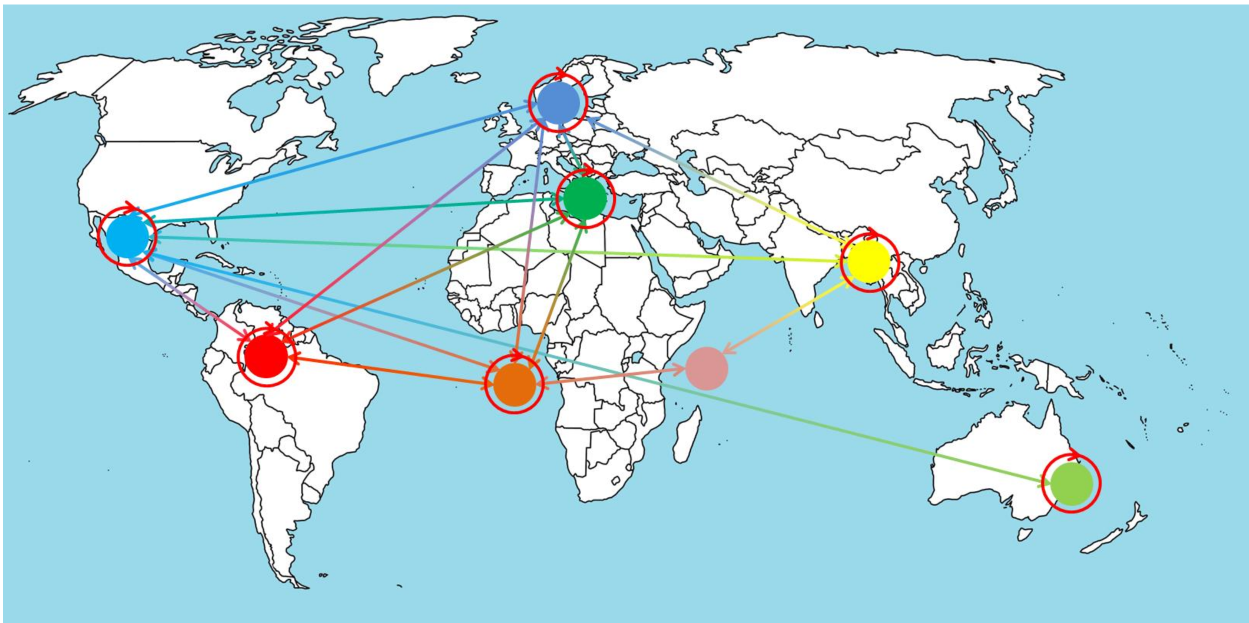
Besides being active in the container shipping market, they are active in next segments of the container market. OPDR is active in logistics, trucking, railing, and barging. Bolunda Lines is active in logistics, trucking, port terminals, and warehousing. IMTC is active in logistics, deports, and trucking. UAL, Nordana Line, EuroAfrica, Portline, and Traninsular: Angola South Line, and SOL are active in logistics. Door-to-door container transport services are important for them.

They are also active on other commodity shipping markets or related markets. OPDR is active with RoRo vessels. Bolunda Lines is active in the tanker market. UAL is active with multipurpose vessels to transport general cargo and containers. Nordana Line is active with RoRo vessels, multipurpose vessels, and tankers. EuroAfrica is active with multipurpose vessels and RoPax vessels. Portline is active with bulk carriers and warehouses. Clipper Shipping Line is active with bulk carriers, multipurpose vessels, tankers, and RoRo vessels. Traninsular is active with RoRo vessels and bulk carriers. CSAL is active with multipurpose vessels. IMTC is active with RoRo vessels and RoPax vessels. Angola South Line is active with multipurpose vessels. Stinnes Linien is active with multipurpose vessels. VACS is active with RoRo vessels. SOL is active with RoRo vessels and bulk carriers. They do this to spread their risks in the shipping market but also to be active in different segments that are related to each other in the shipping market.

Other completely different non-commodity markets in which the competitors are active are towage & salvage for Bolunda Lines. Nordana Line is active in fleet management services, project, and chartering services. EuroAfrica is active with RoPax vessels. Clipper Shipping Line is active with ferries and cruise vessels. IMTC is active with a travel agency. These competitors do this to spread their risks or in case of interrelationships with other markets.

On which trades they are active can be seen in Figure 30.

Figure 30: Trades small competitors

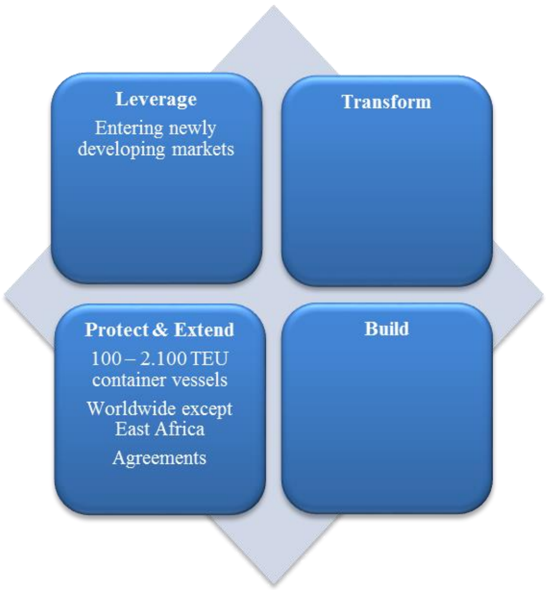


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

Figure 31: Conceptual model small competitors



According to Alphaliner's top 100 and order book (27/07/2011) their fleet consists of 70 container vessels (44 owned and 26 chartered) representing a total nominal TEU capacity of 47.242TEU. Their nominal TEU capacities range from 100TEU to 2.100TEU. They own about 0.5% of the total nominal TEU capacity of the carriers active in West Africa from Alphaliner's top 100 (27/07/2011). They also have vessels sharing agreements and slot agreements with other operators or carriers. This indicates that they very fast want to be present in newly developing markets and they want to use as much market supply capacity as possible. Their conceptual model can be seen in Figure 31.

Figure 32: Portfolio model small competitors

When looking at all the segments in which these small competitors are active, taking their share into account and the duration of their agreements and projects it becomes clear that they are active in commodity and non-commodity markets, which are situated in West Africa to regionally. Because they are active in various ports in these regions, they can more or less easily move away from political risks if they are exposed to it. This results in a portfolio strategy with a quite stable political situation. When knowing that commodity oriented markets have typically, unstable cash flows. The fact that about 50% of the container vessels are chartered which provide considerably stable cash flows due to the hedged charter prices. The positive influence of the activities in the non-commodity markets makes the cash flow more stable.

Comparison between NileDutch and its competitors

When comparing NileDutch to the competition as can be seen in Table 27 it immediately becomes clear that NileDutch is solely focusing on the container shipping market. In other segments of the container market, commodity shipping market or non-commodity shipping market, they have no activities of their own. Looking at the fact that NileDutch has solely been active in the container shipping market since 2010 after stepping out of the ConRo market means they cannot spread their risks over other type of shipping or non-shipping markets in case the West African container shipping market is not doing well. Looking at where in the world NileDutch is active compared with the competition emphasises the limited spread of risk, as they are only active on four trades, which are all related to West Africa. According to NileDutch 2011, trip matrix from paragraph 2.3.4.1 on page 32 NileDutch handles 57% of its TEUs in Angola in West Africa. This is a very significant amount of their total TEU imports. In case Angola gets political unstable or the TEU volumes decrease significantly, NileDutch faces big challenges.

Table 27: Comparison strategy NileDutch versus the competition

Subject	NileDutch	Very large competitors	Large competitors	Medium competitors	Small competitors
Number of competitors in this group	/	3	11	5	16
Provide door to door container transport services	No	3/3	10/11	3/5	9/16
Active in other segments of the container market	No	2/3	9/11	4/5	8/16
Active in other segments of the commodity shipping market	No	1/3	6/11	3/5	14/16
Active in non-commodity shipping markets or total different ones	No	3/3	5/11	4/5	6/16
Locations trades	West Africa	Worldwide	Practically worldwide to worldwide, more practically worldwide than worldwide	West Africa to regionally, more regionally than locally	West Africa to regionally, more in West Africa than regionally
Range nominal TEU capacities container vessels	400 TEU - 2.800 TEU	100 TEU - 15.550 TEU	300 TEU - 14.000 TEU	360 TEU - 4.500 TEU	100 TEU - 2.100 TEU
Owned vs chartered container vessel balance	±5% - 95%	±50% - 50%	±50% - 50%	±50% - 50%	±50% - 50%
Orders	Yes	3/3	9/11	/	/
Max size ordered container vessel	3.500 TEU	18.000 TEU	14.000 TEU	/	/
Options	Yes	2/3	2/11	/	/
Max size container vessel on option	3.500 TEU	18.000 TEU	9.000	/	/
Vessel sharing agreements	Yes	3/3	11/11	3/5	5/16
Slot agreements	Yes	3/3	11/11	3/5	2/16
Type of strategy	Fast follower	Agressive first mover	First mover - fast follower	Fast follower	Late mover

NileDutch is only active on trades with West Africa. The larger the competitor the more active they are in larger regions or worldwide. NileDutch is active on four trades out of the seven trades with West Africa. They are active on the Asia – West Africa, Europe - West Africa, South America – West Africa, and Inter West Africa trades. On The Mediterranean – West Africa, North America – West Africa, and East Africa - West Africa trades. When looking to how NileDutch spreads their risks over the trades with West Africa compared with each competitor group and taking the share of the yearly transported TEUs into account per trade as can be seen in Table 21 of paragraph 2.3.5.1.1 on page 42, it becomes clear that they are active on the trades where 72.3% of the TEUs is annually transported. This means they spread their risks quite well over their trades. This can be even more improved by becoming active on all trades with West Africa.

To miminize costs NileDutch always operates container vessels with the highest possible nominal TEU capacity on each trade. This gives economies of scale costs advantages for lower fixed costs per TEU and lower variable costs per TEU. When doing this they do take the demand and the size of ports into account. According to NileDutch's Shipnet Agency liner System (SNALS) (2011) and NileDutch's Soft Ship Line database (2011) these maximum size container vessels per trade are: 3.421TEU for Asia – West Africa, 2.481TEU for Europe – West Africa, 1.906TEU for South America – West Africa, and 1.300TEU for the inter West African trade as can be seen in Table 28. This table also shows the maximum container vessels sizes the competition operates.

Table 28: Maximum size operated container vessels per trade versus NileDutch

Trade	Max nominal size container vessel (TEU)	Operator	Max nominal size container vessel NileDutch (TEU)
Asia - East Africa - West Africa	8.204	MSC	
Asia - South America - West Africa	7.450	Maersk Line	
Asia - West Africa	4.228	K Line	3.421
Europe - West Africa	8.400	MSC	2.481
Europe - West Africa - South America	850	Grimaldi (Napoli)	
Inter West Africa	2.546	CSAV	1.300
Mediterranean - West Africa	3.005	MSC	
North America - South America - West Africa	1.218	Nordana Lines	
North America - West Africa	3.430	MSC	
South America - West Africa	1.906	CMA CGM	1.906

Alphaliner (29/04/2011 and 02/05/2011), Shipnet Agency Liner System database (2011) and Soft Ship Line database (2011).

In each group, the competitors strive to achieve costs as low as possibleby the use of economies of scale, but the larger competitors and especially the ones in the very large group are very focussed on achieving economies of scale to obtain low costs. Their strategies are to transport containers against very low costs to stay the largest in the container shipping market. In contrast to NileDutch, each competitor has a more or less 50% - 50% balance between chartered and owned container vessels. Owned container vessels have the advantage of having lower costs in comparison with chartered container vessels in the long run. Chartered container vessels are used to benefit from favourable charter prices and are used to provide the desirable TEU capacities in the fluctuating container shipping market. The competitors in the large and very large groups and NileDutch has orders and options for container vessels. This to benefit from the low newly built prices of 2011, having the long-term lower costs for owned container vessels in mind. The competitors in the two smallest groups do not have the finances to benefit from this.

Another way of keeping costs low or to benefit from opportunities in the container shipping market is to have vessel sharing agreements or slot agreements. The larger the competitor the more of these agreements they have. An on-going trend is that larger groups of competitors make agreements to improve the provided container liner services for the customers and to have lower costs when entering new markets or when a market is growing.

In general, one can say NileDutch is a first mover, but also a fast follower. The company is internally organised in such a way so short decision times are possible when wanting to adjust to changes in the market. This is for example the case when chartering different type or different size of container vessels in a short amount of time. They also have a lot of experience in starting up local agencies around the world. Their knowledge about operations and operational costs squeezes the cost margins. Their vast knowledge about the local cultures, languages, and the way of doing business, engagement with local players, personal relations, and meetings with local agencies throughout the year gives them the advance and opportunity to obtain information and use it in their advantage. Due to these first move advantages, they are able to anticipate and act ahead of market changes. However, on the commercial front they are fast followers. They do not have an in house department, which follows the markets commercial changes closely. They often purchase their information or outsource this work, which comes with a delay in time to anticipate to these changes. So on the commercial front they are fast followers. In the past NileDutch has also been a first mover, but also a fast follower in these segments.

The very large competitors are aggressive first movers, the large competitors are first movers or fast followers, the medium size competitors are fast followers and the small size competitors are late movers.

The fifty fifty balance between owned and chartered container vessels of NileDutch’s competitors is used in the calculation model which is decribed in chapter 3.

3 Modelling

A model is required to assist in determining the fleet of container vessels for four different scenarios. When the fleet is known, the supply for NileDutch for 2015 is also known. The obtained fleet aims to have the highest net results by minimalizing costs while transporting the TEU of NileDutch's 2015 trip matrix for four different scenarios and having weekly sailing frequencies. Sudden fluctuations or season changes in TEU volumes are not included in the model. The model uses a homogenious spread of the weekly TEU volumes from the trip matrixes

Two different ways are possible to obtain NileDutch's trip matrix of 2015. One is by using the TEU forecasts per trade and trade lane for 2015 and the other one by using the imported and exported TEU volumes forecasts for West Africa of 2015. NileDutch also requested to look into two supplementary scenarios, which involve changes in ports and TEU volumes. Paragraph 3.5.3 on page 85 contains more detailed information about these four scenarios.

3.1 Methodology

A method to describe and obtain the model is the process interaction modelling method described by Ottjes and Veeke (2010). This method consists of a functional analysis and three model design steps: the conceptual model, the process model[19], and the computer model.

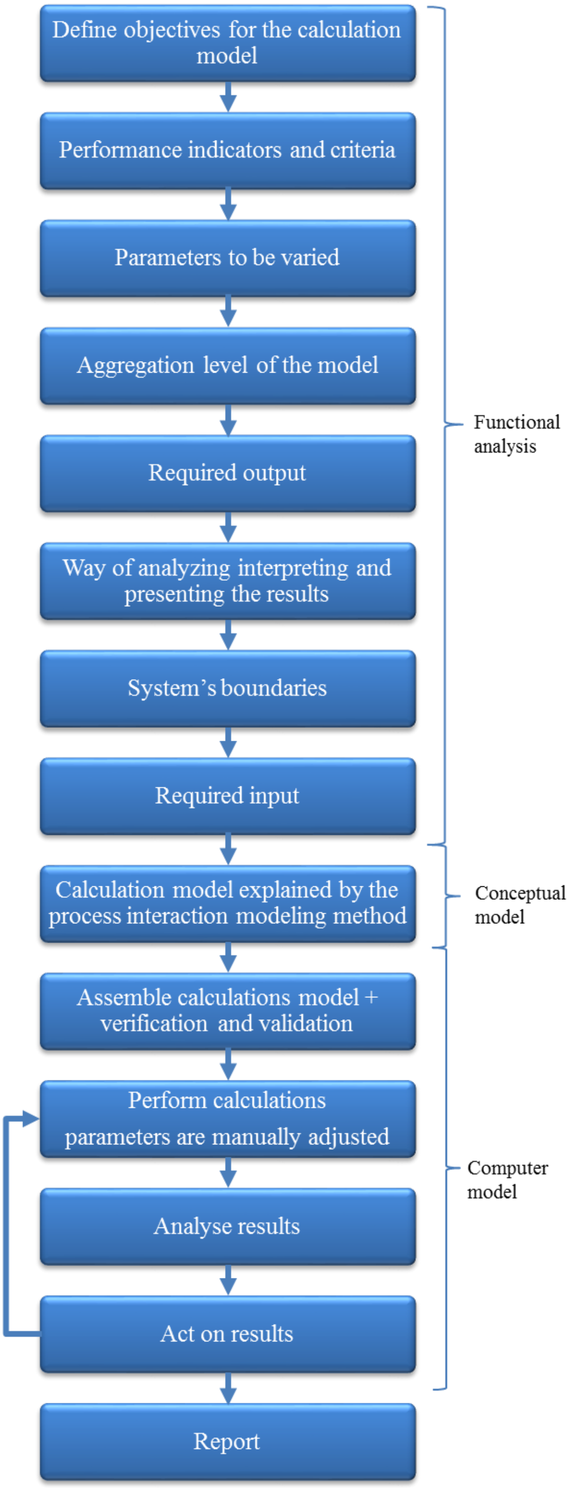
[19] The process model step is not carried out as its level of detail is not required for this master thesis.

3.2 Process interaction modelling

As mentioned before the process followed to obtain the eventual computer model is the process interaction modelling method, which is described by Ottjes and Veeke (2010). This method consists of three model design steps and a functional analysis. The three model design steps are the conceptual model, the process model, and the computer model. The process model describes into depth how the computer model works. Describing this level of detail on paper, however, is considered redundant for this master thesis and is therefore not carried out.

Ottjes and Veeke (2010) also use an experimental plan, which indicates the different required steps to obtain all information about the computer model. Figure 33 illustrates this plan. It also shows the functional analysis part, the conceptual model part, and the computer model part. The iterative character of the calculation based on manually adjusted parameters is also made visible. In case the performance indicators and the criteria are not met, the parameters are adjusted and the new results are analysed. Until the results satisfy the criteria this process is repeated.

Figure 33: Experimental plan



3.3 Conceptual model

The conceptual model defines and decomposes the system in element classes with corresponding attributes. The elements in the systems are container vessels, cranes, bunker spots, and port rotation schedules. The classes *ContainerVessel*, *PortQuay*, *Bunker*, *Voyage, and TEUDisposalShipper* are defined.

A *ContainerVessel* is defined by its nominal TEU capacity, and sails a speed which is variable. It has a certain amount of containers on board, which is called load, and in some cases, it can have the possibility to load and discharge TEUs as there are ships cranes on board the container vessels. According to the *ContainerVessels* load and speed, the container vessel has a certain fuel consumption. The *ContainerVessels* also has a time charter rate in case of a chartered container vessel or capital costs in case of an owned vessel.

PortQuay represents the cranes available in a specific port and in case the container vessel has this port as her bunker place, the bunker operations take place here as well. The cranes have a certain load and discharge capacity that is expressed in container moves per hour. Per location, there are a certain amount of TEUs that need to be loaded on the container vessels or discharged from the container vessels. It is here where TEUs enter and leave the model. The containers that need to be loaded or discharged from container vessels in specific ports depend on NileDutch's 2015 forecasted trip matrix. Each vessel that calls a port needs to pay port costs, which include general vessel expenses, general port costs, agency fees, and authority costs. Per TEU that is loaded, discharged or transhipped in this port, stevedoring costs per container need to be paid as well as commissions and container costs.

ShipQueue is the class that represents the average congestion time per port.

Bunker class represents the locations where the container vessel takes bunkers on board in the model. The time required to bunker depends on the speed of the process and is expressed in tons per hour. Table 29 indicates the elements and their corresponding attributes of this model.

TurnAroundSchedule class gives a list with ports and bunker places in case of offshore bunkering. This is the list the container vessel follows when it sails to go and load and/or discharge containers.

TEUDisposalShipper class gives a list with ports and their average stuffing and stripping time for a TEU when it is at the disposal of a shipper.

Table 29: Element classes and Attributes

Element class	Attributes
ContainerVessel	Nominal TEU capacity, speed, fuel consumption, load, discharge/load capacity
QuayCranes	discharge/load capacity, load, location
ShipQueue	Congestion pattern, location
Bunker	Bunker speed, location
Voyage	List list with ports and bunker places in case of offshore bunkering
TEUDisposalShipper	Stuffing, stripping, and voyage time

Next, a process description is assigned to each class about the movements that take place in this class:

Process PortQuay:

Repeat following actions:
- If TEUs need to be discharged work the container move time
- If TEUs need to be loaded work the container move time
- Work costs

Process ShipQueue:

Repeat following actions:
- Work the congestion time
- Work congestion costs

Process Bunker:

Repeat following actions:
- Work the bunker time
- Work bunker costs

Process Voyage:

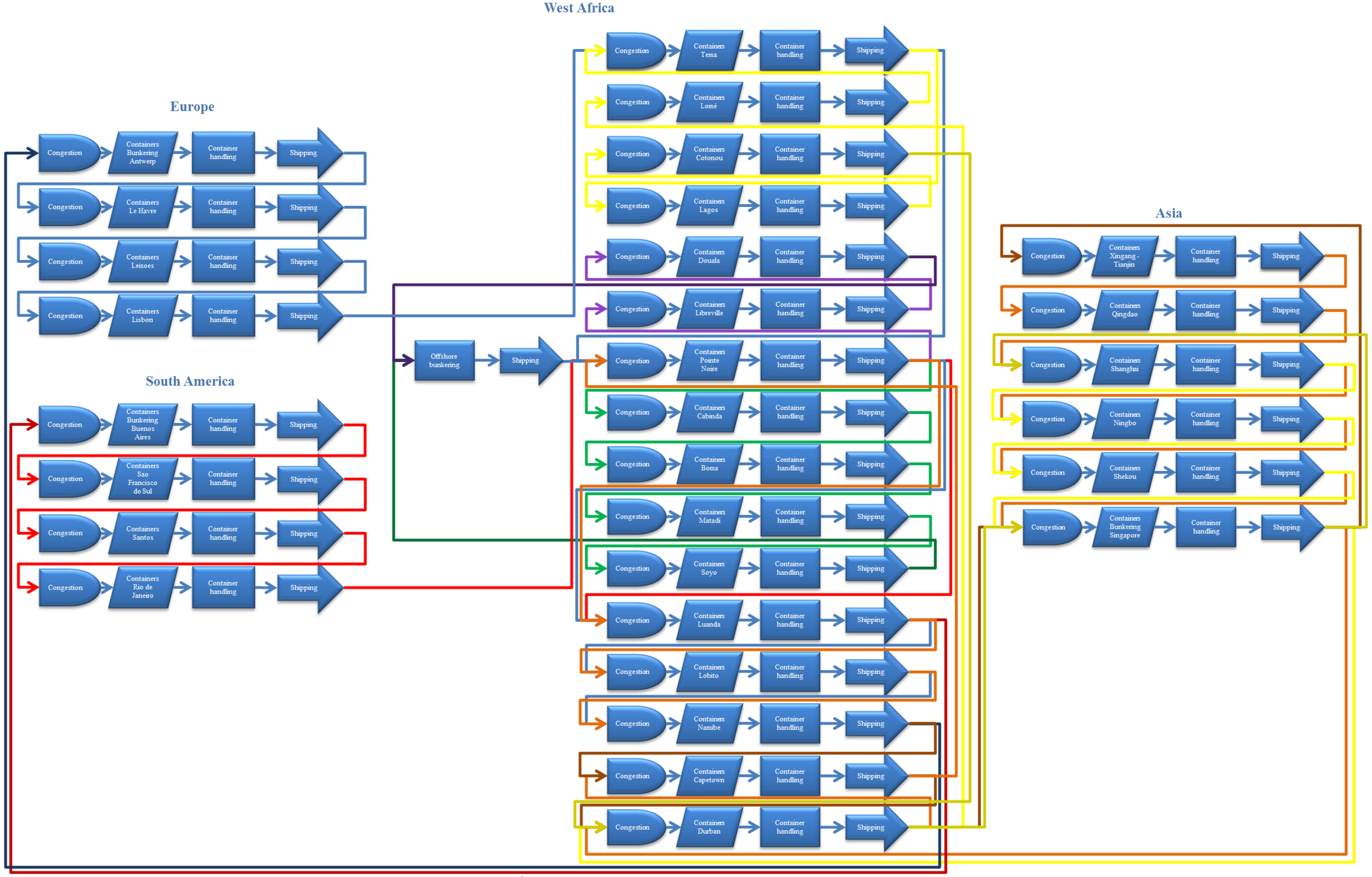
Repeat following actions:
- Work net result voyage
- Work voyage costs
- Work voyage time
- Work minimum required freight rate
- Work minimum required freight rate per mile

Process TEUDisposalShipper

- Work stuffing time
- Work voyage time
- Work Stripping time

A schematic overview of the process that describes the computer model for four different scenarios can be seen in Figure 34, Figure 35, and in Figure 36. These figures use the process mapping symbols used in Slack et al (2007:102).

Figure 34: Schematic overview turnaround schedules scenario 1 & 2 of the computer model

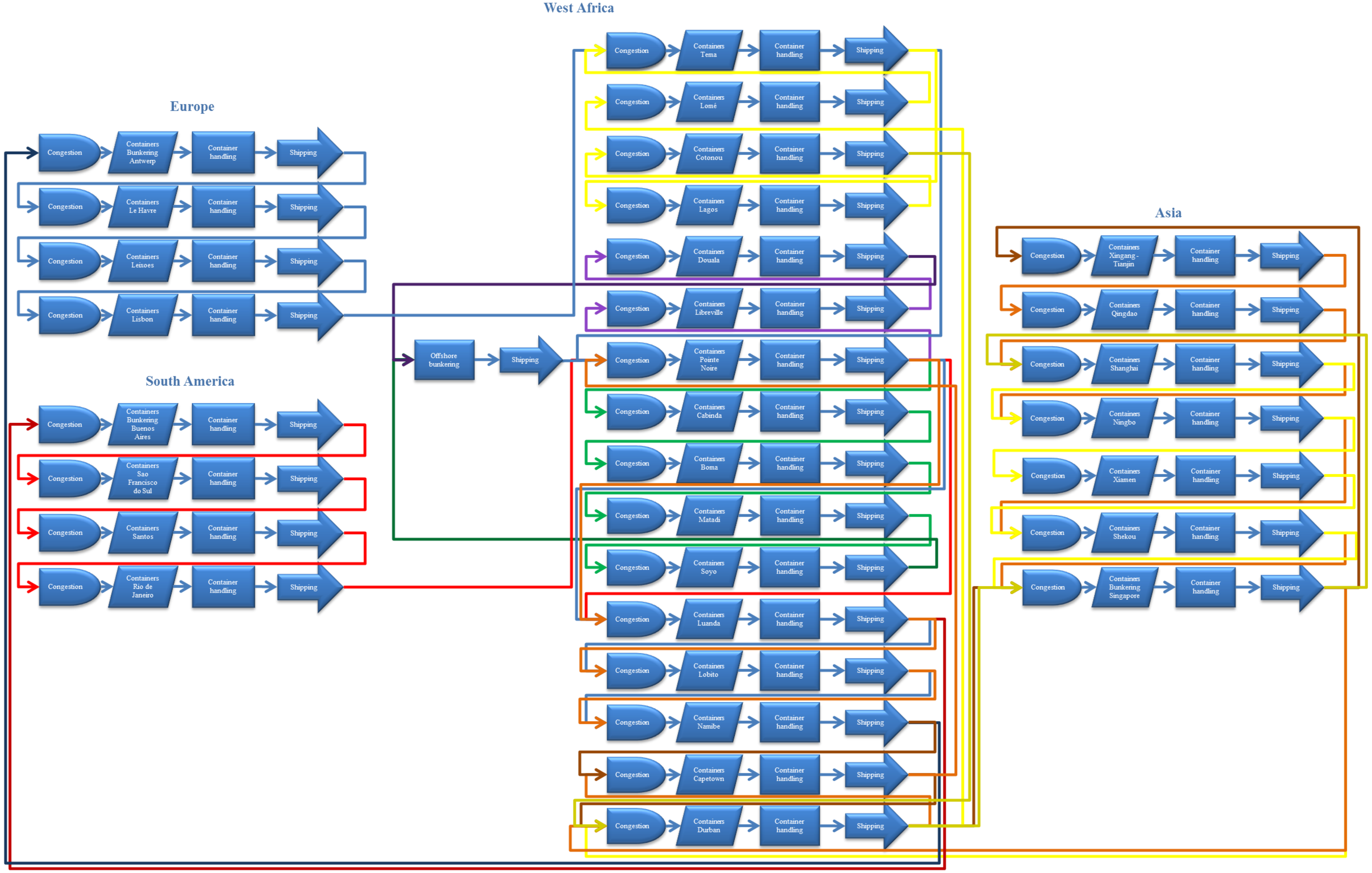


: Delay : Input or output from the process : Activity : Transport : NileDutch's SWAX container liner service, outward voyage : NileDutch's SWAX container liner service, backward voyage : NileDutch's FEWA container liner service, outward voyage

: NileDutch's FEWA container liner service, backward voyage : NileDutch's ECSA container liner service, outward voyage : NileDutch's ECSA container liner service, backward voyage : NileDutch's WAF1 container liner service, outward voyage

: NileDutch's WAF1 container liner service, backward voyage : NileDutch's WEWA container liner service, outward voyage : NileDutch's WEWA container liner service, backward voyage : NileDutch's WAF2 container liner service, outward voyage : NileDutch's WAF2 container liner service, backward voyage

Figure 35: Schematic overview turnaround schedules scenario 3 of the computer model

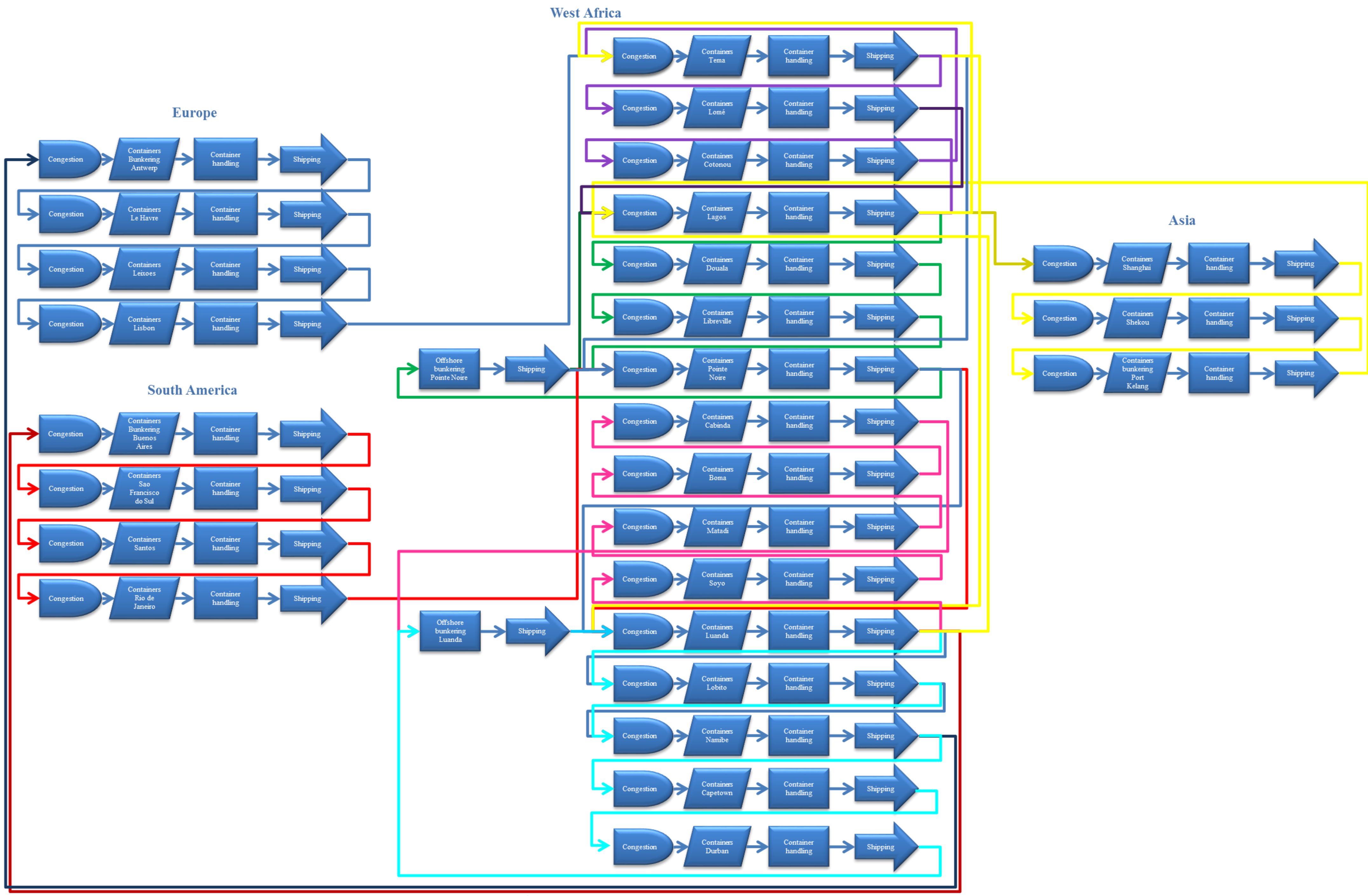


: Delay : Input or output from the process : Activity : Transport : NileDutch's SWAX container liner service, outward voyage : NileDutch's SWAX container liner service, backward voyage : NileDutch's FEWA container liner service, outward voyage

: NileDutch's FEWA container liner service, backward voyage : NileDutch's ECSA container liner service, outward voyage : NileDutch's ECSA container liner service, backward voyage : NileDutch's WAF1 container liner service, outward voyage

: NileDutch's WAF1 container liner service, backward voyage : NileDutch's WEWA container liner service, outward voyage : NileDutch's WEWA container liner service, backward voyage : NileDutch's WAF2 container liner service, outward voyage : NileDutch's WAF2 container liner service, backward voyage

Figure 36: Schematic overview turnaround schedules scenario 4 of the computer model



: Delay : Input or output from the process : Activity : Transport : NileDutch's SWAX container liner service, outward voyage : NileDutch's SWAX container liner service, backward voyage : NileDutch's FEWA container liner service, outward voyage

: NileDutch's FEWA container liner service, backward voyage : NileDutch's WAF3 container liner service, outward voyage : NileDutch's WAF4 container liner service, backward voyage : NileDutch's ECSA container liner service, outward voyage

: NileDutch's ECSA container liner service, backward voyage : NileDutch's WAF1 container liner service, outward voyage : NileDutch's WAF1 container liner service, backward voyage : NileDutch's WAF4 container liner service, outward voyage

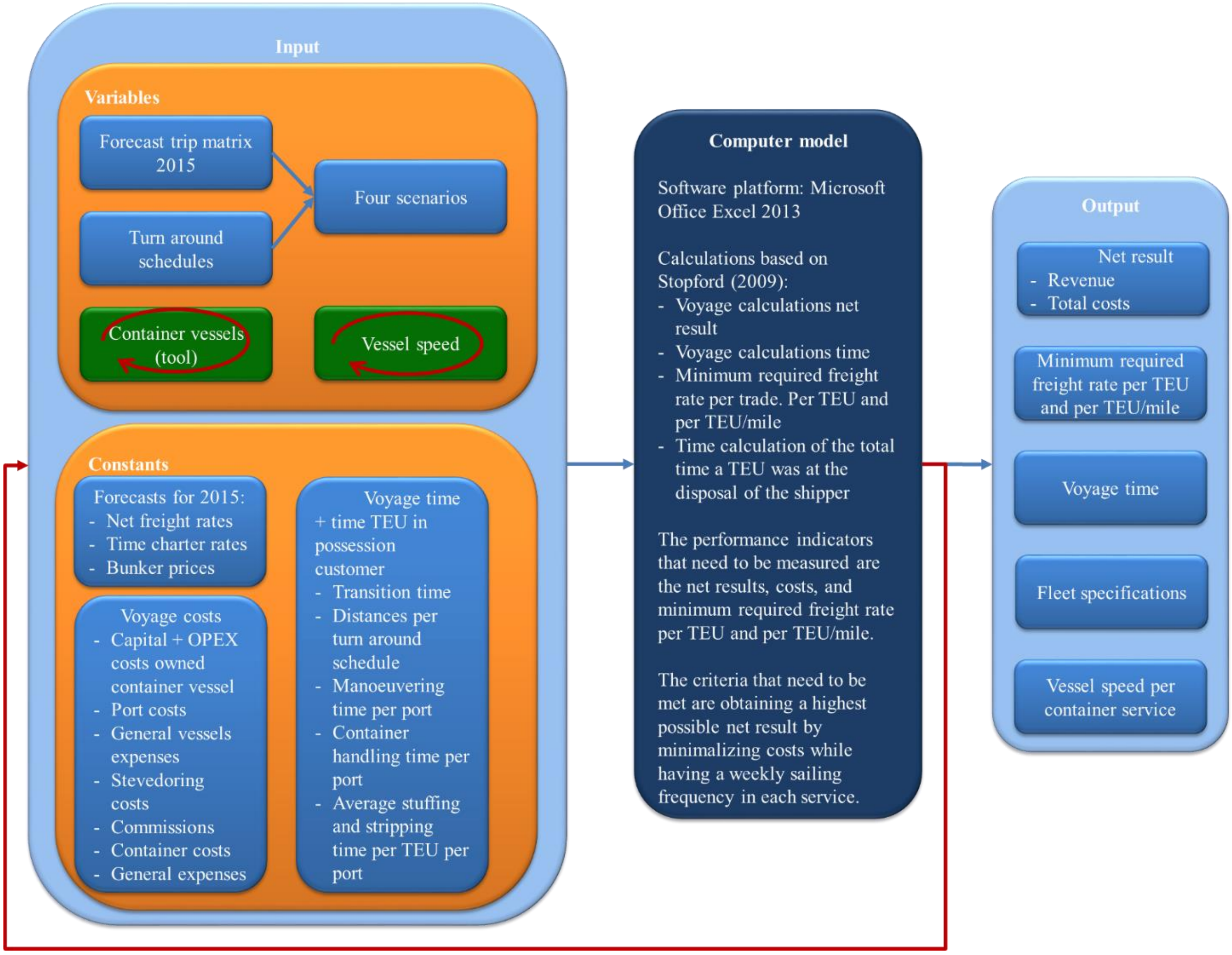
: NileDutch's WAF4 container liner service, backward voyage : NileDutch's WEWA container liner service, outward voyage : NileDutch's WEWA container liner service, backward voyage : NileDutch's WAF2 container liner service, outward voyage : NileDutch's WAF2 container liner service, backward voyage

3.4 Computer model

The computer models used the software platform of Microsoft Office Excel 2013.

How the computer models works can be explained briefly by the use of a flowchart of the model as can be seen in Figure 37.

Figure 37: Flowchart computer model



: Iterative process

The needed input for the model can be summarized as variables and constants. The variables are the trip matrixes for 2015, the turnaround schedules, container vessels, and vessel speed. The container vessels and vessel speed are indicated in green with a red arrow around it. This indicates iterative processes that are manually carried out in the computer model. The container vessels for each container liner service and are generated with a tool. The iterative process in this tool is to match the required power at maximum continuous rating (P_{MCR}) to the design speed (v_{ds}). The tool calculates the design speed based on its input values. The tool uses methods used in the earsly stages of container vessel design. More information about this tool follows in paragraph 3.5.9.1 on page 101.

There are three trip matrixes, which are combined with fixed turnaround schedules. Four combinations between trip matrixes and turnaround schedules are made, which results in four scenarios, which are calculated in the computer model. The variable container vessels contains some specific properties, which are size dependent. Paragraph 3.5.9.1 on page 101 explains this more into depth. Among the constants, there are the forecasts for the net freight rates per trade and trade lane, the time charter rates, and the bunker prices for 2015. Constants related to time calculation are the transition time (to go from service speed to manoeuvring), the distances per turn around schedule, the manoeuvring time per port, congestion time, the container handling time per port, and the average stuffing and striping time per TEU per port. Constants related to cost calculations are the capital costs for an owned container vessel, port costs, general vessel expenses, stevedoring costs, commissions, container costs, and general expenses.

The software platform for the computer model is as mentioned before Microsoft Office Excel 2013[20]. The calculations that are carried out are based on Stopford (2009). These calculations involve the net result per voyage, the voyage time, the minimum required freight rate per TEU, minimum required freight rate per TEU/mile, and the calculation of the total time a TEU was at the disposal of a shipper.

The output of the model are the net result, costs, revenue, minimum required freight rate (MRFR1), minimum required freight rate per mile (MRFR2), voyage times, fleet of container vessels, and vessels speeds.

[20] Microsoft Excel is chosen as a consequence of the advice given by Ottjes and Van Hengst. (14/05/2012)

3.5 Functional analysis

The functional analysis carries out the work to obtain enough information to design and create the computer model. It defines the objectives of the computer model, the performance indicators and criteria, parameters to be varied, aggregation level of the model, required output, way of analysing, interpreting, and presenting the results, the system's boundaries, the required input, what the computer model needs to do explained by the process interaction modelling method, assemble the computer model, perform calculations, analyse results, act on results, and process the results in the report.

3.5.1 Objectives

The main objective is to obtain a fleet of container vessels with a weekly sailing frequency, sailing in a fixed port rotation schedule of each container liner service and having the highest net results by minimalizing costs while transporting the TEU of NileDutch's 2015 trip matrix for four different scenarios. These four scenarios are explained in paragraph 3.5.3 on page 85. Four parameters can be alterated in the model to calculate new conditions. These four parameters are TEU volumes, time charter rates, net freight rates, and bunker prices.

Calculations on revenue, costs, and time need to be made for these four scenarios. To obtain revenue, cost and time data about the container vessels sailing in the container liner services when their design conditions are a sea margin of 15% at fully loaded condition and a block coefficient (C_b) of 0,65. This is the average block coefficient at the design speed draft from the 75 container vessels of the Aalbers (2008) database. The added resistance of each container vessels is 10% in service condition and each container vessels has ship cranes. The minimul vessel speed is 11knots due to engine restrictions.

A sub-objective is to obtain the forecast and prediction of NileDutch's 2015 trip matrix, net freight rates per trade and trade lane for 2015, Time charter prices of container vessels having nominal TEU capacities of 1.100TEU, 1.700TEU, 2.500TEU, 2.700TEU, 3.500TEU and 4.250TEU for 2015 and the average bunker prices for 2015. These forecasts are obtained by the use of an econometric ARIMA model and a Monte Carlo simulation using a Weibull probability density function to determine the confidence bounds of prediction.

Another sub-objective is to obtain data about the six container vessels used in the computer model. The container vessels used in the computer model need to be obtained by an early design stage of container vessels. The design conditions for these container vessels are the need to sail at a sea margin of 15% and a fully loaded condition. A sea margin of 15% means an added power of 15% on top of ideal weather conditions of the container vessel. More into debth objectives are the acquisition and analysis of ship data on which regression analysis with power function is applied, the choice of main dimensions, the resistance estimates, power estimates, fuel consumption & costs estimates, weight estimates, arrangements and stability.

3.5.2 Performance indicators and criteria

The performance indicators that are evaluated are the total costs, net results, minimum required freight rate per TEU, and minimum required freight rate per TEU/ mile. The criteria to be met are obtaining a highest possible net result by minimalizing costs while having a weekly sailing frequency in each container liner service.

Sub-performance indicators are the total costs, net results, minimum required freight rate per TEU, and minimum required freight rate per TEU/mile per trade and voyage made by a charted and owned container vessel.

3.5.3 Parameters to be varied

The trip matrix, turnaround schedules, amount of container vessels, their size, and the container vessel’s speed are the parameters.

As mentioned before the computer model carries out four scenarios. Each scenario has its specified fixed port rotation schedule and fixed trip matrix. Some scenarios have the port rotations schedules of NileDutch from 2011 and other scenarios adjusted ones. There are three trip matrixes that are used in the scenarios. The trip matrix of 2015 can be obtained in two ways. One uses the time series of the container volumes per trade and trade lane. The other one uses the imported and exported container volume time series. These forecasted container volumes are next divided over the ports of loading and final ports of discharge in the same proportion as this was done in 2011. When combining these two ways of obtaining the trip matrix for 2015 with NileDutch’s turnaround schedules of 2011, two scenarios are obtained. NileDutch requested these two scenarios to be able to compare the results the two methods to forecast the trip matrix to each other. A third scenario is obtained by adding TEU flows to the trip matrix based on the container volume time series forecasts per trade and trade lane. The ports of Abidjan and Xiamen are added to the trip matrix. Between the port of Antwerp and the port of Abidjan for 2015, 1.000 full TEUs go South bound and 1.400 full TEUs North bound. Between the port of Le Havre and the port of Abidjan in 2015, 1.000 full TEUs go South bound and 1.400 full TEUs North bound. From the port of Xiamen, full TEUs go to the port of Luanda. For 2015, 500 full TEUs go East bound and 3.000 full TEUs go West bound. NileDutch operations department expects container volumes coming from these ports and want to see how this influences the container vessels fleet. A fourth scenario is obtained by using the trip matrix based on the container volumes forecast per time series of the import and export per region and an adjusted turnaround schedule on the Asia – West Africa trade and Inter West Africa trade. NileDutch requested this scenario as one of their competitor CMA CGM with their Asia - Africa container liner service (West Africa Express - WAX II container liner service) uses a similar scenario as well. They like to see if this scenario has advantages over the other three scenarios.

In general, the direction of the port rotation schedules is done from the port farthest away from West Africa and then continuing calling ports more and more closely to West Africa.

For the Asian container liner services, this means that container vessels call ports from north to South in Asia before making the transit to West Africa. They enter the West African region in the South so they continue calling ports from South to north in West Africa.

The FEWA container liner service first calls port in Lomé in West Africa as in this port a lot of containers are discharged and there are containers that need to be transhipped from Lomé to Tema. Together with the port of Lagos, Lomé has the highest draft (12,5m) in comparison with Tema (12m) and Cotonou (12m). Therefore, Lomé is called before Tema. After a port call in Tema the container vessels sail to Lagos to discharge, but also to load containers with destination Cotonou. This is why the container vessels first call port in Lagos and next in Cotonou. On the way back to Asia, the FEWA container liner service also calls the port of Durban and Singapore to load containers with destination Asia.

In West Africa the SWAX container liner service first calls port in Durban and Cape Town to collect containers for inter West African destinations, then sails North to Pointe noire and continues its voyage from North to South. This to first call port in Pointe Noire as this port functions as the hub of NileDutch. On its way back the container vessels call port in Cape Town, Durban, and Singapore once again to collect containers for the Asia market.

For the European WEWA container liner service, this means ports are called from north to South before making the transit to West Africa. They enter the West African region in the north and continue going South.

The container vessels in the South American ECSA container liner service call ports in the East coast of South America from north to South, next it sails to the port of Pointe Noire as this port has a higher draft than Luanda and because this port serves as NileDutch's hub. Next, they sail to the port of Luanda before making the transit back to South America.

WAF1 and WAF2 are feeder container liner services starting in NileDutch's hub Pointe Noire to transport containers to further destinations in West Africa. WAF1 sails north of Pointe Noire and WAF2 sails South of Pointe Noire. When they do this, they first call the port closest to Pointe Noire and then move further away to call other ports.

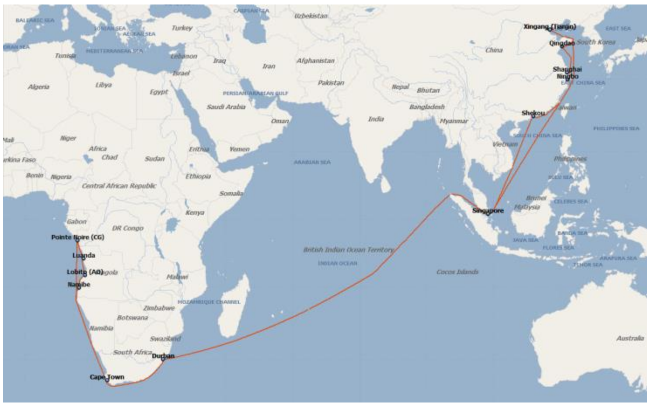
Next, the scenarios are described.

Scenario 1

The first scenario is to use the forecasted full TEU flows of 2015 per trade and trade lane and divides these container volumes over the ports of loading and final ports of discharge in the same proportion as this was done in 2011. Therefore, the market shares stay equal.

The port rotation schedules for the first scenario are:

Figure 38: Port rotation schedule FEWA container liner service scenario 1

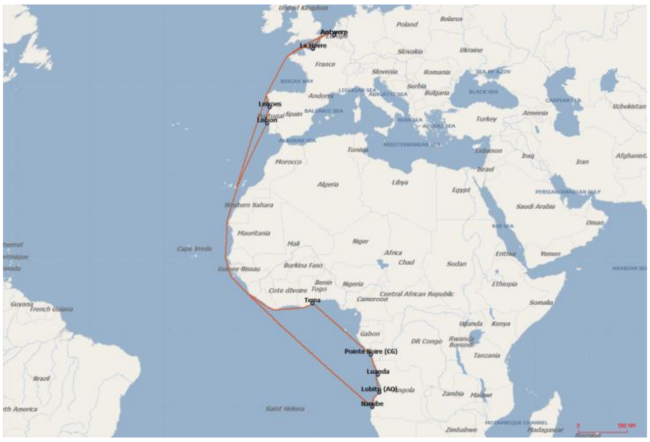


Far East – West Africa container liner service (FEWA container liner service): Asia: Xingang-Tianjin, Qingdao, Shanghai, Ningbo, Shekou, Singapore, Durban, Cape Town, Pointe Noire, Luanda, Lobito, Namibe, Cape Town, Durban, Singapore, and Xingang-Tianjin. The bunker place in the port rotation schedule is Singapore.

Figure 39: Port rotation schedule SWAX container liner service scenario 1

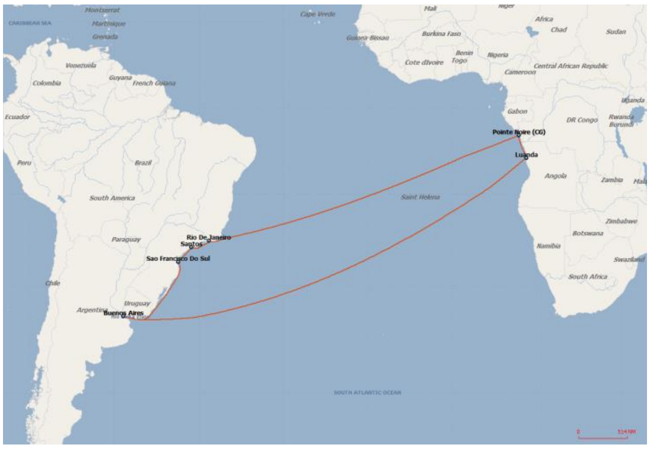
South – West Africa Express Container liner service (SWAX container liner service): Shanghai, Ningbo, Shekou, Singapore, Durban, Lomé, Tema, Lagos, Cotonou, Durban, Singapore, and Shanghai. The bunker place in this port rotation schedule is Singapore.

Figure 40: Port rotation schedule WEWA container liner service scenario 1



West Europe – West Africa container liner service (WEWA container liner service): Antwerp, Le Havre, Leixoes, Lisbon, Tema, Pointe Noire, Luanda, Lobito, Namibe, and Antwerp. The bunker place in this port rotation schedule is Antwerp.

Figure 41: Port rotation schedule ECSA container liner service scenario 1



East Coast South America – West Africa container liner service (ECSA container liner service): Buenos Aires, São Francisco do Sul, Santos, Rio de Janeiro, Pointe Noire, Luanda, and Buenos Aires. The bunker place in this port rotation schedule is Buenos Aires.

Figure 42: Port rotation schedule West Africa feeder 1 scenario 1

West Africa feeder 1 container liner service (WAF1 container liner service): Pointe Noire, Libreville, Douala, Offshore Pointe Noire, and Pointe Noire. The bunker place in this port rotation schedule is Offshore Pointe Noire. This is a bunker only place so no cargo handling takes place here.

Figure 43: Port rotation schedule West Africa feeder 2 scenario 1

West Africa feeder 2 container liner service (WAF2 container liner service): Pointe Noire, Cabinda, Boma, Matadi, Soyo, Offshore Pointe Noire, and Pointe Noire. The bunker place in this port rotation schedule is Offshore Pointe Noire. This is a bunker only place so no cargo handling takes place here.

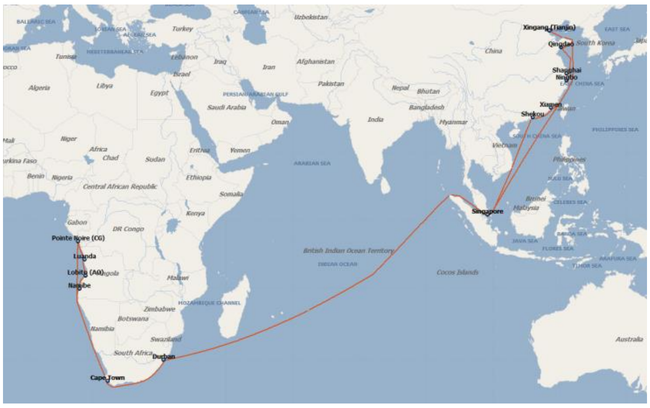
In each port the average congestion time, the time and costs for bunkering the average loading and discharging time for the TEUs out of NileDutch's 2015 trip matrix,

Scenario 2

The second scenario is based on the first scenario but the port of Abidjan in Ivory Coast and the port of Xiamen in China is added to the ports. To the port of Abidjan full TEU volumes come from the port of Antwerp and the port of Le Havre. Between the port of Antwerp and the port of Abidjan for 2015, 1.000 full TEUs go South bound and 1.400 full TEUs North bound. Between the port of Le Havre and the port of Abidjan in 2015, 1.000 full TEUs go South bound and 1.400 full TEUs North bound. From the port of Xiamen, full TEUs go to the port of Luanda. For 2015, 500 full TEUs go East bound and 3.000 full TEUs go West bound.

The port rotation schedules for the second scenario are:

Figure 44: Port rotation schedule FEWA container liner service scenario 2

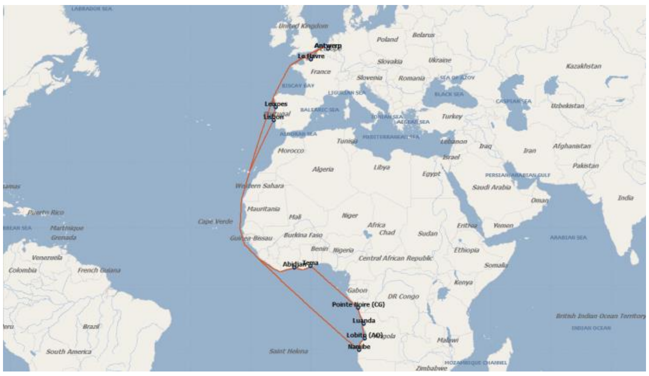


Far East – West Africa container liner service (FEWA container liner service): Asia: Xingang-Tianjin, Qingdao, Shanghai, Ningbo, Xiamen, Shekou, Singapore, Durban, Cape Town, Pointe Noire, Luanda, Lobito, Namibe, Cape Town, Durban, Singapore, and Xingang-Tianjin. The bunker place in the port rotation schedule is Singapore.

Figure 45: Port rotation schedule SWAX container liner service scenario 2

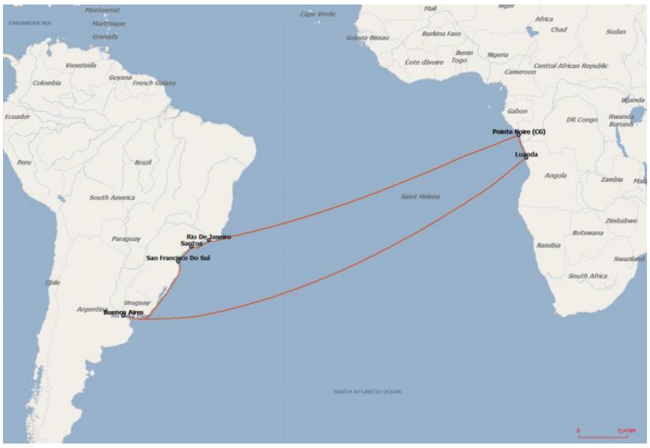
South – West Africa Express Container liner service (SWAX container liner service): Shanghai, Ningbo, Shekou, Singapore, Durban, Lomé, Tema, Lagos, Cotonou, Durban, Singapore, and Shanghai. The bunker place in the port rotation schedule is Singapore.

Figure 46: Port rotation schedule WEWA container liner service scenario 2



West Europe – West Africa container liner service (WEWA container liner service): Antwerp, Le Havre, Leixoes, Lisbon, Abidjan, Tema, Pointe Noire, Luanda, Lobito, Namibe, and Antwerp. The bunker place in this port rotation schedule is Antwerp.

Figure 47: Port rotation schedule ECSA container liner service scenario 2



East Coast South America – West Africa container liner service (ECSA container liner service): Buenos Aires, São Francisco do Sul, Santos, Rio de Janeiro, Pointe Noire, Luanda, and Buenos Aires. The bunker place in this port rotation schedule is Buenos Aires.

Figure 48: Port rotation schedule West Africa feeder 1 scenario 1

West Africa feeder 1 container liner service (WAF1 container liner service): Pointe Noire, Libreville, Douala, Offshore Pointe Noire, and Pointe Noire. The bunker place in this port rotation schedule is Offshore Pointe Noire. This is a bunker only place so no cargo handling takes place here.

Figure 49: Port rotation schedule West Africa feeder 2

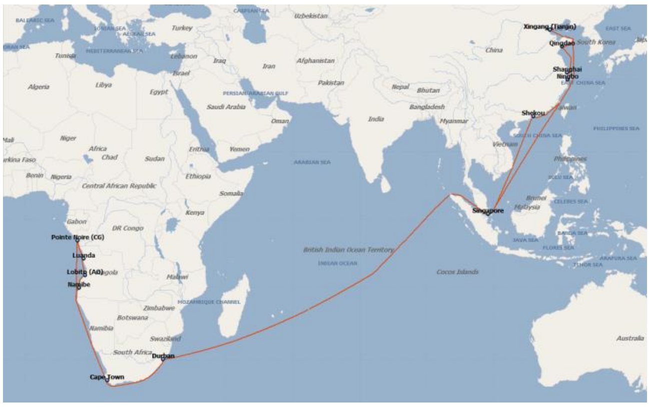
West Africa feeder 2 container liner service (WAF2 container liner service): Pointe Noire, Cabinda, Boma, Matadi, Soyo, Offshore Pointe Noire, and Pointe Noire. The bunker place in this port rotation schedule is Offshore Pointe Noire. This is a bunker only place so no cargo handling takes place here.

Scenario 3

The third scenario is to use the forecasted import and export TEU flows of 2015 and divides these container volumes over the trades and trade lanes in the same proportion, as this was the case in 2011. Further division over the ports of loading and final ports of discharge is done in the same proportion, as this was the case in 2011. Therefore, the market shares stay equal.

The port rotation schedules of the container liner services in the third scenario are:

Figure 50: Port rotation schedule FEWA container liner service scenario 3

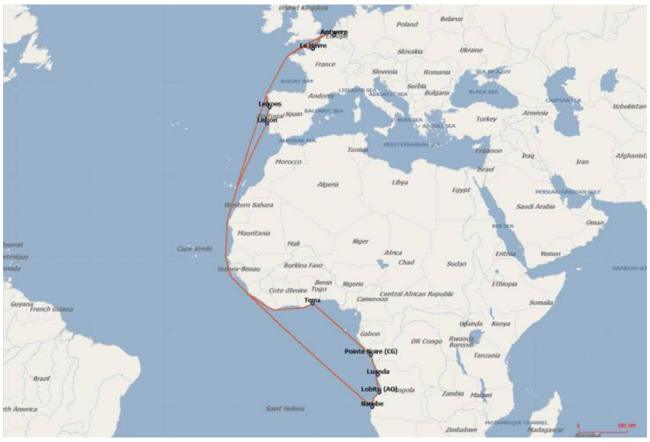


Far East – West Africa container liner service (FEWA container liner service): Asia: Xingang-Tianjin, Qingdao, Shanghai, Ningbo, Shekou, Singapore, Durban, Cape Town, Pointe Noire, Luanda, Lobito, Namibe, Cape Town, Durban, Singapore, and Xingang-Tianjin. The bunker place in the port rotation schedule is Singapore.

Figure 51: Port rotation schedule SWAX container liner service scenario 3

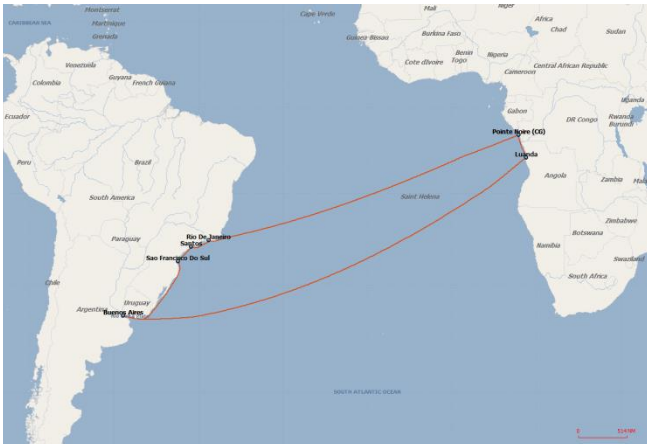
South – West Africa Express Container liner service (SWAX container liner service): Shanghai, Ningbo, Shekou, Singapore, Durban, Lomé, Tema, Lagos, Cotonou, Durban, Singapore, and Shanghai. The bunker place in this port rotation schedule is Singapore.

Figure 52: Port rotation schedule WEWA container liner service scenario 3



West Europe – West Africa container liner service (WEWA container liner service): Antwerp, Le Havre, Leixoes, Lisbon, Tema, Pointe Noire, Luanda, Lobito, Namibe, and Antwerp. The bunker place in this port rotation schedule is Antwerp.

Figure 53: Port rotation schedule ECSA container liner service scenario 3



East Coast South America – West Africa container liner service (ECSA container liner service): Buenos Aires, São Francisco do Sul, Santos, Rio de Janeiro, Pointe Noire, Luanda, and Buenos Aires. The bunker place in this port rotation schedule is Buenos Aires.

Figure 54: Port rotation schedule West Africa feeder 1 scenario 1

West Africa feeder 1 container liner service (WAF1 container liner service): Pointe Noire, Libreville, Douala, Offshore Pointe Noire, and Pointe Noire. The bunker place in this port rotation schedule is Offshore Pointe Noire. This is a bunker only place so no cargo handling takes place here.

Figure 55: Port rotation schedule West Africa feeder 2 scenario 3

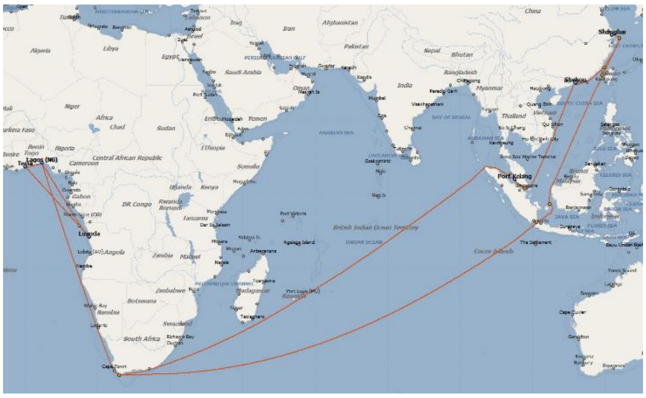
West Africa feeder 2 container liner service (WAF2 container liner service): Pointe Noire, Cabinda, Boma, Matadi, Soyo, Offshore Pointe Noire, and Pointe Noire. The bunker place in this port rotation schedule is Offshore Pointe Noire. This is a bunker only place so no cargo handling takes place here.

Scenario 4

The fourth scenario is based on the third scenario but adjustments are made in Asia. There is only be one container liner service on the Asia – West Africa trade. The port rotation schedule is Shanghai, Shekou, Port Kelang, Lagos, Tema, and Luanda. There are four feeder container liner services in West Africa.

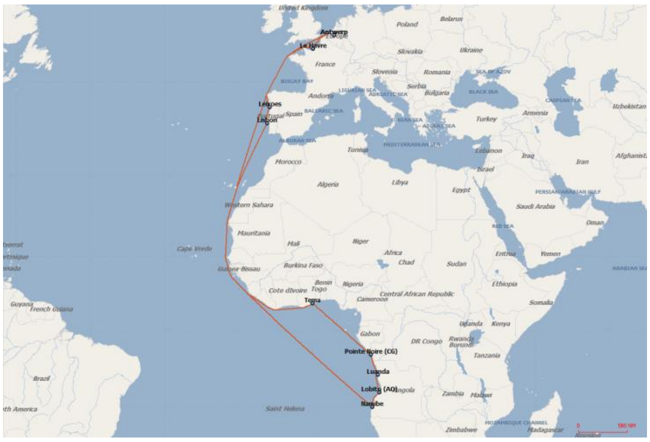
The port rotation schedules for the fourth scenario are:

Figure 56: Port rotation schedule SWAX container liner service scenario 4



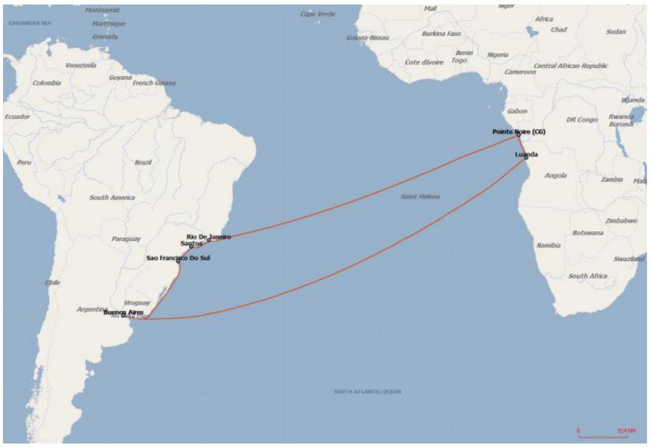
South – West Africa Express Container liner service (SWAX container liner service): Shanghai, Shekou, Port Kelang, Lagos, Tema, Luanda, Lagos, and Shanghai. The bunker place in this port rotation schedule is Port Kelang.

Figure 57: Port rotation schedule WEWA container liner service scenario 4



West Europe – West Africa container liner service (WEWA container liner service): Antwerp, Le Havre, Leixoes, Lisbon, Tema, Pointe Noire, Luanda, Lobito, Namibe, and Antwerp. The bunker place in this port rotation schedule is Antwerp.

Figure 58: Port rotation schedule ECSA container liner service scenario 4



East Coast South America – West Africa container liner service (ECSA container liner service): Buenos Aires, São Francisco do Sul, Santos, Rio de Janeiro, Pointe Noire, Luanda, and Buenos Aires. The bunker place in this port rotation schedule is Buenos Aires.

Figure 59: West Africa feeder 1 scenario 4

West Africa feeder 1 container liner service (WAF1 container liner service): Lagos, Cotonou, Lomé, Tema, and Lagos. The bunker place in this pot rotation schedule is Tema.

Figure 60: West Africa feeder 2 scenario 4

West Africa feeder 2 container liner service (WAF2 container liner service): Lagos, Douala, Libreville, Pointe Noire; Offshore Pointe Noire, and Lagos. The bunker place in this port rotation schedule is Offshore Pointe Noire. This is a bunker only place so no cargo handling takes place here.

Figure 61: West Africa feeder 3 scenario 4

West Africa feeder 3 container liner service (WAF3 container liner service): Luanda, Soyo, Matadi, Boma, Cabinda, Offshore Luanda, and Luanda. The bunker place in this port rotation schedule is Offshore Luanda. This is a bunker only place so no cargo handling takes place here.

Figure 62: West Africa feeder 4 scenario 4

West Africa feeder 4 container liner service (WAF4 container liner service): Luanda, Lobito, Namibe, Cape Town, Durban, Offshore Luanda, and Luanda. The bunker place in this port rotation schedule is Offshore Luanda. This is a bunker only place so no cargo handling takes place here.

3.5.4 Aggregation level of the model

The aggregation levels of the computer model per scenario controls the amount of data. Table 30 shows the added data per aggregation level per scenario in the computer model.

Table 30: Aggregation levels computer model per scenario

Aggregation level	Aggregation	Description
1	Outward and backward voyage	Calculations of revenu, costs, minimum required freight rate, and time of outward and backward voyages per vessel
2	All container vessels	Summations of calculated data of revenu, costs, minimum required freight rate, and time of aggregation level 1 for all container vessels in all services.

3.5.5 Required output

The required output from the computer model are per scenario the total costs, net results, minimum required freight rate per TEU, and minimum required freight rate per TEU/mile and for the entire market, per trade, and per voyage made by a chartered and owned container vessel.

Another output is the fleet that meets the criteria and performance indicators for all four scenarios. Per scenario, a list of container vessels together with their specifications is the required output. The vessel speed is an important output as well.

3.5.6 Iterative process

Obtaining a calculation in the computer model, which meets the performance indicators, is an iterative process. The size of container vessels and the container vessel's speed are the parameters that are manually varied in the computer model. Per liner service the amount of full and empty TEUs is dertermind on board the container vessel between each port in the rotation schedule. The maximum value of the summation of full and empty TEUs on board a container vessel between two ports is used to calculate the nominal capacity and 14 ton TEU capacity required for a container vessels to transport thers full and empty TEUs. Next, per container liner service a container vessels is generated which fulfils these requirements. When the size of each container vessels is determined an iterative process takes place to determine the engine power at maximum continuous rating (P_{MCR}) for a predetermined vessels design speed (v_{ds}).

Next, the The speed of each container vessels in each container liner service is varied from 11 knots[21] to 20 knots in steps of 0,5 knots. This iterative process determines at which vessel speed the highest net results is achieved while minimizing the total costs.

3.5.7 Way of analysing, interpreting and presenting the results

The output of the computer model is represented in tables. As mentioned before the required output from the computer model are per scenario the vessel speeds, the total costs, net results, minimum required freight rate per TEU, and minimum required freight rate per TEU/mile for the entire market and per trade. Tis output is also obtained per voyage made by a chartered and owned container vessel.

[21] 11 knots is the lowest service speed as a container vessel needs to sail at a miminum engine speed to not get problems with the engine. Keeping the engine at the right temperature is an important technical limitation herein.

Another output is the fleet that meets the criteria and performance indicators for all four scenarios. Per scenario, a list of container vessels together with their specifications is the output. These specifications give an idea about how the container vessel looks like and are based on input values used in the container vessel tool. This information is thus only informative. The container vessel tool is described in paragraph 3.5.9.1 on page 101.

3.5.8 System's boundaries

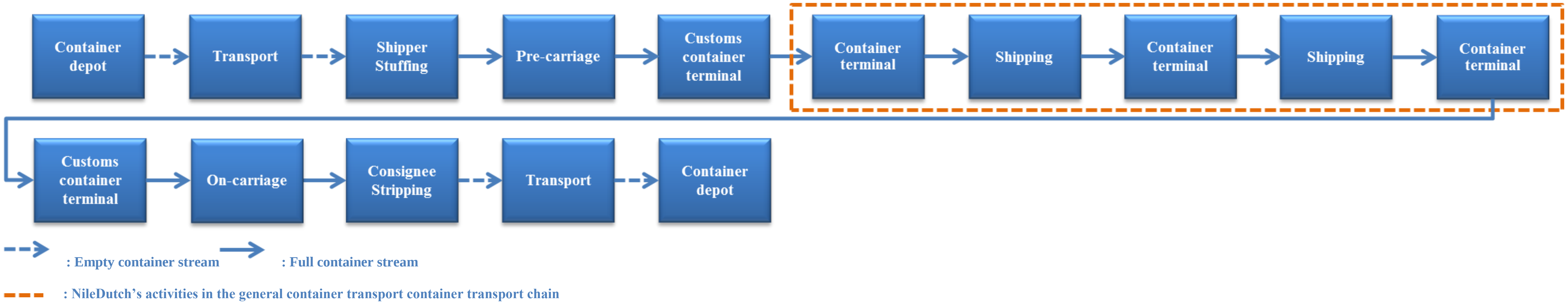
To explain the systems boundaries of the computer model of the container transport chain, more understanding is required about the container transport chain in general and NileDutch's container transport chain in particular.

Firstly, the container transport chain in general is described. The general container transport chain indicates the part, in which NileDutch is active. Next follows the representation of NileDutch's container transport chain. More details about the activities, costs, and revenue of each step in NileDutch's container transport follow. A description of how it differs from the general container transport chain is given. NileDutch's container transport chain indicates the part the computer model treats as well. This to get an overview of the general container transport chain and NileDutch's container transport chain as well as an overview of what is included and excluded in the computer model.

3.5.8.1 Container transport chain in general

Figure 63 also indicates the part of the general container transport chain in which NileDutch is active. Step by step this general container transport chain is explained as next. When a shipper wants to send commodities in a container to a consignee, the container transport chain may take different forms. In case the container is not shipper's owned and it needs to be transhipped, the container is taken out of the depot and transported to the shipper. Next, the shipper stuffs the container with his commodities. Stuffing takes place on the container terminal but also at the shipper's address. In case stuffing took place at the shipper's address, pre-carriage takes place to the terminal of the port of loading if necessary. Pre-carriage takes place by trucking, railing, the use of a barge, or a feeder. Before a crane puts the container on the container terminal, customs clears the container. When the crane puts the container on the container terminal, it awaits to be loaded on board a container vessel to sail to the transshipment port. In the transshipment port, a crane discharges the container at quay and waits to be loaded onto the next container vessel that brings the container to its final port of discharge. After discharging the container in its final port of discharge, customs clears the container before the on-carriage can take place. The on-carriage brings the container to the consignee so he can strip the container and bring it back to the local container depot. Figure 63 shows these steps in the container transport chain. When the consignee returns the container to the container depot, the container waits for a new customer to re-use it or the owner or the lessee of the container can relocate it. Figure 63 also indicates the part of the general container transport chain in which NileDutch is active and each type of arrow indicates if the container is full or empty after each activity. Next, a description of the difference between the general container transport chain and NileDutch's container transport chain follows.

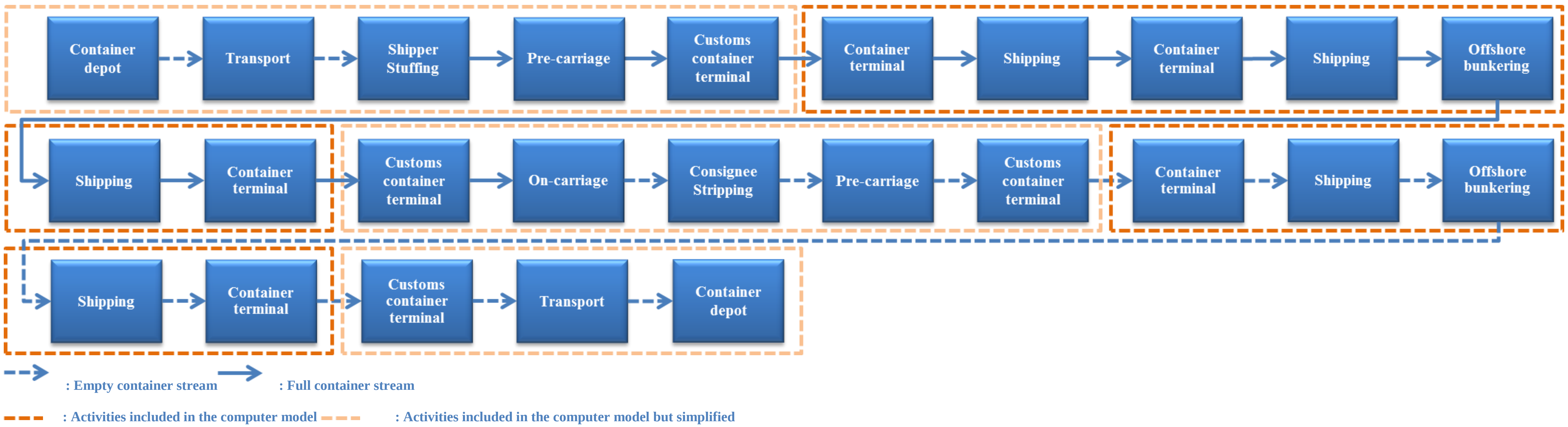
Figure 63: Container transport chain by shipping.



3.5.8.2 Container transport chain of NileDutch

The difference between NileDutch's container transport chain in the West African container shipping market and the general container transport chain can be found in the part of the container transport chain in West Africa. The difference is that there are no container depots in West Africa and bunkering cannot always take place in port. Bunkering can however take place offshore in Luanda and Pointe Noire. When for example a not shipper's owned container is transhipped to West Africa and afterwards repositioned by transshipment to another port. In this case, the container transport chain looks like Figure 64. Figure 64 also indicated which steps are included to what extent in the calculations model and each type of arrow indicates if the container is full or empty after each activity.

Figure 64: Container transport chain by NileDutch



Appendix K contains a description of each step in the container transport chain in terms of activity, costs, and revenue.

3.5.8.3 Container transport chain of the computer model

As can be seen in Figure 64 the computer model mainly focuses on the part of NileDutch's container transport chain between the terminals of the ports of loading and the terminals of the final ports of discharge. The time, costs and revenue that are involved in the previous and following steps are included in the computer model but in a simplified way. The computer model takes the full and empty TEU into account, as this is necessary for the costs, revenue and time calculations.

Demurrage and detention are not included in the calculation. Demurrage and detention generate revenue. Their share in revenue is however negligible small, but nervertheless revenue and by consequence the net result should have higher values. Container costs coming from restowing containers in ports is also not included in the model. Restowing is done to put heavier container lower in the container vessels for a better stability of the container vessel. Their share in container costs is negligible small. Restowing dependends also on the container vessel's stability and the weight of the particulat container.

The computer model uses the forecasts of the full TEU flows of 2015 expressed in full TEU capacities per week between the ports of loading and the final ports of discharge. The empty TEUs are relocated to the ports where they are required to avoid leasing containers. The TEU flows are Asia – West Africa East and West bound, Europe – West Africa North and South bound, South America - West Africa East bound, and inter West Africa. Six TEU flows in total. The aim of the computer model is to build a calculation for four scenarios. In each scenario, container vessels are active in container liner services where they have to transport the amount of TEUs of NileDutch's 2015 trip matrix.

Sudden fluctuations or season changes in TEU volumes are not included in the model. The model uses a homogenious spread of the weekly TEU volumes from the trip matrixes. Per container liner service there is a weekly sailing per port. The vessels maximum speed is obtained when the engine is running at maximum continuous rating (P_{MCR}). The container vessels in the computer model are not be limited in their draft and/or length in order to call port. The container vessels in the computer model do not take into account the tropical draft, summer draft and winter draft during sailing. The required size per container vessels in terms of nominal TEU capacity and 14 ton TEU capacity is calculated per container liner service and per scenario. The amount of container vessels needed is also calculated in the computer model. The container vessel's speed is a parameter that is varied from 11 knots to 20 knots in steps of 0,5 knots. The port rotation schedules of each container liner service are fixed. The aim is to transport all the TEUs from NileDutch's 2015 trip matrix with the aim of having a high net result by minimalizing costs. The computer model takes the congestion behaviour, average stuffing time per port, average striping time per port, and container handling times into account. The computer model takes additional time into account for offshore bunkering[22]. The reference points are the ports, fleet, the costs, and port rotation schedules of 2011. The Ports of Lagos

[22] Bunkering takes place at sea. A bunker barge will come and sail alongside the container vessels for the duration of the bunker operations. The container vessel will not divert its course for this operation but will have a longer transit time, as it needs to slow down its speed.

Tincan and Lagos Apapa are close located to each other and are considered one port, which is named the port of Lagos. In 2011, the ports were subdivided over four regions: Asia, Europe, South America, and West Africa. The ports of Asia are: Ningbo, Shanghai, Shekou, Singapore, Xingang-Tianjin, and Qingdao. The ports of Europe are: Antwerp, Le Havre, Leixoes, and Lisbon. The ports of South America are: Buenos Aires, Santos, São Francisco do Sul, and Rio de Janeiro. The ports of West Africa are: Boma, Cabinda, Cape Town, Cotonou, Douala, Durban, Lagos, Libreville, Lobito, Lomé, Luanda, Matadi, Namibe, Pointe Noire, Soyo, and Tema.

3.5.9 Required input

The required input of the model are alterations of four parameters, variation of vessel speed, and the container vessels. The four parameters are TEU volumes, net freight rates, time charter rates, and bunker prices. The vessels' speed is varied from 11 knots to 20 knots. The input of container vessels come from an manually interative process by the use of a tool. This tool is described in next paragraph.

3.5.9.1 Container vessel tool

This paragraph describes how the tool works that provides input data for the computer model about container vessels designed in the preliminary stages of container vessels design. First, the required output data of the tool are described. Next, the design versus service conditions of a container vessel are treated. After that the five steps about the acquisition and analysis of ship data in the early design method is described to obtain the container vessels. Next the methods are describe which explain the choice of main dimensions, the design speed estimate, weight estimate for ship and machinery, the resistance estimate, power estimate, capital costs estimate, and daily running costs estimate is treated.

The design criteria for the container vessels are a design speed at a sea margin of 15% at a fully loaded condition. The service conditions of the container vessels are at an added power margin of 10% The container vessels have a block coefficient (C_b) of 0.65. This is the average block coefficient at the design speed draft from the 75 container vessels of the Aalbers (2008) database. This database contains container vessels built between 1967 and 2014.

Output data tool

The computer model needs input data about the container vessels used in the calculation. To obtain these data a tool is made which provides the required data.

These data involves the nominal TEU capacity, the 14 ton TEU capacity, amount of reefer plugs, length between perpendiculars (L_{pp}), beam (B), draft (T), LBD, B/T, the displacement weight (Δ), displacement volume (∇), deadweight tonnage (dwt), weight ship and machinery (W_{sm}), weight steel (W_{st}), design speed (v_{ds}), maximum speed ($v_{s_{\max}}$), Longitudinal centre of buoyancy (LCB), block coefficient (C_b), midship coefficient (C_m), prismatic coefficient (C_p), diameter propeller (D_p), draft aft (T_a), draft fore (T_f), average draft in ballast ($T_{av_{ballast}}$), admiralty coefficient (C_{ad}), fuel consumption per interval for the design condition ($\dot{m}_{fi_{design}}$), generator power, time charter rate ($C_{T/C}$), and capital costs owned container vessels (C_{co}).

The input value for the container vessels tool is the nominal TEU capacity. It can, however, be practical to use the 14 ton TEU capacity of a container vessel as input value. The relationship between the 14 ton TEU capacity and the nominal TEU capacity has already been determined in paragraph 2.3.5.1 on page 36.

Design versus service conditions of a container vessel

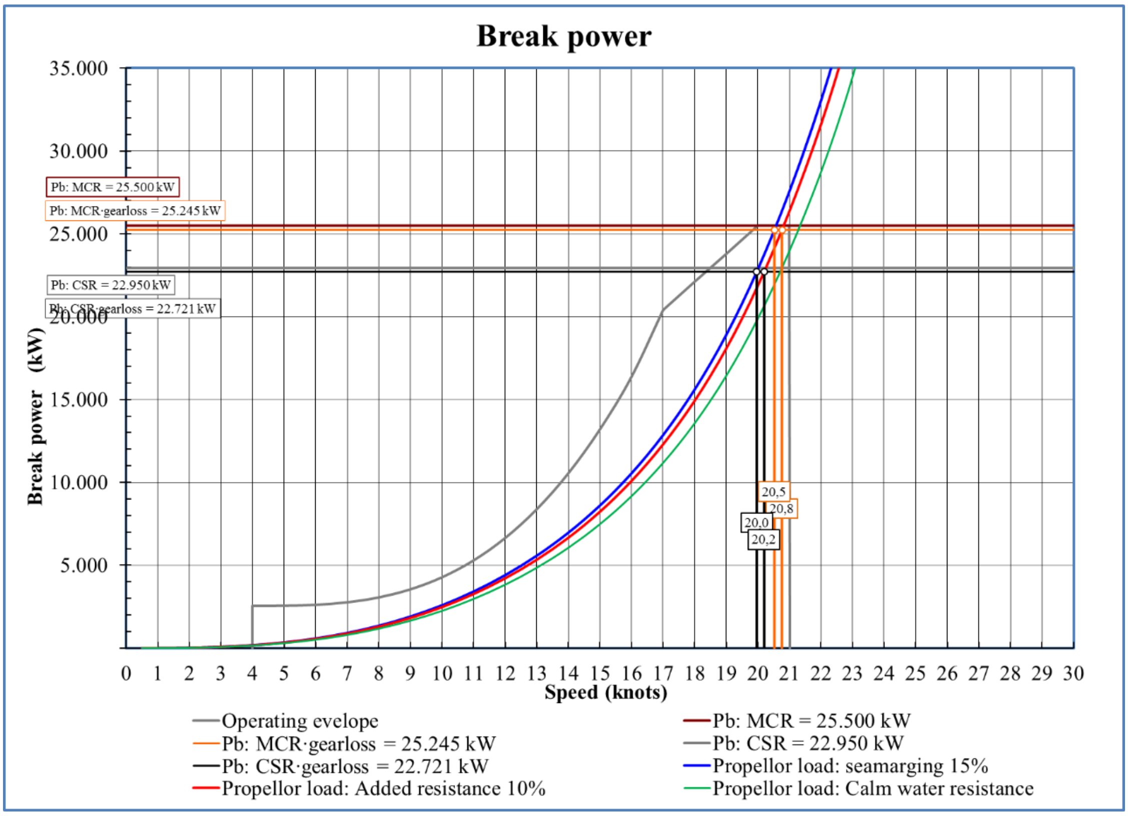
The selection of the engine power in the early design stages of a container vessel is done based on the total resistance of the vessel sailing at a design speed, a sea margin of 15% and fully loaded condition. According to ITTC (2008) this is an added resistance of 15% on top of the ideal weather resistance of the vessel. This ideal weather resistance can for example be determined by the Holtrop and Mennen method. This method is further described in paragraph 3.5.9.1.2.3 on page 112. When knowing the resistance at a design speed of 20 knots and a 15% sea margin, the required engine power can be determined. During the selection the required engine power an extra engine margin needs to be taken into account. This way the engine can deliver extra power when needed. Engine margins are typically 10 to 15%. In this example, an engine margin of 10% is used. When the engine is running at its maximum capacity this is named Maximum Continuous Rating (MCR). When a 10% engine margin is subtracted from the MCR, the Continuous Service Rating (CSR) is obtained. At this rating, the engine is designed to operate. In addition, a gear loss due to the presence of a gear box needs to be taken into account in case of a four stroke engine and gear box. This gear loss involves losses in power transfer from the gearbox and shaft. The combination of these losses are also named transmission losses. These losses are about 1% for the shaft and 2,5% for the gearbox. Bringing the total transmission loss to 3,5% in case of a four stoke engine with gear box and 1% in case of a two stroke engine. This transmission loss needs to be deducted from the MCR and CSR. Knowing the engine margin and the gear loss, the required power for the design condition can be determined. Figure 65 shows an engine with a break power of 25.500 kW at MCR. When considering the transmission loss and engine margin this engine delivers a break power of 22.721 kW at CSR. This break power is in this case sufficient to make the vessel sail 20 knots at design speed and a sea margin of 15%. When using its MCR power this vessel is able to sail 20,5 knots under design circumstances.

If up to 3.500kW MCR is needed a four stroke engine is used in the container vessel tool. When more than 3.500kW MCR is needed a two stroke engine is used. This due to the lower fuel consumption and thus lower fuel costs of a two troke engine and because there are only four stoke engines available when and MCR is needed below 3.500 kW[23].

[23] Four stroke engines have higher specific fuel consumptions in comparison with a two stroke engine delivering the same power. Therefore two stroke engine have lower fuel consumption values and thus fuel costs. For example the four stroke Wärtsilä 26 12V26 engine has a specific fuel consumption of 181 g/kWh and the two stroke Wärtsilä X35 engine has a specific fuel consumption of 171 g/kWh. Both engines deliver a power of 3.500kW. Source: Wärsilä (07/02/2015)

When a container vessel is in service these design conditions do not apply anymore. This because the added resistance on top of the ideal weather resistance is due to fouling, displacement, sea state, and water depth. The added resistance on top of the ideal weather condition can in such a case be for example 10%. This is also referred to as a power margin of 10%. When looking to Figure 65 this 10% power margin at a CSR results in a vessel service speed of 20,2 knots at fully loaded condition. When the MCR power is used, the vessel is able to sail 20,5 knots in design condition and 20,8 knots in service condition with an added resistance of 10%.

Figure 65: Design versus real life conditions engine break power of a container vessel



3.5.9.1.1 Acquisition and analysis of ship data

Ship data are acquired from the Aalbers (2008) database. These database consists of 75 container vessels which partly come from former publications of the significant ships. To update the database with more recent container vessels, five container vessels are replaced in the database. Four container vessels are built at the best three shipyards in the world to construct container vessels according to Clarkson (2011). Namely, Daewoo Shipbuilding & Marine Engineering (DSME), Hyundai Heavy Industries (HHI), and Samsung Heavy Industries (SHI).These three shipyards are all located in South Korea. Three container vessels are selected out of the journal Significant ships from the Royal Institution of Naval Architects (RINA) (2010 and 2011). The first container vessel, which replaces another one, is Cap Ines, which has a nominal TEU capacity of 4.600TEU and is built at DSME in South Korea in 2010. The second container vessel Hanjin Korea has a nominal TEU capacity of 10.000TEU and is built at SHI in South Korea in 2010. The third container vessel is Maersk Edison, which has a nominal TEU capacity of 13.102TEU and is built at HHI in South Korea in 2011. Besides the fact that they come from the three largest container vessels shipyards, they are also selected for their nominal TEU capacity. This to obtain a wide range. The fourth container vessels replaced in the database is the Maersk Mc-Kinney Møller from Maersk. This is the largest operational container vessel up to now. It has a nominal TEU capacity of 18.270TEU and is built at DSME in South Korea in 2013. Its data for the database is obtained from Maersk (27/05/2014). NileDutch’s newly built container vessel replaces the fifth container vessel in the database. This way NileDutch’s newly built vessel can be compared with the other container vessels in the database. NileDutch’s new built container vessel has a nominal TEU capacity of 3.508TEU and is built in China State Shipbuilding Corporation (CSSC) in 2014. The container vessels from the database that are replaced by these five container vessels are Bunga Pelangi (1992), Namura (1979), Seniority (1991), Post Suez (2010), Suezmax (2010), and Post Suez. The first three container vessels show strong resemblances to other container vessels and are built in various years. The Suezmax container vessels is replaced as its data were incorrectly put in the database. Post Suez was put in the database before it was actually built and represents the Maersk Mc-Kinney Møller container vessels. This vessel is replaced because its current information is more accurate. By replacing these five container vessels, the database represent containers vessels from small to large, but also from old and outdated to modern.

The analysis of the ship data are split up in two phases. The first phase determines the container vessel’s dimensions, the design speed, the weight of ship and machinery, the resistance the power, the fuel consumption, and the capital costs when the sole input value is the nominal TEU capacity of a container vessel. The second phase analyses the data to compare NileDutch’s newly built vessels to the other container vessels in the database. The other container vessels in the database are split up in three groups, namely container vessels older than ten years, container vessels younger than ten years but older than three years, and the container vessels younger than three years.

3.5.9.1.2 Phase 1

3.5.9.1.2.1 Main dimensions

The main dimension[24] of a container vessels are determined by the use of Aalbers (2008) excel sheet. An approximate length between perpendiculars (L_{pp}), an approximate beam (B), an approximate draft (T), the displacement volume (∇), and block coefficient (C_b) are needed as input values. Aalbers (2008) puts a 10% margin around this approximate length between perpendiculars, the approximate beam, and the approximate draft. The output length between perpendiculars, beam and draft must fall within this margin. To obtain the approximate length between perpendiculars, the approximate beam and the approximate draft a regression functions of respectively the length between perpendiculars (L_{pp}), beam, and draft as functions of nominal TEU capacity is determined. To obtain the displacement volume (∇) a regression function of the displacement weight (Δ) as a function of nominal TEU capacity is determined. When deriving the displacement weight by the density of salty water 1,025 kg/m³ the displacement volumes is obtained. The block coefficient (C_b) is determined to be 0.65.

The regression analysis uses the power function and the estimation method of least squares. The power function is chosen due to its flexible properties. Paragraph I.1 of Appendix I explains this method. The analysis results in five power functions. Before the power functions are determined, datasets are checked for usable data. In case the data are missing or are unrealistic, they are excluded from the regression. The regression function looks as next:

$$y = a_0 \cdot x^{a_1} \quad (2)$$

- y : Output value
- a_0 : Regression coefficient
- a_1 : Regression coefficient
- x : Input value

Next, an overview follows of the regression results.

[24] The main dimensions are length between perpendiculars (L_{pp}), Beam(B), and Draft (T).

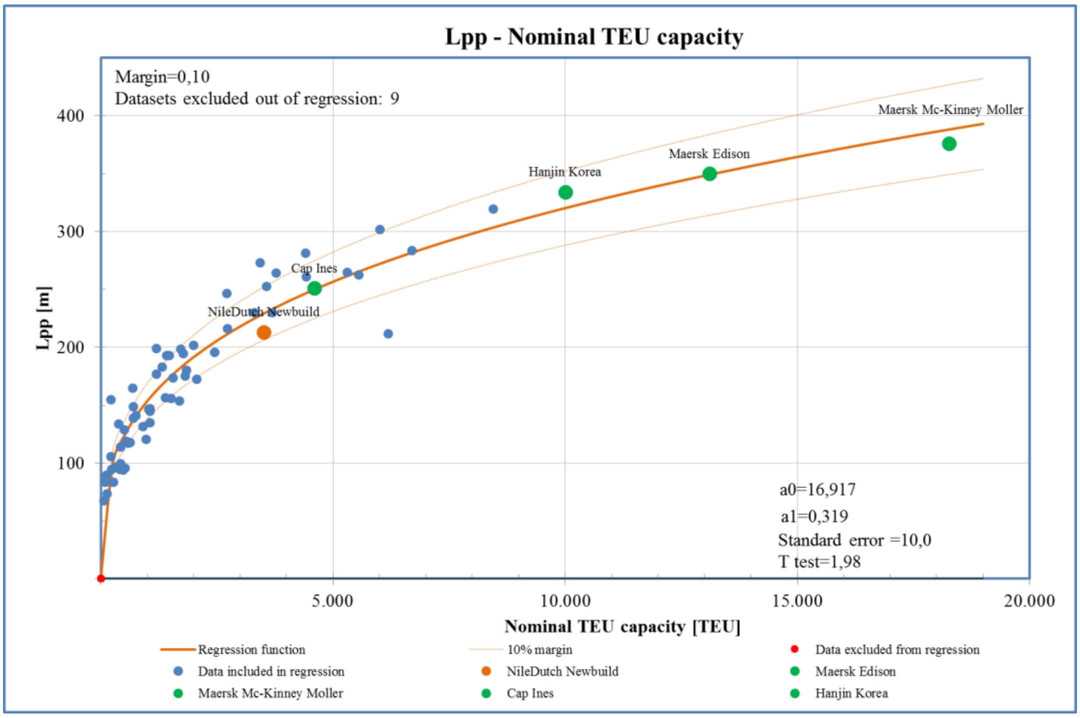
Approximate length between perpendiculars (L_{pp}) as a function of nominal TEU capacity

$$y = 16{,}197 \cdot x^{0{,}319} \quad (3)$$

- x : Nominal TEU capacity of the container vessel
- y : Length between perpendiculars of the container vessel

66 out of 75 datasets are used for this regression. Its standard error value is 10,0 and its T test value is 1,98. Figure 66 shows the graph of this regression.

Figure 66: Regression length between perpendiculars as a function of nominal TEU capacity



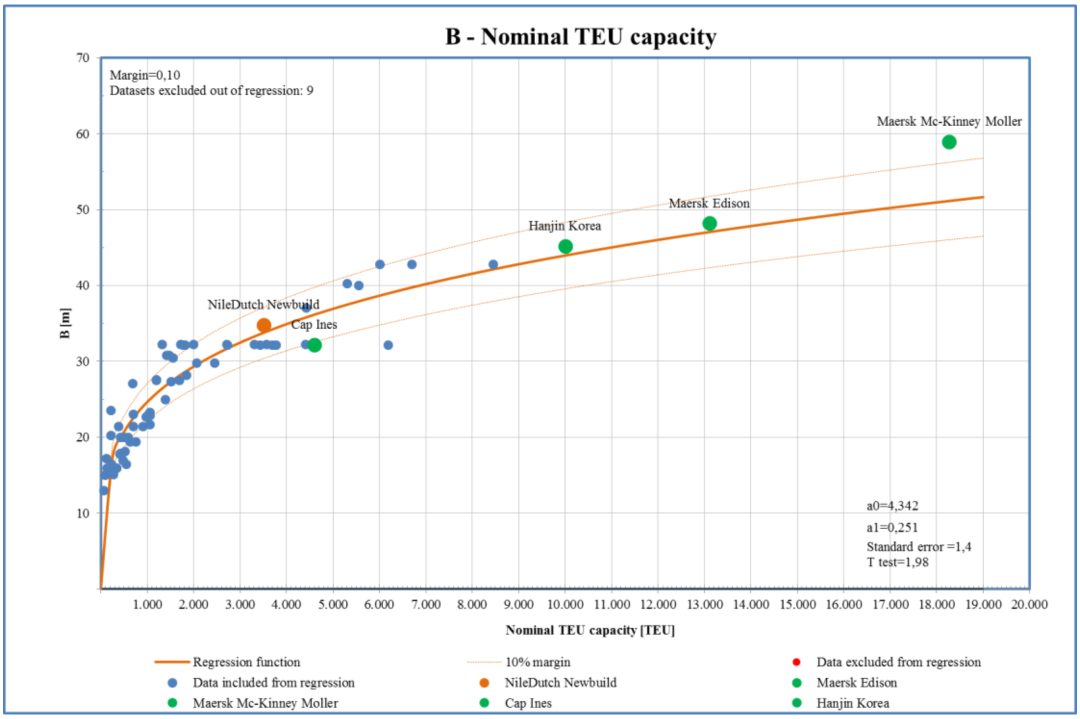
Approximate beam (B) as a function of nominal TEU capacity

$$y = 4{,}342 \cdot x^{0{,}251} \qquad (4)$$

- x : Nominal TEU capacity of the container vessel
- y : Beam of the container vessel

66 out of 75 datasets are used for this regression. Its standard error value is 1,4 and its T test value is 1,98. Figure 67 shows the graph of this regression.

Figure 67: Regression beam as a function of nominal TEU capacity



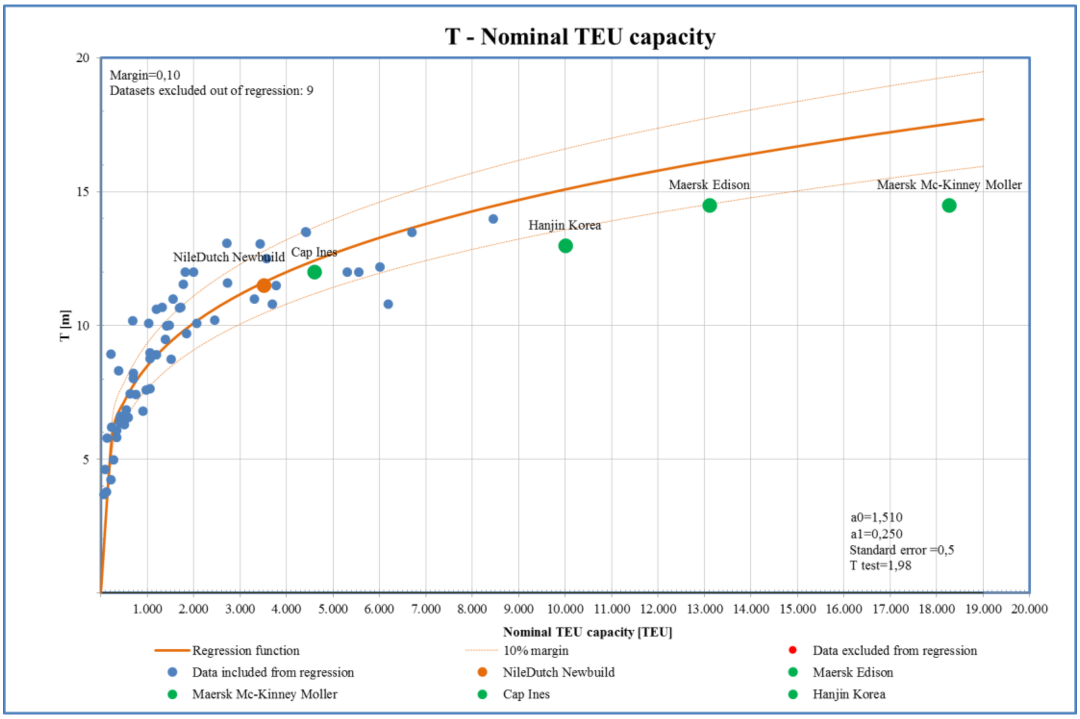
Approximate draft (T) as a function of nominal TEU capacity

$$y = 1,510 \cdot x^{0,250} \qquad 5$$

- x : Nominal TEU capacity of the container vessel
- y : Draft of the container vessel

66 out of 75 datasets are used for this regression. Its standard error value is 0,5 and its T test value is 1,98. Figure 68 shows the graph of this regression. This regression function shows too large draft values for larger container vessels. The draft restriction in ports are nowadays 15m. Thus for larger container vessels this regression fuction is not realistic. Data left from the regression line can be excluded from the regression. This would result in a less curvy and less realistic regression function for the smaller container vessels. As no large container vessels are used in the computer model only the left part of the regression function would be used.

Figure 68: Regression draft as a function of nominal TEU capacity



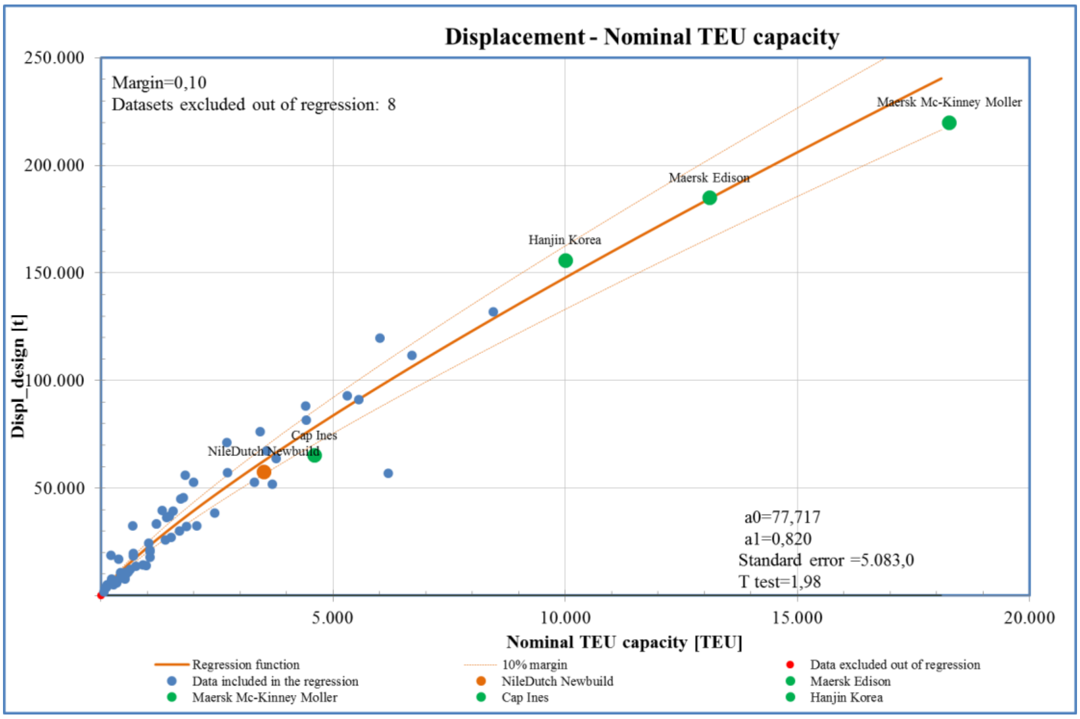
Displacement weight (Δ) as a function of nominal TEU capacity

$$y = 77,717 \cdot x^{0,820}$$ 6

- x : Nominal TEU capacity of the container vessel
- y : Displacement of the container vessel

67 out of 75 datasets are used for this regression. Its standard error value is 5.083,0 and its T test value is 1,98. Figure 69 shows the graph of this regression.

Figure 69: Regression displacement weight as a function of nominal TEU capacity



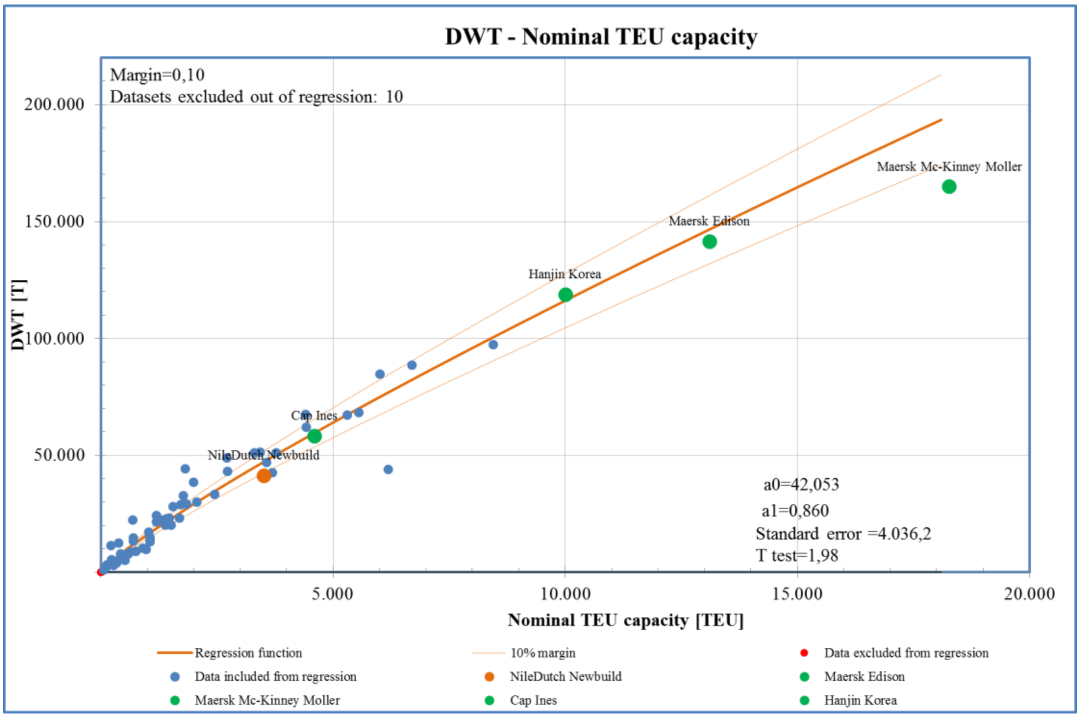
Deadweight tonnage (dwt) as a function of nominal TEU capacity

$$y = 42,053 \cdot x^{0,86} \quad (7)$$

- x : Nominal TEU capacity of the container vessel
- y : deadweight tonnage of the container vessel

65 out of 75 datasets are used for this regression. Its standard error value is 4.036,2 and its T test value is 1,98. Figure 70 shows the graph of this regression.

Figure 70: Regression deadweight tonnage as a function of nominal TEU capacity



Having obtained all necessary input values Aalbers (2008) next determines three matrixes with possible length between perpendiculars, beams and drafts. These values are obtained as follows:

Matrix with possible length between perpendiculars

$$L_{pp} = \begin{bmatrix} l_{pp_{1,1}} & l_{pp_{1,2}} & \cdots & l_{pp_{1,n}} \\ l_{pp_{2,1}} & l_{pp_{2,2}} & \cdots & l_{pp_{2,n}} \\ \cdots & \cdots & \cdots & \cdots \\ l_{pp_{m,1}} & l_{pp_{m,2}} & \cdots & l_{pp_{m,n}} \end{bmatrix} \quad (8)$$

$$l_{pp_{i,j}} = \sqrt[3]{a^2 \cdot c \cdot \frac{\nabla}{C_b}} \quad (9)$$

- $i = (1, \ldots \mathrm{m}) : m = 19$
- $j = (1, \ldots \mathrm{n}) : \mathrm{n} = 11$
- $a = \frac{L}{B} = (1,\ 1.5,\ 2,\ ...,\ 10)$
- $c = \frac{B}{T} = (2.5,\ 2.6,\ 2.7,\ ...,\ 3.5)$
- ∇ : Displacement volume $\left[m^3\right]$
- C_b :Block coefficient belonging to the length between perpendiculars $[-]$

Matrix with possible beams:

$$B = \begin{bmatrix} b_{1,1} & b_{1,2} & \cdots & b_{1,n} \\ b_{2,1} & b_{2,2} & \cdots & b_{2,n} \\ \cdots & \cdots & \cdots & \cdots \\ b_{m,1} & b_{m,2} & \cdots & b_{m,n} \end{bmatrix} \quad (10)$$

$$b_{i,j} = l_{pp_{i,j}} \cdot a^{-1} \quad (11)$$

- $i = (1, \ldots \mathrm{m}) : m = 19$
- $j = (1, \ldots \mathrm{n}) : \mathrm{n} = 11$
- $a = \frac{L}{B} = (1,\ 1.5,\ 2,\ ...,\ 10)$

Matrix with possible drafts:

$$T = \begin{bmatrix} t_{1,1} & t_{1,2} & \dots & t_{1,n} \\ t_{2,1} & t_{2,2} & \dots & t_{2,n} \\ \dots & \dots & \dots & \dots \\ t_{m,1} & t_{m,2} & \dots & t_{m,n} \end{bmatrix} \qquad 12$$

$$t_{i,j} = b_{i,j} \cdot c^{-1} \qquad 13$$

- $i = (1,\dots\mathrm{m}) : m = 19$
- $j = (1,\dots\mathrm{n}) : \mathrm{n} = 11$
- $c = \frac{B}{T} = (2.5,\ 2.6,\ 2.7,\ ...,\ 3.5)$

Values in these matrices within the 10% margin of the approximate length between perpendiculars, beam, and draft are selected. Next, the positions of these selected values are compared with each other. In case a selected matrix position is also selected in the other two matrixes, this $L_{pp}\ B\ T$ combination forms a possible set of main dimensions for the container vessel. In case there are various possible sets of main dimensions, the set with the highest $\frac{B}{T}$ value is the final set of main dimension. This because higher $\frac{B}{T}$ values results in a more stable container vessel as a wider beam compared with the draft makes the container vessels have a better GM value[25].

3.5.9.1.2.2 *Vessel design speed estimate*

A container vessel's design speed (v_{ds}) can be estimated by the use of a regression analysis. The regression analysis uses the power function and the estimation method of least squares. The power function is chosen due to its flexible properties. Paragraph I.1 of Appendix I explains this method. The power function expresses the design speed as a function of the length between perpendiculars. The results can be seen below and in Figure 71.

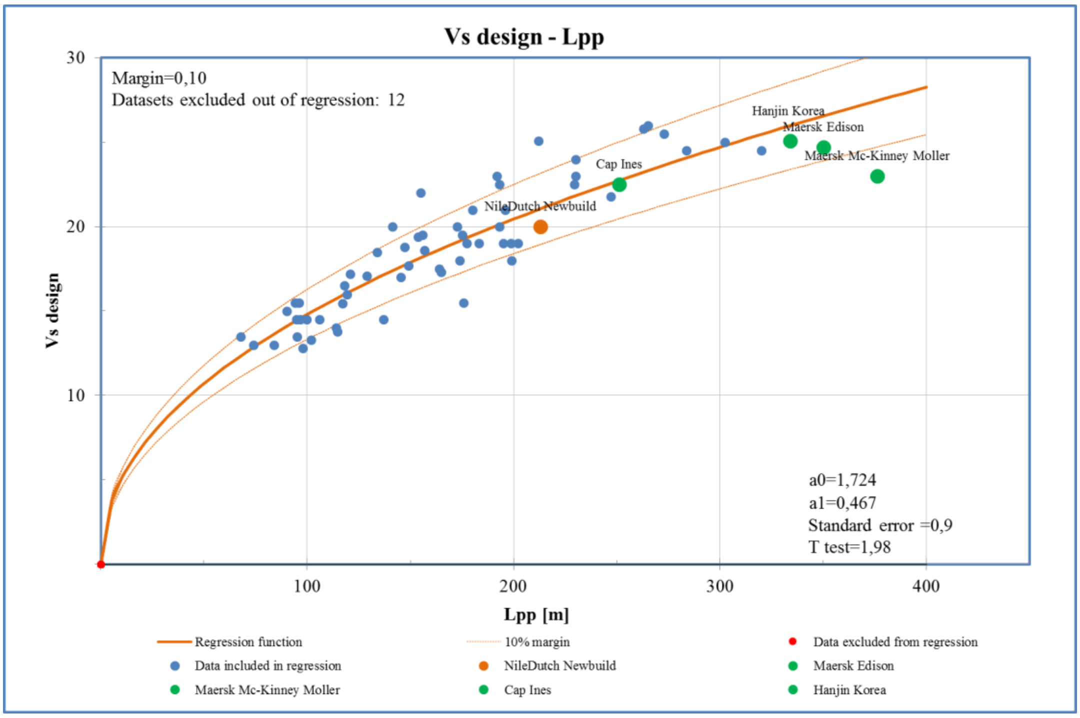
$$y = 1{,}724 \cdot x^{0{,}467} \qquad 14$$

- x : Length between perpendiculars of the container vessel
- y : Design speed of the container vessel

63 out of 75 datasets are used for this regression. Its standard error value is 0,9 and its T test value is 1,98.

[25] GM value: metacentric height which is a measurement for a vessels stability.

Figure 71: Regression design speed as a function of the length between perpendiculars



3.5.9.1.2.3 Weight estimate ship and machinery

The weight estimate methods for a container vessel are numerous: Miller (1968) based his work on Benford (1963 and 1966) and made adjustments by the use of empirical data, Watson and Gilfillan (1977) created a weight estimation method for various vessels types, including container vessels. He modernised the work of Watson (1962) as since 1962 the average maximum size ship has changed, the installed power in the engine room is at least doubled, and more calculations with computers are possible and imperial units changed into metric units. Schneekluth (1972) also created a weight estimation method for various vessel types, including container vessels, but only for the steel weight. Another way of estimating the weight of a container vessel is by regression analysis when a database of container vessels is provided. This way the weight of ship and machinery (W_{sm}) can be estimated as a power function of $L_{pp} \cdot B \cdot D$. The weight estimation method chosen in this thesis is the regression analysis. Regression analysis is chosen as Schneekluth only calculated the steel weight. Watson and Gilfillan require input data about the superstructure of the container vessels, which is time consuming to obtain. This regression analysis is selected, as it is a uncomplicated method to obtain the weight of ship and machinery. The regression analysis uses the power function and the estimation method of least squares. The power function is chosen because of its flexible properties. Paragraph I.1 of Appendix I explains this method.

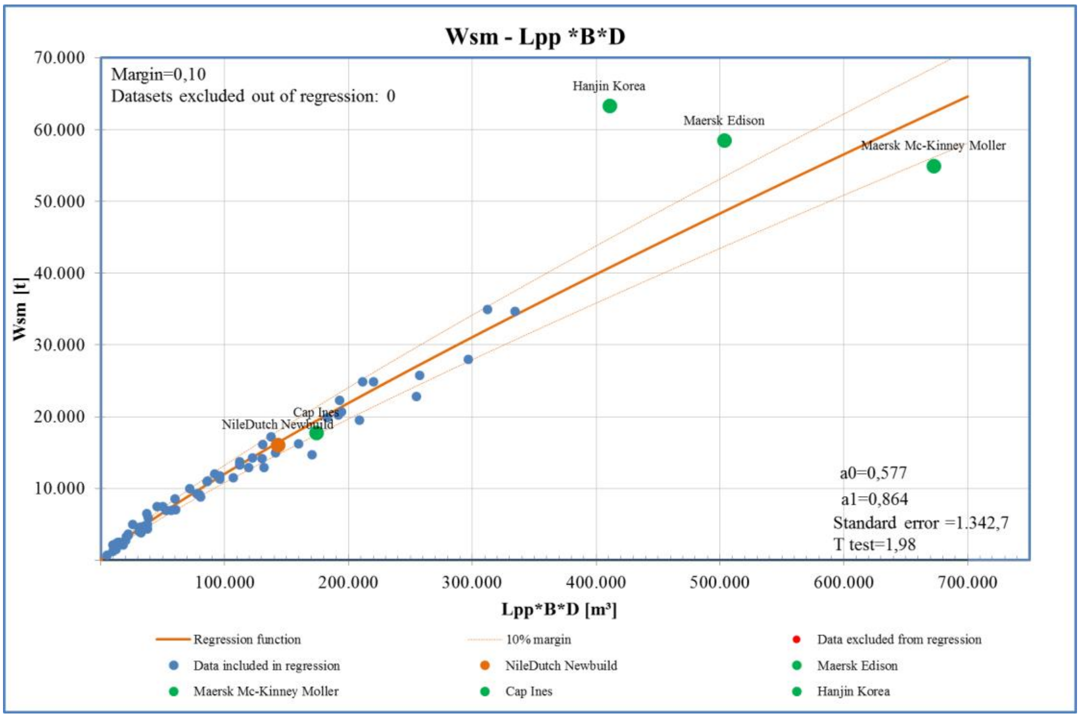
The results can be seen in Figure 72. The obtained regression function is as next:

$$y = 0,577 \cdot x^{0,864} \quad (15)$$

- x : $L_{pp} \cdot B \cdot D$ of the container vessel
- y : Weight ship and machinery of the container vessel

75 out of 75 datasets are used for this regression. The regression has a T value of and a standard error value of 1342,7 and a value for the T test of 0,98. Figure 72 shows the graph of this regression.

Figure 72: Regression weight ship and machinery as a function of Lpp*B*D



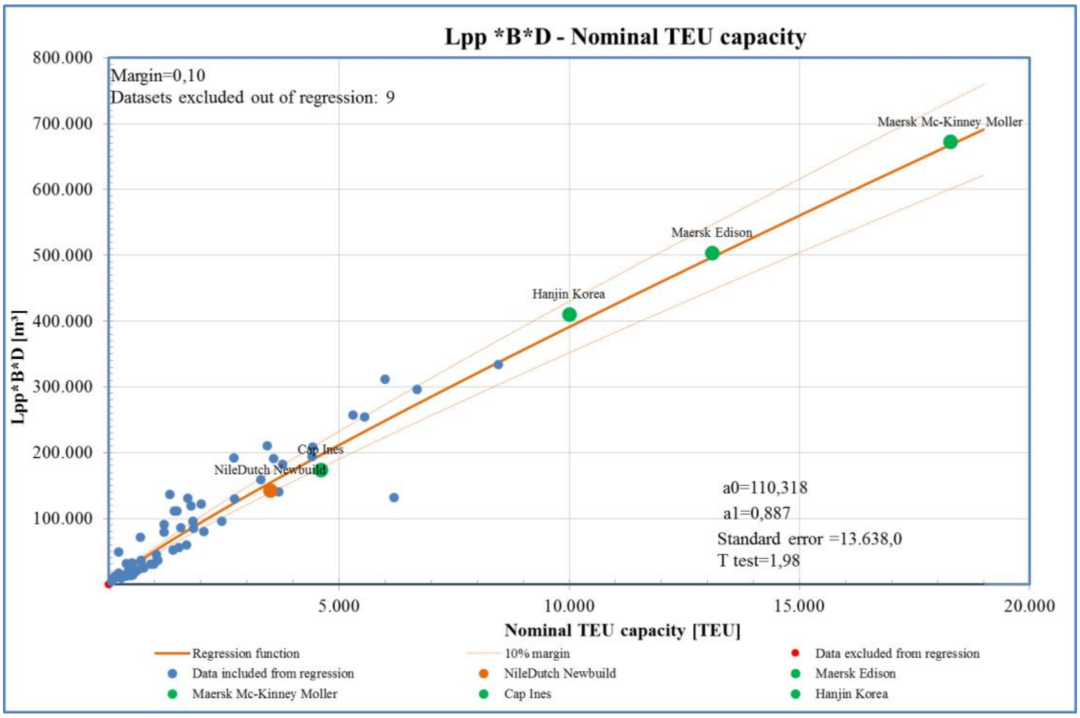
The input value LBD can be obtained via another regression function namely LBD as a function of the nominal TEU capacity. The results of this regression can be seen below and Figure 73 shows the graph of this regression.

$$y = 110,318 \cdot x^{0,887} \qquad 16$$

- x : $L_{pp} \cdot B \cdot D$ of the container vessel
- y : Nominal TEU capacity of the container vessel

66 out of 75 datasets are used for this regression. Its standard error value is 13.638 and its T test value is 1,98.

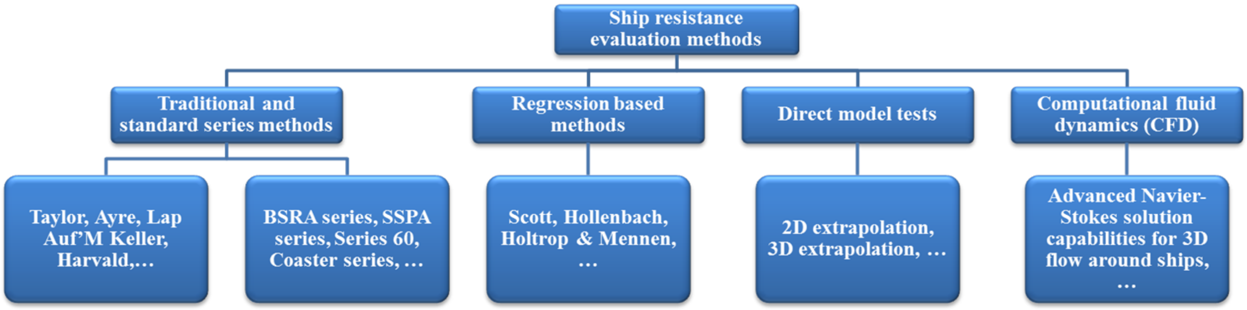
Figure 73: Regression LBD as a function of nominal TEU capacity



3.5.9.1.2.4 Resistance

Different types of methods can estimate the resistance of a vessel. According to Molland (2008), there are four types of resistance estimation methods: The traditional and standard series methods, the regression based methods, the direct model tests, and the Computational fluid Dynamics (CFD). Figure 74 shows examples of methods of each type of resistance estimation method.

Figure 74: Ship resistance evaluation methods and examples



Source: Molland (2008)

We now take a closer look at the methods of Lap-Auf'M Keller and Holtrop & Mennen. The first method is based on Lap (1954) and Auf'M Keller (1973). Lap created this method originally, but due to the even increasing dimensions of single screw ships, the parameters fell outside the diagrams. Auf'M Keller did model tests on 107 large single screw ships to make extended diagrams. This way it became the method of Lap-Auf'M Keller. According to the International Towing Tank Conference (ITTC 2002), the method bases itself on the friction resistance according to the wave resistance, and additions.

The second method bases itself on Holtrop and Mennen (1978 and 1982) and Holtrop (1984 and 1988). Holtrop & Mennen is a statistical method to determine the required power for a vessel in an early design stage of a vessel. The data are based on random model experiments and full-scale data from the Netherlands Ship Model Basin. Because the method seemed to be unreliable for unconventional combinations of main parameters such as slender naval ships (complex appendages arrangement and immersed transom sterns) and high block ships with low L/B-ratios. Holtrop and Mennen (1982) adjusted the method. They adjusted and tested the numerical prediction model. Data from specific cases served for verification. The new method could now be applied to a wider range of applications. Next a new problem surfaced for high-speed vessels with Froude numbers higher than 0,5. For these types of vessels, the output data often appeared to be wrong. Holtrop (1984) therefore added more data of interest to obtain a wider range up to a Froude number of 0,6. The series 64 hull forms are an example of added data. All together, the method bases itself on tests made with 334 ship models. Holtrop (1984) together with a MARIN Co-operative Research programme added new formulas for the influence of a cavitating propeller and a propeller that is partly submerged.

An excel sheet provided by Aalbers (2008) is based on the Holtrop & Mennen resistance calculations method. This sheet is adjusted to calculate the appendages by the use of formulas found in Visch (2007), the vessel's propeller diameter with a formula found in Watson (1998), and calculation of the vessel's fuel consumption for a specified engine by the use of Klein Woud & Stapersma (2003).

3.5.9.1.2.5 Power estimate

When knowing a container vessel's resistance and design speed (v_{ds}) at a sea margin of 15% in a fully loaded condition and knowing that the Froude number is not exceeding 0,6 the required power can be determined. This value is obtained as an output value of Aalbers (2008) excel sheet after an iterative process that matches the required power to the design speed.

Calculation Froude number:

$$F_n = \frac{v_{ds}}{\sqrt{g \cdot L_{wl}}}$$

- F_n : Froude number $[-]$
- v_{ds} : Vessel design speed $[kn]$
- g : Gravitational constant $\left[9{,}81 \frac{m}{s^2}\right]$
- L_{wl} : Length on load water line $[m]$

3.5.9.1.2.6 Fuel consumption

The fuel consumption needs to be calculated for the design conditions of a container vessels being fully loaded, sailing at is design speed at a sea margin of 15%. The fuel consumption also needs to be calculated when the container vessels is partially loaded, sailing at an arbitrary speed and at an added resistance of 10% in service condition.

The calculation of the fuel consumption per period ($\dot{M}_f$) is as next:

$$\dot{M}_f = \sum_i \left(\dot{m}_{fi} \cdot \Delta t_i \right) \quad (17)$$

- $\dot{M}_f$: fuel consumption $[tons]$
- Δt_i : time intervals $[h]$
- $\dot{m}_{fi}$: mass flow rate of fuel per interval $\left[\frac{tons}{h}\right]$

In general the mass flow of fuel ($\dot{m}_f$) in tons per hour can be calculated as:

$$\dot{m}_f = \frac{sfc \cdot P_B(v_s,\ \text{added resistance, } \Delta)}{10^6} \qquad 18$$

- $\dot{m}_f$: Mass flow rate of fuel $\left[\frac{tons}{h}\right]$
- sfc : Specific fuel consumption $\left[\frac{g}{kWh}\right]$
- P_B : Brake power $[W]$
- v_s : Vessel's speed $[kn]$
- Added resistance $[\%]$
- Δ : Displacement weight $[tons]$

The specific fuel consumption (sfc) is assumed to be 190 g/kWh. Normally the sfc is engine specific. This is further explained in Appendix P.

The break power (P_B) value depends on speed, the added resistance and the loading condition of the container vessel. The loading condition of the contained vessels has it influence on the displacement weight (Δ) of the container vessel.

By the use of the admiralty coefficient, the engine power (P_B) for a specific loading condition can be obtained:

$$C_{ad} = \frac{\Delta^{2/3} \cdot v_{s,Max}^3}{P_{B,Max}} \qquad 19$$

- C_{ad} : admiralty coefficient $[-]$
- Δ : Displacement weight $[tons]$
- $v_{s,Max}$:Maximum vessel's speed $[kn]$
- $P_{B,Max}$:Brake power at maximum continuous rating $[kW]$

When knowing the admiralty coefficient, the same formula can be used to know the break power (P_B) at any given loading condition of the container vessel and when the container vessel's speed is known.

$$P_B = \frac{\Delta^{2/3} \cdot v_s^3}{C_{ad}} \qquad 20$$

- P_B : Brake $[kW]$
- Δ : Displacement weight $[t]$
- v_s : Vessel's speed $[kn]$

For the loading conditions in the computer model, a distinction needs to be made between the inbound and outbound loading condition of a voyages.

The inbound loading condition can be expressed as:

$$\Delta_{inbound} = 1{,}1 \cdot \left(W_{sm} + W_{TEU} \right) \qquad 21$$

- $\Delta_{inbound}$: Displacement weight inbound voyage $[t]$
- W_{sm} : Weight ship and machinery $[t]$
- W_{TEU} : Weight TEUs $[t]$

In this formula factor 1,1 signifies a margin of 10% which includes the weight of the fuel, ballast, and consumables during the inbound voyage. A simplyfied conculations about the loading conditions inbound is in this case used due to a lack of information about the ballast condition and how the containers are distributed in the container vessel. The ballast condition and loading condition also have an influence on the fuels consumption of the container vessel.

The weight of the TEUs (W_{TEU}) loaded on board the container vessel can be obtained by multiplying the amount of empty and full TEUs on board the container vessels with the average TEU weights of full and empty TEUs per trade and trade lane. Table 31 shows the average TEU weights of full and empty TEUs per trade and trade lane.

The average full and empty TEU weights per TEU for each trade and trade lane combination are obtained of the NileDutch Container Management Control database (01/01/2007 to 31/12/2011). Table 31 shows the average full and empty TEU weights per trade and trade lane. ParagraphQ.1 of Appendix Q explains how the average full TEU weight per trade and trade lane are obtained. Paragraph Q.2 of Appendix Q explains how the average empty TEU weight per trade and trade lane are obtained. Do remark that the outbound voyages have higher average weights per full TEU in comparison with the inbound voyages. The average empty TEU weights are based on the gross container weights. In case the averages are higher than 2,23ton, which is the weight of an empty 20' DV, this means more special container are used such as reefers, high cubes, and flat racks. More details about empty container weight per container type can be found in Appendix S.

Table 31: Average full and empty TEU weights per trade and trade lane

Trade + trade lane	Tons/full TEU	Data sets	Tons/empty TEU	Data sets
Asia - West Africa, East bound	18,6	17.663	2,9	33.931
Asia - West Africa, West bound	14,6	205.881	3,4	163
Europe - West Africa, North bound	17,3	20.300	2,8	35.546
Europe - West Africa, South bound	15,4	211.337	3,4	2
South America - West Africa, East bound	18,8	47.024	4,5	1
South America - West Africa, West bound	21	63	3,1	11
Inter West Africa	14,6	65.113	2,8	21.348

Source: NileDutch's Container Management Control database (01/01/2007 to 31/12/2011)

The outbound loading condition can be obtained by determining the draft and displacement of the container vessels when it is sailing in ballast. This draft can be obtained by calculating the average draft based on the fore and aft draft. In ballast, these drafts can be expressed as next:

$$T_a = D_p + 0,5$$

- T_a : Draft aft $[m]$
- D_p : Diameter propeller $[m]$

The diameter of the propeller can be obtained by the formula of Watson (1998):

$$\mathrm{D}_p = 16,2 \cdot \frac{\mathrm{P}_{MCR}^{\;0,2}}{\mathrm{N}_{P_{design}}^{0,6}}$$

- D_p : Diameter propeller $[m]$
- P_{MCR} : Power of maximum continuous rating $[kW]$
- $N_{P_{design}}$: Propeller speed at design condition $[rpm]$

$N_{P_{design}}$ is taken as a constant with value 85. This is where NileDutch's newly built container vessels has a propeller diameter of 9,1m. P_{MCR} is determined by the use of Albers (2008) excel sheet which uses the Holtrop and Mennen resistance estimation method.

$$T_f = T_a - 1$$

- T_f : Draft fore $[m]$
- T_a : Draft aft $[m]$

$$T_{av} = \frac{T_a}{T_f}$$

- T_{av} : Average draft $[m]$
- T_a : Draft aft $[m]$
- T_f : Draft fore $[m]$

By the use of the Delftship program, the displacement at ballast draft can be determined. This is done for five container vessels with nominal TEU capacities of 100TEU, 500TEU, 3.500TEU, 7.000TEU, and 11.000TEU. Delftship provides lines plans of several container vessels. The container vessels Parent 51 is selected for scaling and hull transformation due to its block coefficient of 0,6583. This block coefficient is closest to the design block coefficient of 0,65 which is used to design container vessels in the preliminary stages of container vessels design in the computer model. Scaling is done by entering the percentage change with the Parent 51 container model. Hull transformation in Delftship is done by selecting the Lackerby method. Unfortunately, this method does not permit to transform the container vessels to their desired displacement weight and desired block coefficient. As the displacement is more important than the block coefficient, the block coefficient is determined by Delftship. The results of the scaling and hull transformation for the five container vessels can be found in Figure 75. The figure shows a lower block coefficient for each container vessel size. By the use of interpolation, the displacement when sailing in ballast can be found for each container vessels having a nominal TEU capacity between 100TEU and 11.000TEU.

Figure 75: Scaled and hull transformed container vessels in Delftship

Values after scaling and hull transformation	100 TEU	500 TEU	3.500 TEU	7.000 TEU	11.000 TEU
L	75,8m	124,1m	221,7m	283,8m	318,1m
B	15,2m	22,8m	37,0m	43,6m	48,8m
T	4,3m	6,5m	10,8m	12,5m	14,4m
Displacement	3.312t	12.197t	58.992t	103.423t	149.147t
LCB	-3,14m	-1,60m	-1,28m	-0,63m	-0,80m
Cb	0,65	0,65	0,65	0,65	0,65
Cb (scaled + hulltransformed)	0,6152	0,6097	0,614	0,6132	0,613
Tav (ballast)	4,73m	6,38m	9,08m	10,40m	11,22m
Displacement ballast	3.735t	11.890t	47.695t	82.106t	109.523t

A simplyfied conculations about the loading conditions outbound is in this case used due to a lack of information about the ballast condition and how the containers are distributed in the container vessel. The ballast condition and loading condition also have an influence on the fuels consumption of the container vessel.

3.5.9.1.2.7 Costs owned container vessel

The costs for an owned vessel consist of capital costs and operation costs.

Capital costs

The capital costs for an owned container vessels are calculated by the use of Aalbers (1997) excel sheet. His calculations about the capital costs are based on Benford (1965) and Carreyette (1977). Benford developed a method for engineering economy as a tool in ship design to obtain capital costs. Carreyette developed a method for assessing the approximate capital costs for merchant ships in very early stages of design. This excel sheet is used to calculate the capital costs of a container vessels when constructed at a Chinese shipyard. The excel sheets input values are weight ship and machinery (W_{sm}), steel weight total nett (W_{st}), LBD, blockcoefficent (C_b), equipment weight, accommodation area, cargo system weight, installed generator power, prime power per independent system, number of independent systems, Hull numeral L(B+D), cargo system weight, costs per man hour, interest during construction, interest on cash flow, interest on loan, period of loan, redemptions loan, grace period loan, inflation per year, instalment 1-6, subsidy percentage, loan percentage, depreciation period, depreciation value, residual value, and tax percentage. Some input values have already already been calculated earlier in this report. Such as weight ship and machinery (W_{sm}), LBD, blockcoefficent (C_b), prime power per independent system (or engine power), and number of independent systems (one engine). Other input values can easily be calculated such as the hull numeral L(B+D). Other input values remain constant independently of the container vessels size or are standard values when calculating the capitals costs of a container vessels. An overview of these values can be seen taken directly from Aalbers(1997) can be seen in Figure 76. The capital costs are calculated per year over a depreciation period of fifteen years. The computer model uses the average capital costs over these fifteen years as input.

Figure 76: Input values excel sheet capital costs

Input value	Value
Number of independent systems	1
Cargo system weight	0
Area accomodation	500m²
Grace period loan	0 year
Interest during construction	5%
Interest on cashflow	4,00%
Interest on loan	5%
Period of loan	15 year
Redemptions loan	12 year
Grace period loan	0 year
Inflation per year	0,33%
Instalment 1-5	10%
Instalment 6	50%
Subsidy percentage	0%
Loan percentage	60%
Depreciation period	15 year
Depreciation value	95%
Residual value	5%
Tax percentage	40%

The installed generator power is based on Gorski and Giernalczyk (2011). They dermined the relationship between the nominal TEU capacity of a container vessel and the required generator power. For container vessels up to a nominal TEU capacity of 2.000TEU this formula is as next:

$$P_{gen} = 500 + \frac{1.500}{2.000} \cdot nTEU \qquad 22$$

- P_{gen} : Generator power $[kW]$
- $nTEU$: Nominal TEU capacity $[TEU]$

For container vessels with a larger than 2.000TEU nominal TEU capcity of this formula is:

$$P_{gen} = 2.000 + \frac{18.000}{13.000} \cdot (nTEU - 2.000) \qquad 23$$

- P_{gen} : Generator power $[kW]$
- $nTEU$: Nominal TEU capacity $[TEU]$

Steel weight total nett (W_{st}) is according to Aalbers (1997) determined as next:

$$W_{st} = 0,27 \cdot LBD^{0,9}$$

- W_{st} : Weight steel [t]
- LBD : Length (L), beam (B), depth (D) [m³]

According to Schneekluth and Bertram (1998:168), the equipment weight for a container vessel can be obtained by next formula:

$$W_E = K \cdot L_{pp} \cdot B$$

- W_E: Weight equipment [t]
- K: Variable depending on ship type and size $\left[\frac{t}{m^2}\right]$
- L_{pp}: Length between perpendiculars [m]
- B: Beam [m]

The variable K ranges between 0,34 and 0,38 for container vessels. Its average value of 0,36 is used in the calculations. This results in:

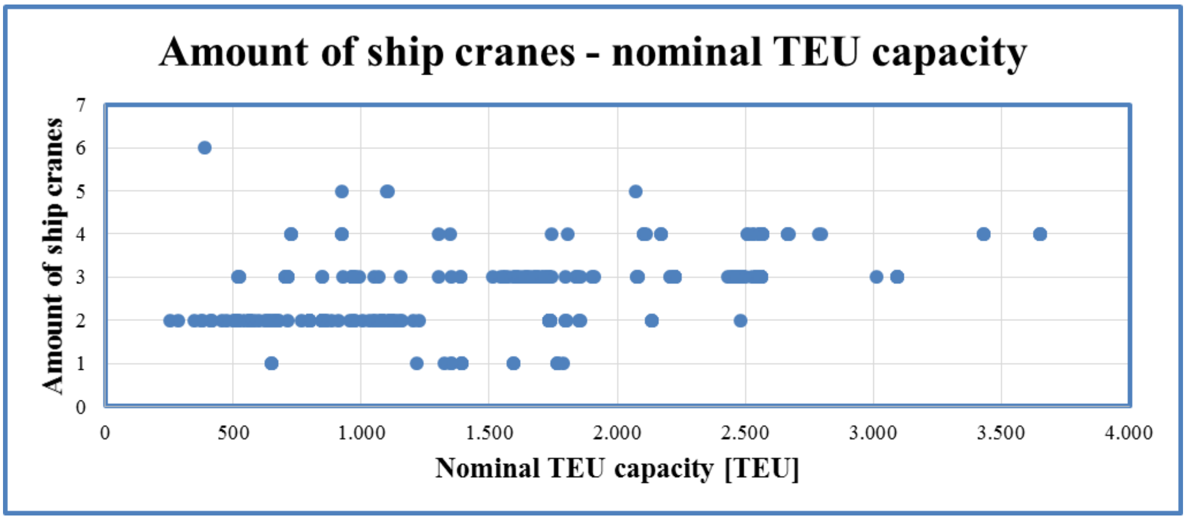
$$W_E = 0{,}36 \cdot L_{pp} \cdot B \qquad 24$$

The costs per man hour are based on the average wage of a construction worker in China. According to China Labour Bulletin (09/03/2014), the average wage per day of a construction worker is 160 Yuan. This results in a wage per hour of $3,246 when the Oanda (09/03/2014) exchange rate of 0,1623 is used to convert from Yuan to US Dollar.

The weight for the cargo systems can be based on the weight of a Liebherr CBW ship crane. This ship crane has a weight of 45t. The amount of cranes per container vessel depends on its nominal TEU capacity. Figure 77 shows this relationship. This graph is based on the data of 345 container vessels from Alphaliner (2011) database for which the nominal TEU capacity and the amount of ship cranes are given. These database consists of a total of 487 container vessels.

The weight of the cargo systems is based on two ship cranes when the nominal TEU capacity is between zero and 1.225TEU. Between 1.225TEU and 2.500TEU there are three ship cranes and when the container vessel has a nominal TEU capacity between 2.500TEU and 4.000TEU the container vessels have four ship cranes. In case the container vessels have a higher nominal TEU capacity than 4.000TEU there are no ship cranes on board the container vessel.

Figure 77: Relationship amount of ship cranes and nominal TEU capacity



3.5.9.1.2.8 Operation costs

The operation costs for an owned container vessels can be calculated in various ways. Benford (1967) who based its calculation on Walton (1959). Walton (1959) used trend line analysis. Next, Gentle and Perkins (1982) who used regression analysis. And finally, Evans and Marlos (1990) who's work is based on Benford (1967) which is improved for various ship types. Evans & Marlos (1990) method is used to calculate the operation costs of a container vesselsas this is the most recent method.

Operation costs consist of crew costs, supplies and lubricant oils costs, maintenance & repair costs, insurance costs, and administration costs. The administration costs are provided by NileDutch. They can be found in Paragraph M.6 of Appendix M.

Operation costs are calculated as next:

$$C_{op} = \frac{C_{crew} + C_{\sup} + C_{M\&R} + C_{INS} + C_{ADM}}{365} \qquad 25$$

- C_{op} : Operation costs $[\$ / day]$
- C_{crew} : Crew costs $[\$]$
- $C_{\sup}$: Supplies and lubricant oils costs $[\$]$
- $C_{M\&R}$: Maintenance & repair costs $[\$]$
- C_{INS} : Insurance costs $[\$]$
- C_{ADM} : Administration costs $[\$]$

The crew costs are calculated as next in case the crew consists of European officers and Asian petty-offers and seamen:

$$C_{crew} = 38.000 \cdot N_{crew}^{0,95} \qquad (26)$$

- C_{crew} : Crew costs $[\$]$
- N_{crew} : Number of crew $[-]$

$$N_{crew} = 11 + 0,07 \cdot \frac{CN}{1.000} + 0,018 \cdot P_{MCR}^{0,5} \qquad (27)$$

- N_{crew} : Number of crew $[-]$
- CN : Cubic number $[m^3]$
- P_{MCR} : Engine power at maximum continuous rating $[kW]$

$$CN = L_{pp} \cdot B \cdot D \qquad (28)$$

- L_{pp} : Length between perpendiculars $[m]$
- B : Beam $[m]$
- D : Depth $[m]$

The Supplies and lubricant oils costs are calsulated as next for a two stroke engine:

$$C_{\sup} = 3.500 \cdot N_{crew} + 4.000 \cdot (L_{pp} \cdot B \cdot T)^{0,25} + 200 \cdot P_{MCR}^{0,7} \qquad (29)$$

- $C_{\sup}$: Supplies and lubricant oils costs $[\$]$
- N_{crew} : Number of crew $[-]$
- L_{pp} : Length between perpendiculars $[m]$
- B : Beam $[m]$
- T : Draft $[m]$
- P_{MCR} : Engine power at maximum continuous rating $[kW]$

The maintenance and repair costs are calculated as next for a two stroke engine:

$$C_{M\&R} = 0,0035 \cdot C_0 + 105 \cdot P_{MCR}^{0,66} \quad 30$$

- $C_{M\&R}$: Maintenance & repair costs $[\$]$
- C_0: Investment costs $[\$]$
- P_{MCR}: Engine power at maximum continuous rating $[kW]$

The investment costs (C_0) are taken from the capital costs calculation excel sheet from Aalbers (1997).

The insurance costs are calculated as next:

In case the deadweight < 20.000t:

$$C_{INS} = 0,01 \cdot v_{ds} + 11,5 \cdot GT \quad 31$$

- C_{INS}: Insurance costs $[\$]$
- v_{ds}: Vessel design speed $[kn]$
- GT: Gross tonnage $[m^3]$

In case the deadweight > 20.000t but <80.000t:

$$C_{INS} = 0,008 \cdot v_{ds} + 5 \cdot GT \quad 32$$

In case the deadweight > 80.000t:

$$C_{INS} = 0,006 \cdot v_{ds} + 2,5 \cdot GT \quad 33$$

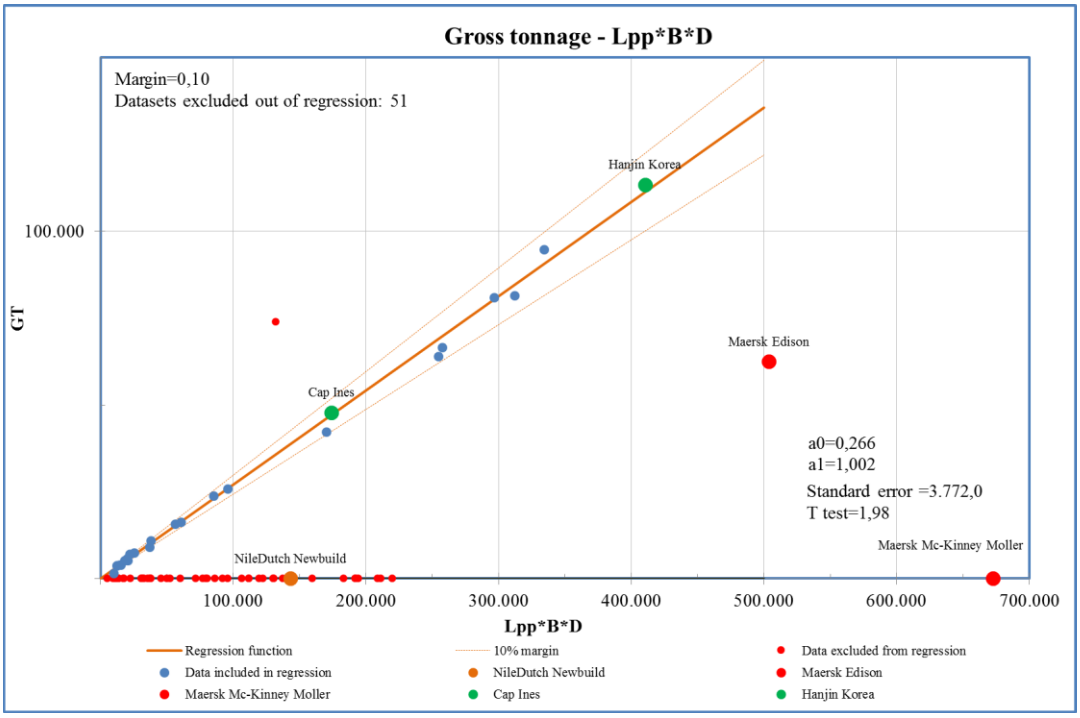
The gross tonnage value is obtained by the used of a next :power regession function:

$$y = 0,226 \cdot x^{1,002} \qquad (34)$$

- x : $L_{pp} \cdot B \cdot D$ of the container vessel
- y : Gross tonnage

51 out of 75 datasets are used for this regression. Its standard error value is 3.772,0 and its T test value is 1,98. Figure 78shows the graph of this regression.

Figure 78: Regression gross tonnage as a function of Lpp*B*D



3.5.9.1.3 Phase 2

The comparison of NileDutch's newly built vessel to the other vessels in the database is done in three steps. In the first two steps NileDutch's newly built vessel is compared with three groups, namely container vessels older than ten years, container vessels younger than ten years but older than three years and container vessels younger than three years.

Firstly, the fuel consumption at design speed and service speed is determined based on the installed power per 14 ton TEU/mile. The relationship between the costs of an owned container vessel per 14 ton TEU/mile and per ton/mile is also determined.

Secondly, plots are made of the costs of an owned container vessel per 14 ton TEU/ mile and per ton/mile as a function of their building year, the displacement, length and nominal TEU capacity of the container vessels. It also plots the nominal TEU capacity as a function of LxB, the nominal TEU capacity as a function of the displacement volume, and the deadweight tonnage as a function of the nominal TEU capacity.

Thirdly, the ideal L/B relationship for costs as low as possible per 14 ton TEU/mile is determined. In case the container ships length or beam changes, this has a positive or negative effect on the costs per 14 ton TEU/mile. It also takes the relationship of the nominal TEU capacity as a function of the beam and the length as a function of the beam into account as this is important for the container vessel's stability.

First the design speed and service speed of each container vessel in the database is obtained by the use Aalbers (2008) excel sheet which is based on the Holtrop & Mennen resistance calculations method. The design speed given in the database is not used as it is unclear what the specific design conditions such as the engine margin (EM), the gearbox efficiency (η_{GB}), and shaft efficiency (η_S) are per container vessel. To be better able to compare the container vessels to each other, the design speed is calculated by the use of Aalbers (2008) excel sheet. The needed input values are length between perpendiculars (L_{pp}), beam (B), draft (T), displacement weight (Δ), installed power (P_{MCR}), sea margin/added resistance (SM), engine margin (EM), gearbox efficiency (η_{GB}), and shaft efficiency (η_S). In the design condition, an added resistance of 15% (sea margin) on top of the ideal weather resistance is assumed. In service condition, the added resistance on top of the ideal weather resistance is 10%. The engine margin (EM) is assumed to be 10%. The transmission losses are assumed to be 1%. The specific fuel consumption (sfc) is assumed to be 190 $\frac{g}{kWh}$.

The fuel consumption at design speed based on the installed power per 14 ton TEU/mile can be obtained as next based on Klein Woud and Stapersma (2003:482) for the fuel consumption per mile:

$$\frac{fcm}{\#14\,\text{ton}\,TEU} = \frac{\frac{\dot{m}_f}{v_{ds}}}{\#14\,\text{ton}\,TEU} \quad 35$$

- $\frac{fcm}{\#14\,\text{ton}\,TEU}$:Fuel consumption design speed per 14 ton TEU/mile $\left[\frac{kg}{14tonTEU \cdot Mile}\right]$
- $\dot{m}_f$: Mass flow rate of fuel $\left[\frac{tons}{h}\right]$
- v_{ds} : Design speed $[kn]$
- $\#14\,\text{ton}\,TEU$: Amount of 14 ton TEU $[14tonTEU]$

Klein Woud and Stapersma (2003:482) calculate the mass flow of fuel as next:

$$\dot{m}_f = \frac{sfc \cdot P_{B_{design}}(v_{ds})}{10^6} \quad 36$$

- $\dot{m}_f$: Mass flow rate of fuel $\left[\frac{tons}{h}\right]$
- sfc : Specific fuel consumption $\left[\frac{g}{kWh}\right]$
- $P_{B_{design}}$: Brake power design condition $[W]$
- v_{ds} : Design speed $[kn]$

The specific fuel consumption (sfc) is assumed to be 190 $\frac{g}{kWh}$.

$$P_{B_{design}}(v_{ds}) = P_{CSR} \quad 37$$

- $P_{B_{design}}$: Brake power design condition $[W]$
- v_{ds} : Design speed $[kn]$
- P_{CSR} : Power continuous service rating $[W]$

Klein Woud and Stapersma (2003:417) calculate the power at continuous service rating as next:

$$P_{CSR} = EM \cdot P_{MCR} \qquad 38$$

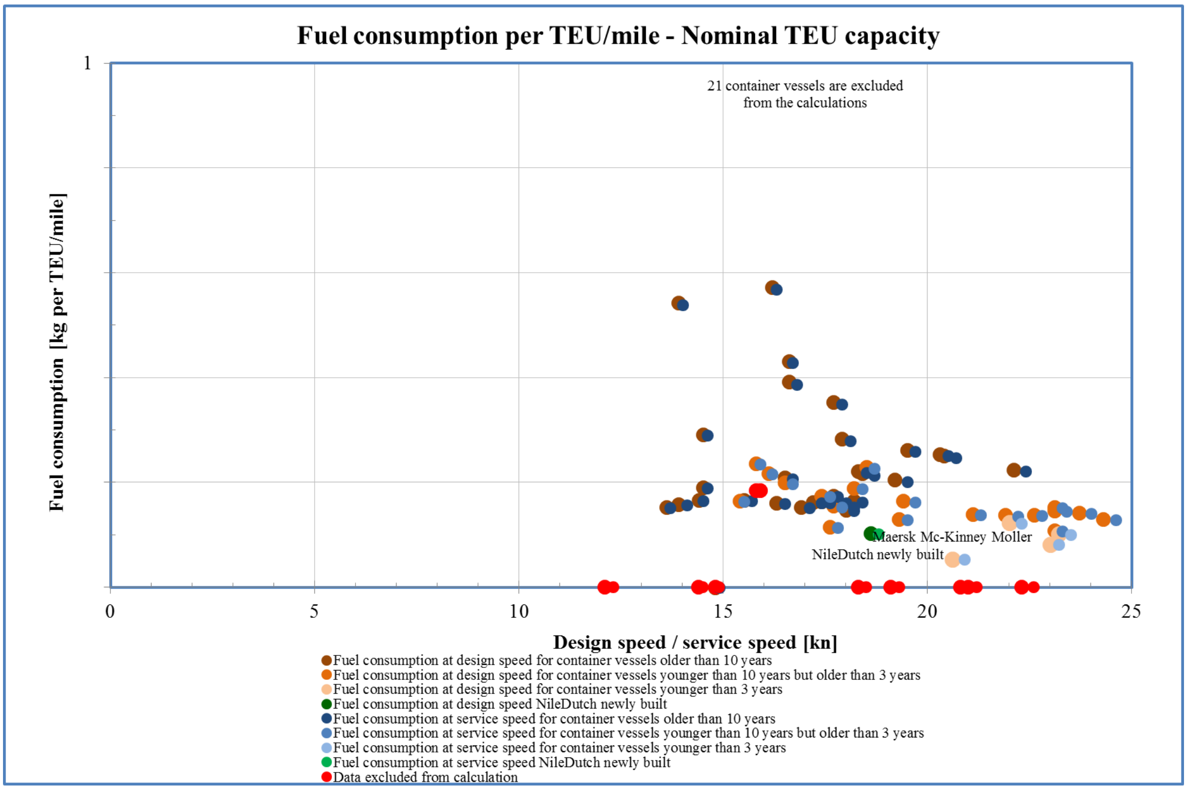
- P_{CSR} : Power at continuous service rating $[W]$
- EM : Engine margin $[\%]$
- P_{MCR} : Power at maximum continuous rating $[W]$

The engine margin (EM) is assumed to be 10%.

The fuel consumption at design speed and service speed based on the installed power per 14 ton TEU/mile is calculated in the same way as the fuel consumption at design speed based on the installed power per 14 ton TEU/mile. Only the design speed is replaced by the service speed.

The results of these calculations per group can be found in Figure 79. 22 datasets did not have the required data to obtain the results. One dataset among these 22 did not have a building year. Figure 79 shows a lower fuel consumption at service speed in comparison with the fuel consumption at design speed. This due to the fact that the vessels sail faster at service speed in comparison with the design speed. Thus having the same power at continuous service rating (P_{CSR}) and the same mass flow rate of fuel ($\dot{m}_f$), a container vessels can sail further in service condition in comparison with design condition due to the 10% power on the ideal weather resistance instead of 15% added resistance on the ideal weather resistance. The figure also shows the lower fuel consumption per 14 ton TEU/mile when the container vessels are younger. This can be explained by two reasons. The first reason is the design of more fuel-efficient engines in the recent years. This results in a lower fuel consumption and thus a lower fuel consumption per 14 ton TEU/mile. The second reason is larger designed container vessels, which also have a larger container intake in the recent years. Container vessels are designed with a higher nominal TEU capacity and 14 ton TEU capacity due to market demand. Having a higher 14 ton TEU capacity gives technical economies of scale, which results in an even lower fuel consumption per 14 ton TEU/mile. Maersk Mc-Kinney Moller container vessels illustrates this very well. It has the lowest fuel consumption per 14 ton TEU/mile at desing speed and service speed. NileDutch's newly built container vessel has a very low fuel consumption per 14 ton TEU/mile at design speed and service speed in comparison with other container vessels.

Figure 79: Comparison fuel consumption at design and service speed per group



Next, the costs for an owned container vessel per 14 tonTEU/ mile and per ton/mile are calculated. As mentioned before in paragraph 3.5.9.1.2 on page 105 the costs for an owned container vessel can be split up in capital costs and operation costs. The capital costs calculation are done with Aalbers (1997) excel sheet which bases its calculation on Benford (1965) and Carreyette (1977). This excel sheet is also expanded with the calculation for the operation costs. The operation costs are based on Evans & Marlos (1990).

The costs for an owned container vessel per 14 ton TEU/mile and per ton/mile can be calculated as next:

$$C_{oc_{14tonTEU/mile}} = \frac{C_{oc}}{\#14\,\text{ton}\,TEU \cdot v_{ds}} \tag{39}$$

- $C_{oc_{14tonTEU/mile}}$: Costs owned container vessel per 14 ton TEU/mile $\left[\frac{\$}{14tonTEU \cdot mile}\right]$
- C_{oc} : Costs owned container vessel $\left[\frac{\$}{day}\right]$
- $14\,\text{ton}\,TEU$: 14 ton TEU capacity container vessel $[14tonTEU]$
- v_{ds} : Design speed $[kn]$

$$C_{oc_{\text{ton}/mile}} = \frac{C_{oc} \cdot 24}{14tonTEU * 14 \cdot v_{ds}} \qquad 40$$

- $C_{oc_{\text{ton}/mile}}$: Costs owned container vessel per ton/mile $\left[\frac{\$}{t \cdot mile}\right]$
- C_{oc} : Costs owned container vessel $\left[\frac{\$}{day}\right]$
- $14tonTEU$: 14 ton TEU capacity container vessel $[14tonTEU]$
- v_{ds} : Design speed $[kn]$

Figure 80 and Figure 81 show the costs for an owned container vessel respectively per 14 ton TEU/mile and per ton/mile. Both graphs exclude 22 container vessels out 75 in the database as data are lacking to calculate the costs for an owned container vessel. Per 14 ton TEU/mile, the costs for an owned container vessel are significantly higher than the costs for an owned container vessel per ton/mile. Both graphs show lower costs for an owned container vessel per 14 ton TEU/mile or per ton/mile when the container vessels have been built more recently. This can be explained by design improvements, which resulted into more container intake per container vessel. Having a higher nominal TEU capacity and 14 ton TEU capacity results in a better container intake per vessel. Maersk Mc-Kinney Moller container vessel and CMA CGM Exellent container vessels illustrates this very well. Looking at NileDutch’s newly built container vessel, it shows no significant deviation in costs for an owned container vessel in comparison with other container vessels from the younger than 3 years group. Its costs for an owned container vessel are significantly lower than the majority of container vessels older than 3 years.

Both graphs show also lower costs for an owned container vessel when the container vessels have higher nominal TEU capacities. The most top left dot in both graphs show a very big deviation from where most dots are in the graph. This container vessel has a nominal TEU capacity of only 60TEU and is the tiniest one in the database.

Figure 80: Costs owned container vessel per TEU/mile

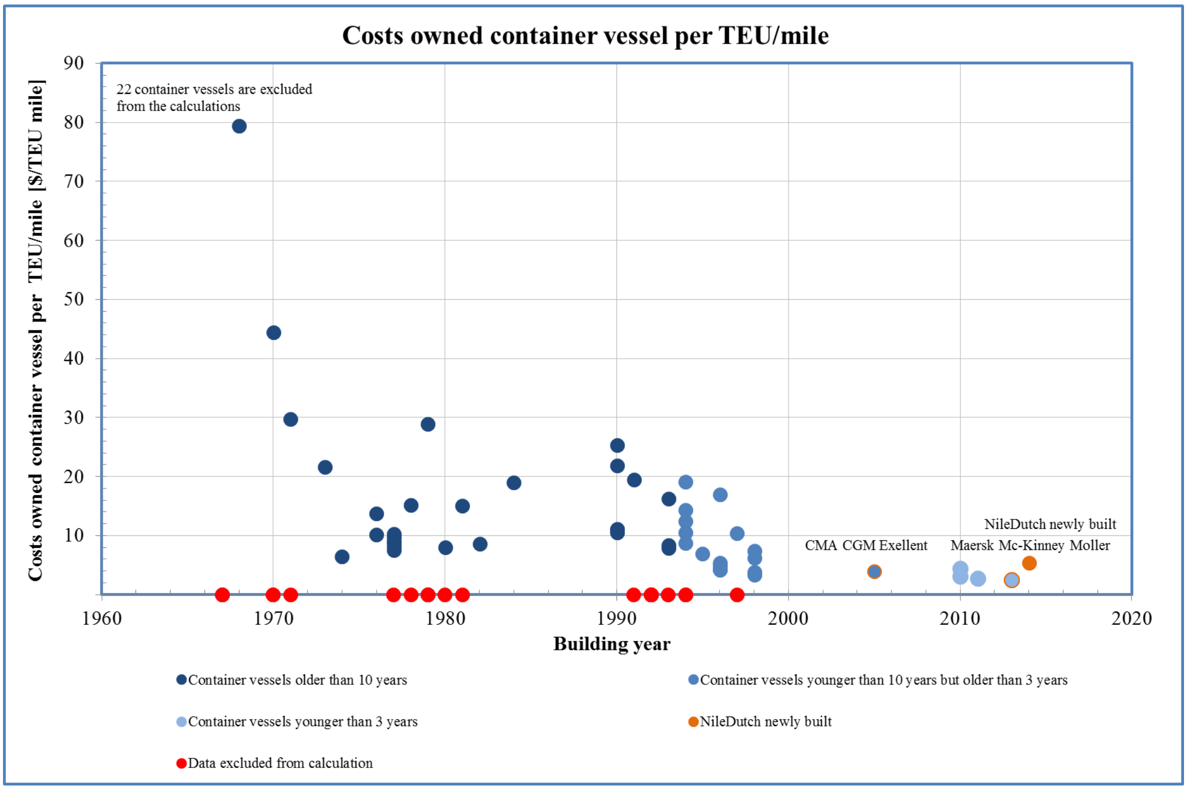


Figure 81: Costs owned container vessel per ton/mile

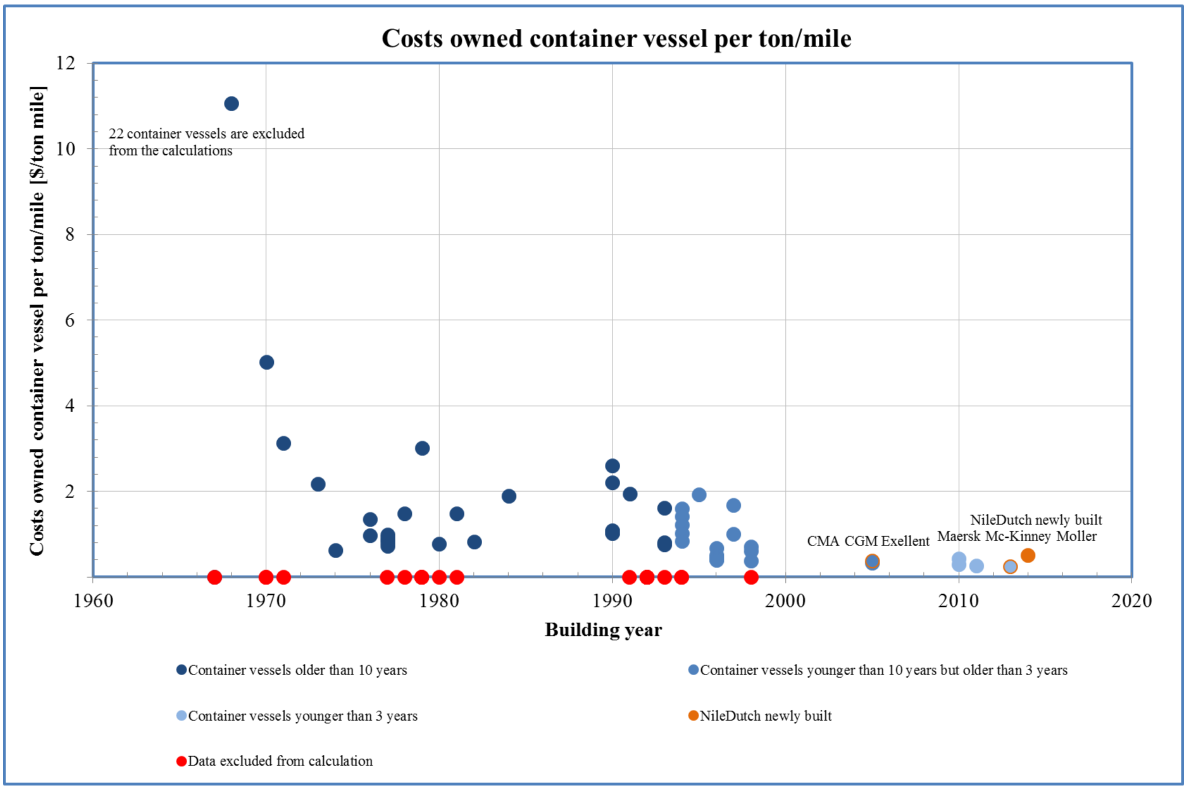


Figure 82 and Figure 83 show the costs for an owned container vessel respectively per TEU/mile and per ton/mile in relationship to the displacement. Figure 84 and Figure 85 show the costs for an owned container vessel respectively per TEU/mile and per ton/mile in relationship to the length between perpendiculars. Figure 86 and Figure 87 show the costs for an owned container vessel respectively per TEU/mile and per ton/mile in relationship to the nominal TEU capacity. All graphs exclude 22 container vessels out 75 in the database as data are lacking to calculate the costs for an owned container vessel. These graphs show lower costs for an owned container vessel with higher displacements, length between perpendiculars, and nominal TEU capacities. The younger groups of container vessels show lower costs for an owned container vessel in comparison with older container vessel groups. This can be explained by design improvement, which result in a better container intake per container vessel. These design improvement can be a lager beam, higher deckhouse, or a deckhous which is put more forward on the container vessel.

These graphs also show lower costs for an owned container vessel with increasing displacements, lengths between perpendicular, and nominal TEU capacity. These technical economies of scale effects can be explained by the use of the building costs and operation costs. The building costs are the yards price for purchasing a container vessel. In oter words the investment. Capital costs are the redemptions and interest payments of the loan that finances the investment in a container vessel. Table 32 and Table 33 show respectively the building costs and operation costs of container vessels with nominal TEU capacities of respectively 3.500TEU and 7.000TEU and having a design speed of respectively 21,5kn and 24,1kn. All costs have increased except for the accommodation costs, but recall that the accommodation surface is taken as a constant. All these costs have increased significantly.Although the nominal TEU capacity of the container vessels is doubled, no cost type is doubled. The total building costs have increased by 63,9%. The total operation costs per day have increase by 43,5%. This explains why larger container vessels have lower costs for an owned container vessel per TEU/mile or ton/mile.

Table 32: Building costs 3.500TEU and 7.000TEU container vessel

Building costs	3.500 TEU	7.000 TEU	Difference
General costs	6.242.836	9.236.219	47,9%
Hull costs	28.403.920	49.182.414	73,2%
Ship equipment costs	9.017.502	12.626.946	40,0%
Accommodation costs	774.789	774.789	0,0%
Electrical installation costs	2.053.930	2.663.699	29,7%
Propulsion & power generation costs	26.950.422	46.495.175	72,5%
Systems for propulsion & powergeneration costs	4.722.059	7.439.369	57,5%
Bilge & ballast systems costs	2.063.967	3.106.066	50,5%
Total	**80.229.424**	**131.524.677**	**63,9%**

Table 33: Operation costs 3.500TEU and 7.000TEU container vessel

Operation costs	3.500 TEU	7.000 TEU	Difference
Operational costs per day	$3.499,12	$5.719,47	63,5%
Number of crew	14	16	15,8%
Crew costs	$454.482,67	$522.404,23	14,9%
Supplies and Lub oils	$318.966,13	$601.433,59	88,6%
Maintenance and Repair	$326.030,01	$634.739,32	94,7%
Insurance costs	$177.699,44	$329.028,51	85,2%

Looking back at Figure 82 to Figure 87 Maersk Mc-Kinney Moller container vessel and CMA CGM Exellent container vessels illustrate the effects of improved designs on the one hand and the effect of the technological economies of scale on larger container vessels very well. The more recently built container vessels are positioned lower in the graph in comparision with older container vessels with comparable displacements. NileDutch's newly built container vessel shows no significant deviation in costs for an owned container vessel in comparison with other container vessels from the younger than 3 years group in these graphs. Its costs for an owned container vessel are significantly lower than the majority of container vessels older than 3 years. The most top left dot in all graphs shows a very big deviation from where most dots are in the graph. This container vessel has a nominal TEU capacity of only 60TEU and is the tiniest one in the database. There is also one red dot floting around in the graphs which is excluded out of the calculations although the required data are available. This container vessel is excluded out of the calculations as the building year is not provided for these data.

Figure 82: Costs owned container vessel per TEU/mile as a function of the displacement

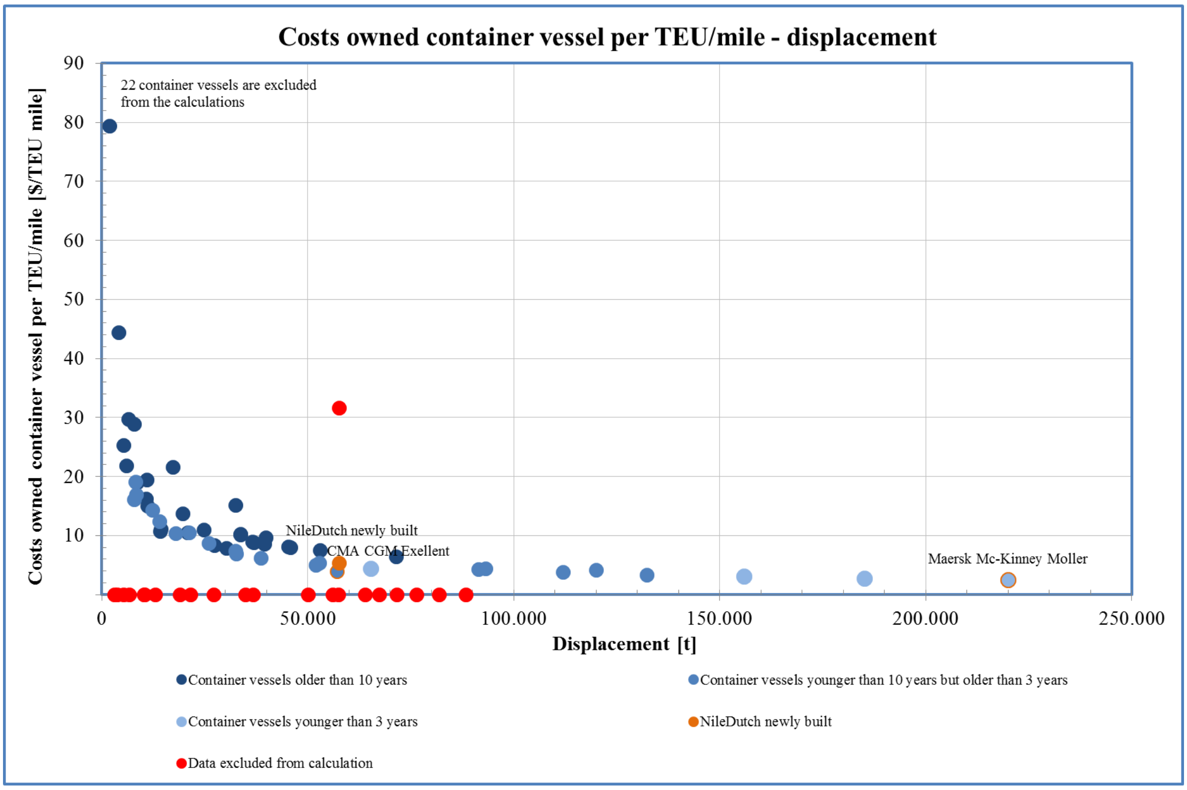


Figure 83: Costs owned container vessel per ton/mile as a function of the displacement

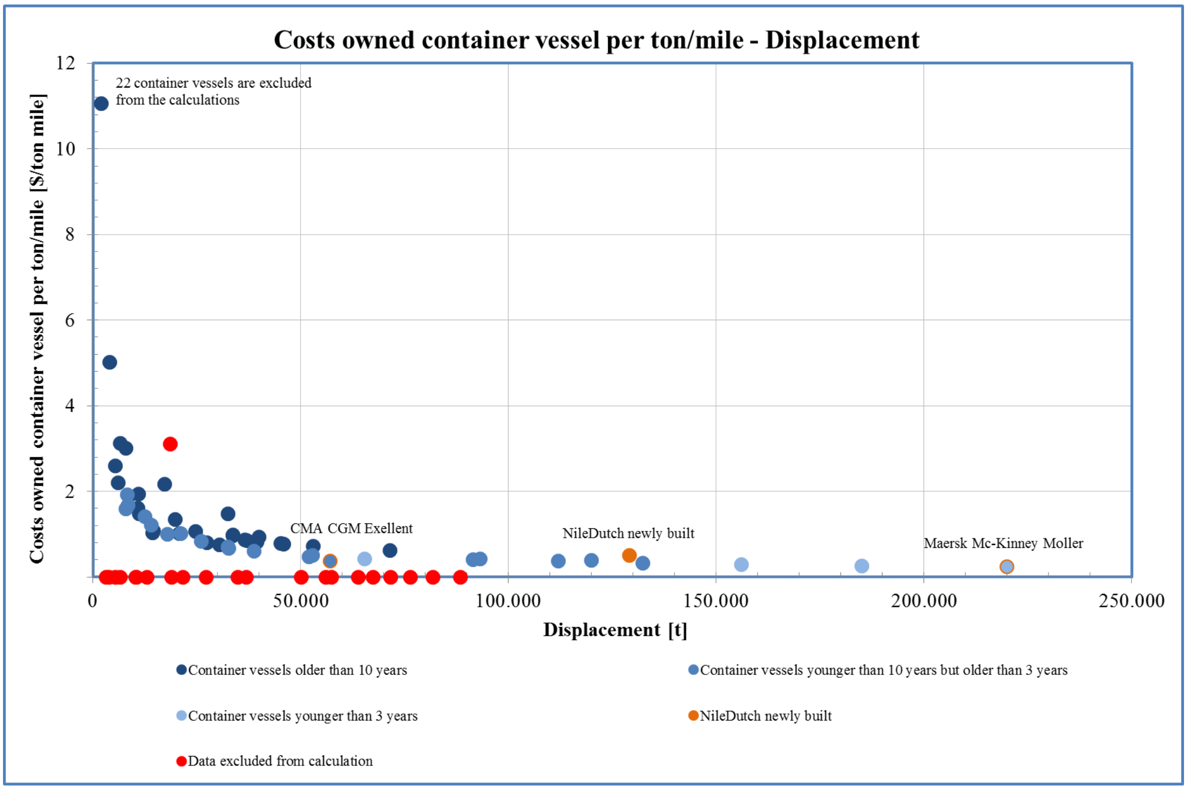


Figure 84: Costs owned container vessel per TEU/mile as a function of the length between perpendiculars

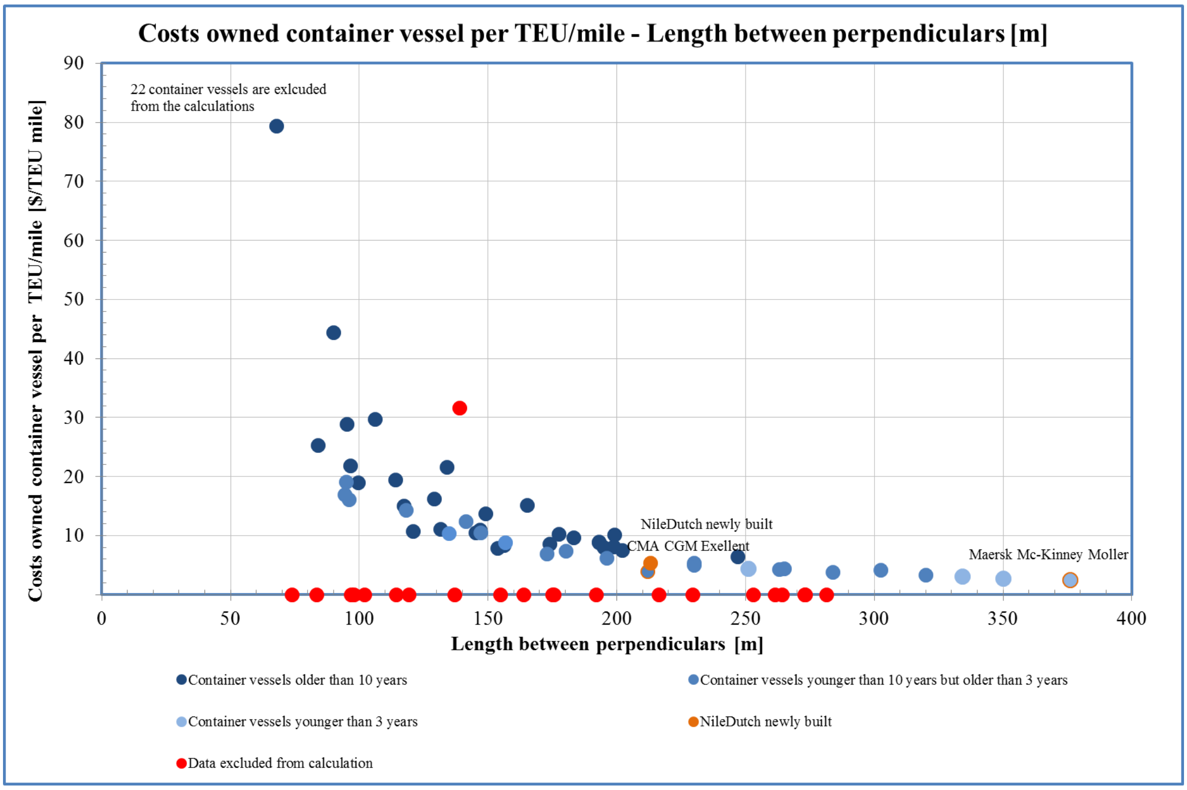


Figure 85: Costs owned container vessel per ton/mile as a function of the length between perpendiculars

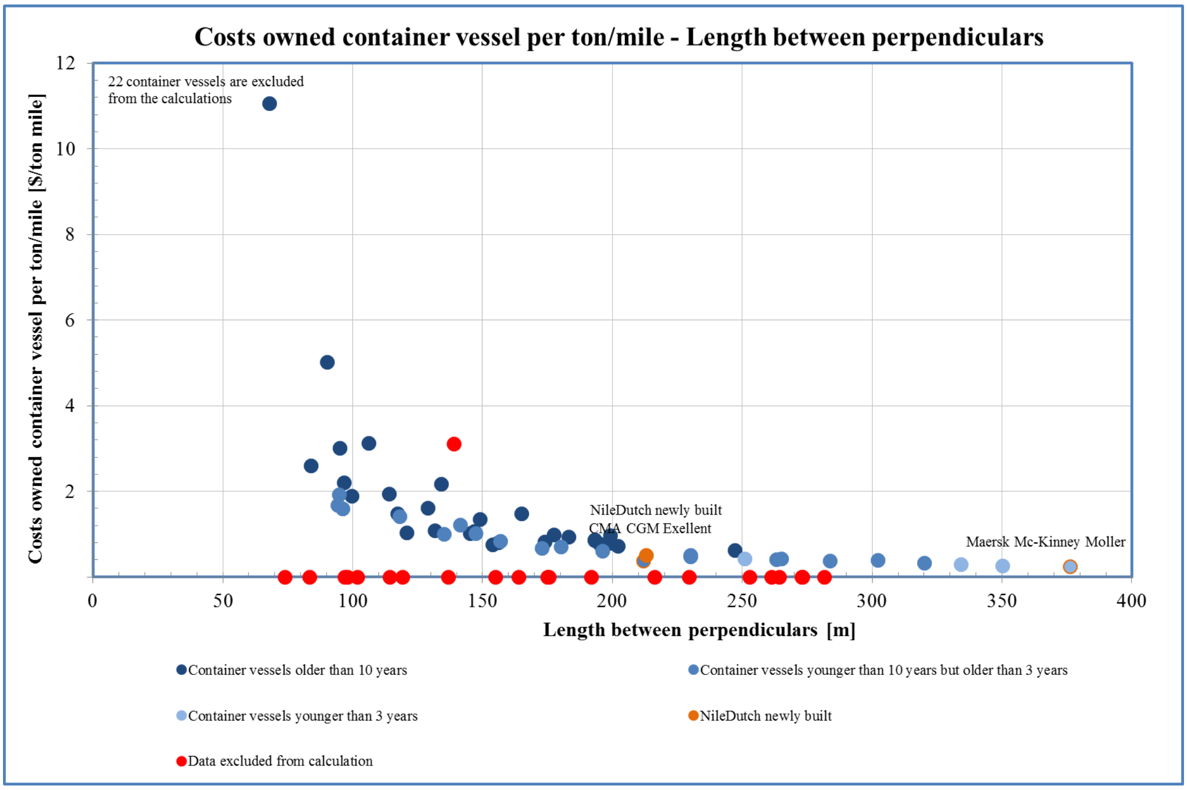


Figure 86: Costs owned container vessel per TEU/mile as a function of the nominal TEU capacity

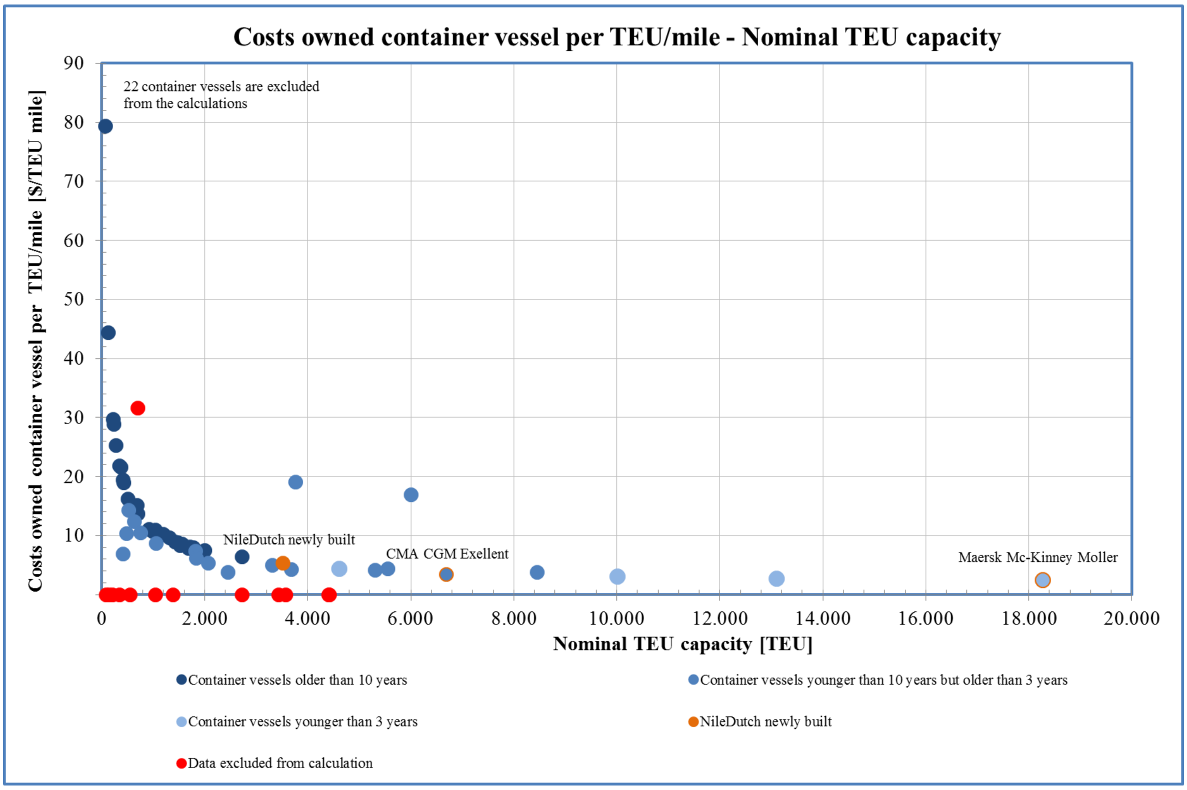


Figure 87: Costs owned container vessel per ton/mile as a function of the nominal TEU capacity

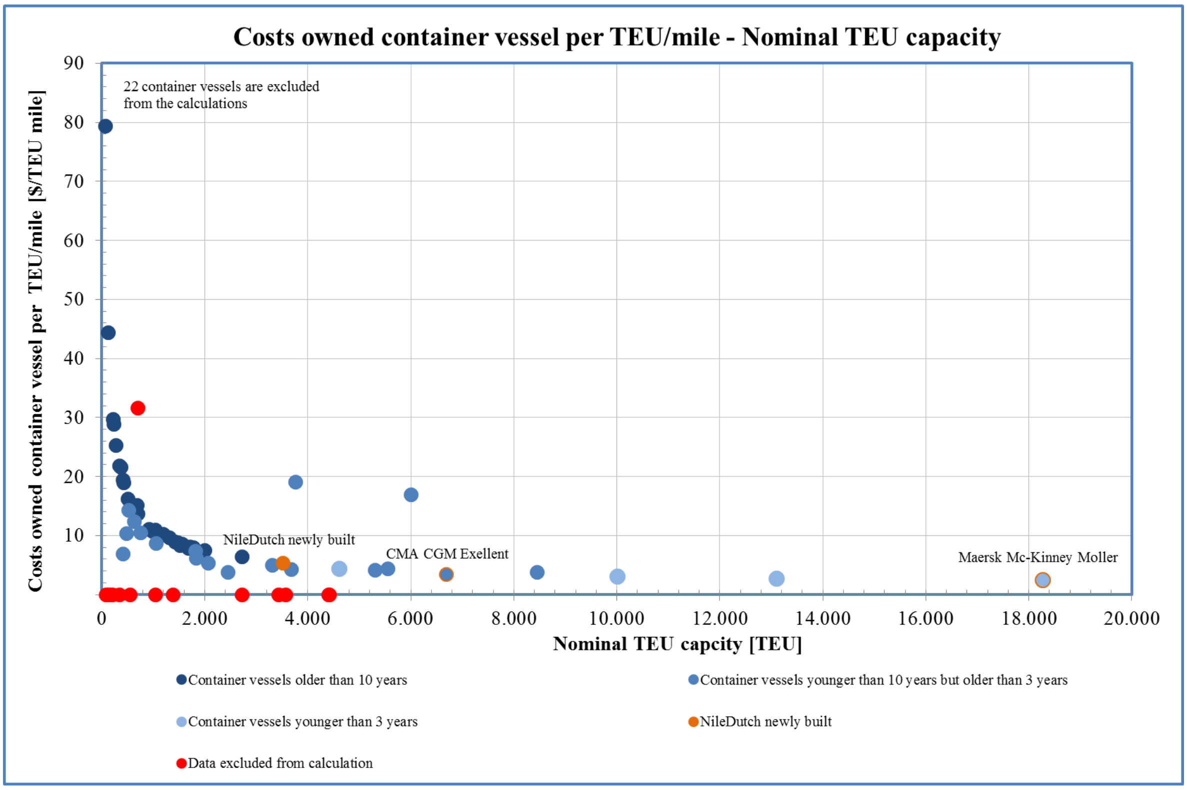


Figure 88 shows LxB in relationship to the nominal TEU capacity per group of container vessels. Having larger and/or wider container vessels obviously results in more container intake, but better container intakes have been achieved in the more recent years due to design improvements. Figure 88 shows this as well as the dots on the more recent container vessels are positioned higher in the graph. Although NileDutch's newly built container vessels have been constructed very recently it does not show a better container intake in comparison with the container vessels younger than ten years, but older than three years. Do keep in mind that many container vessels in Aalbers (2008) excel sheet come from publication of significant ships. Therefore, many container vessels excel in one way or another. CMA CGM Exellent container vessel shows a significant better container intake in comparison with comparable container vessels. In comparison with the container vessels younger than three years, it also shows a better container intake.

Figure 88: Comparison LxB per group

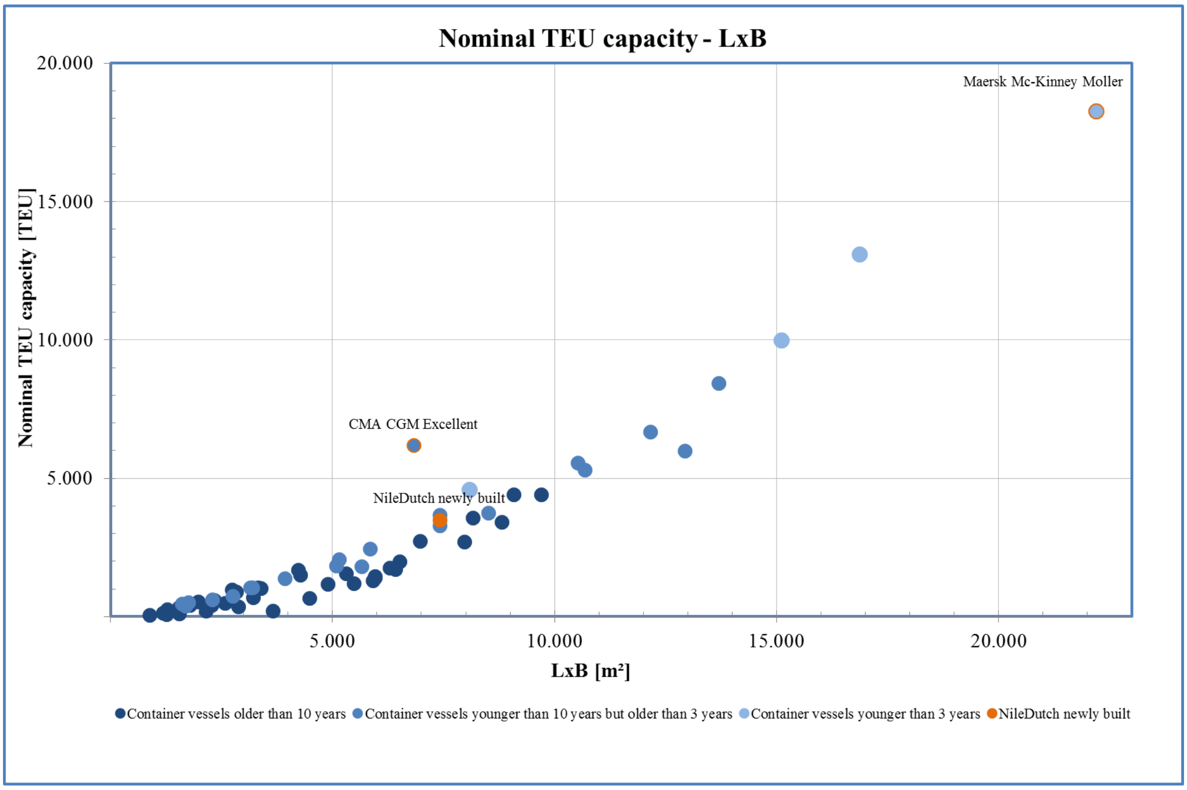


Figure 89 shows the relationship between the nominal TEU capacity as a function of the displacement volume. Having higher displacement obviously results in more container intake, but better container intakes have been achieved in the more recent years due improved designs. Figure 89 shows this as well as the dots on the more recent container vessels are positioned higher in the graph. Although NileDutch's newly built container vessel is very recently constructed is does not show a better container intake in comparison with the container vessels younger than ten years, but older than three years. NileDutch's newly built vessels have been designed with a lighter hull, a higher deckhouse, thus more container intake, and an improved relationship between beam and displacement resulted in more intake of full containers. Do keep in mind that many container vessels in Aalbers (2008) excel sheet come from publication of significant ships. Therefore, many container vessels excel in one way or another. CMA CGM Exellent container vessel shows a significant better container intake in comparison with comparable container vessels. In comparison with the container vessels younger than three years, it also shows a better container intake.

Figure 89: Comparison displacement volume per group

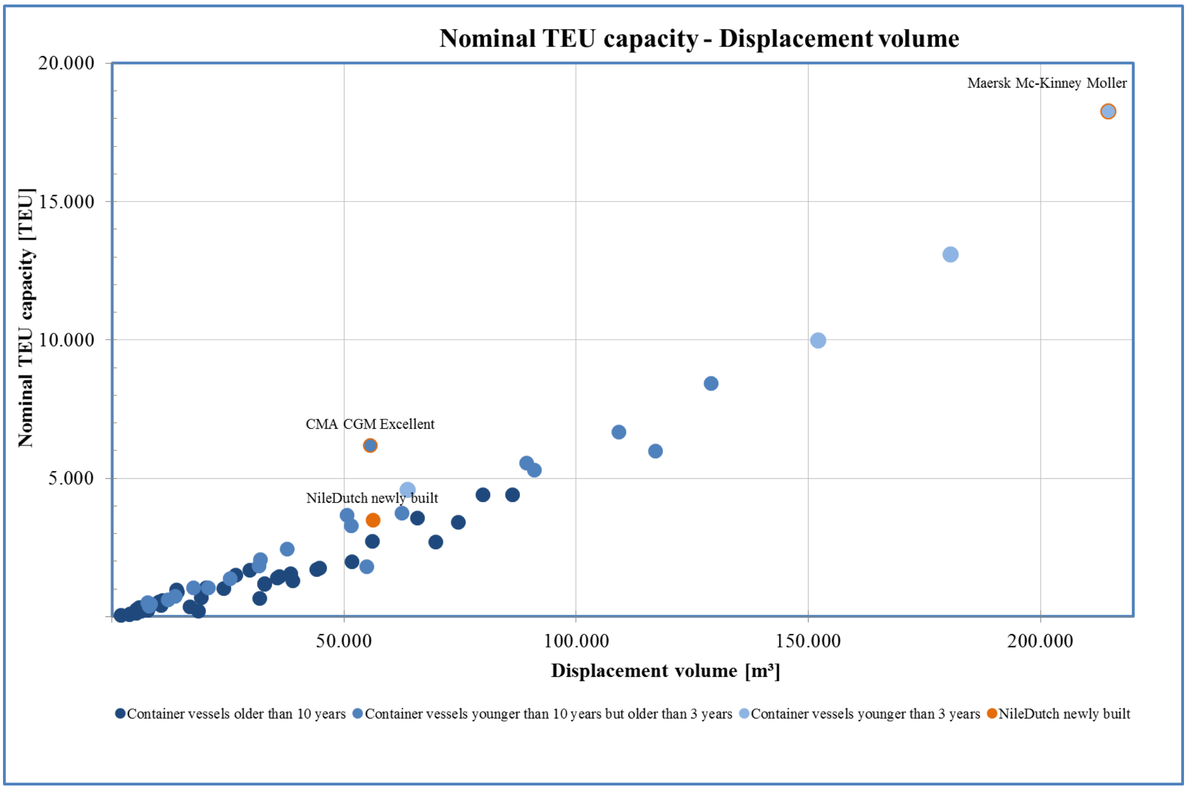
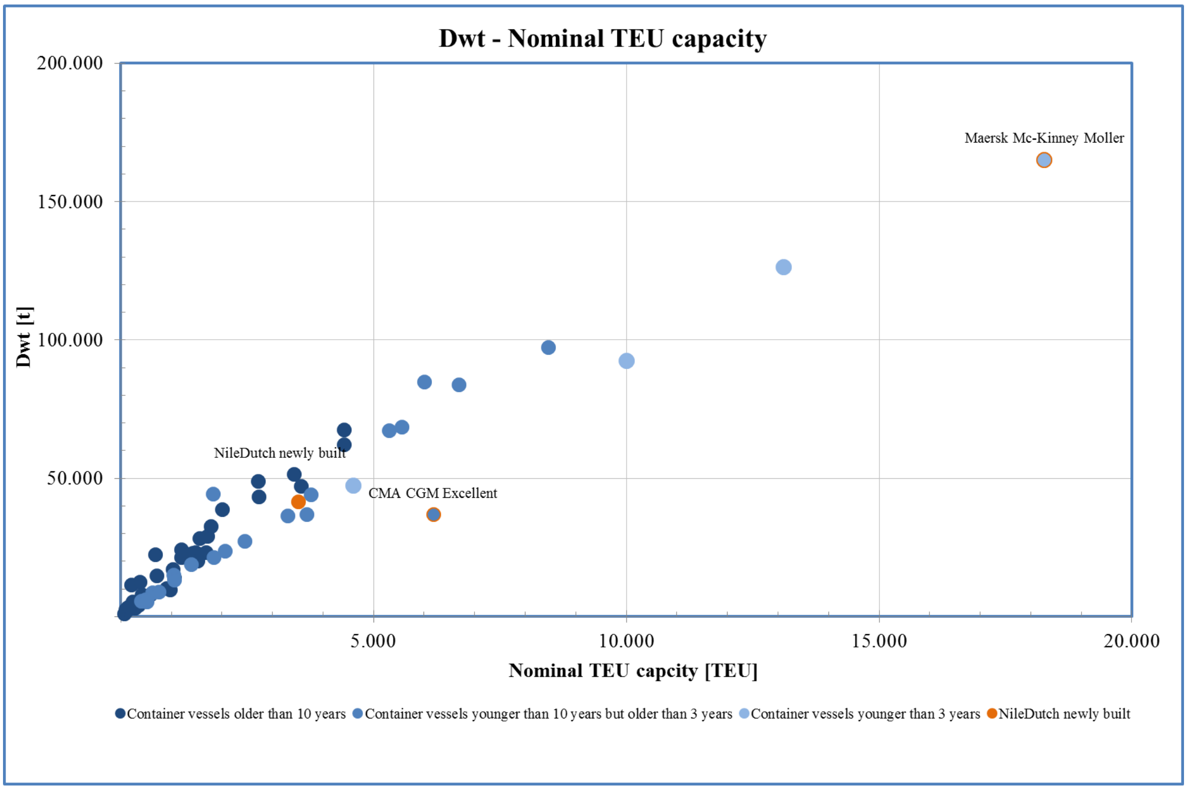


Figure 90 shows the deadweight tonnage as a function of the nominal TEU capacity. Having higher Nominal TEU capacities obviously results in a higher deadweight tonnage, but lesser deadweight is needed per TEU in the more recent years due to improved designs. Figure 90 shows that as well as the dots on the more recent container vessels are positioned lower in the graph. Although NileDutch's newly built container vessel has been constructed very recently and having made design improvedments it does not show a lower deadweight tonnage in comparison with the container vessels younger than ten years, but older than three years. Do keep in mind that many container vessels in Aalbers (2008) excel sheet come from publication of significant ships. Therefore, many container vessels excel in one way or another. CMA CGM Exellent container vessel shows a significant lower deadweight tonnage in comparison with comparable container vessels. In comparison with the container vessels younger than three years, it also shows a lower deadweight tonnage.

Figure 90: Comparison Nominal TEU capacity per group



3.6 Calculations model

This paragraph first gives an overview of the required calculations in the computer model. These calculations are about the amount of container vessels per container liner service, the revenue per voyage, the costs calculations of a voyage, the time calculations of a voyage, and time calculation of the total time a TEU is at the disposal of the shipper. These calculations are based on Stopford (2009) or how NileDutch's calculations department (2011) calculates these values. These calculations are displayed per voyage, but can also be applied for an inbound voyage, outbound voyage, trade, or the entire market. Next, the method is described how to obtain desired data about the container vessels. These data concerns estimates of the dimensions, resistance, power, fuel consumption, weight, arrangements, and stability. Then an overview follows of the required data and the way of obtaining these data. This involves estimates of data for 2015 and data from 2011. Some data cannot be estimated for 2015 because there are no time series available to carry out a forecast so average or simplified data are used from 2011. The estimated data for 2015 is NileDutch's weekly trip matrix, NileDutch's average net freight rates per trade and trade, average time charter rates for six container vessels, and bunker prices. A forecasting method estimates these data. The remaining required data average calculated values of costs or time obtained of NileDutch's databases or from the experience of NileDutch's operations department.

3.6.1 Voyage calculations and minimum required freight rate

The computer model executes the amount of container vessels calculations, the voyage calculations, and minimum required freight rate calculations. The voyage calculations consists of a part where costs are calculate for all container vessels and container liner services and part where the duration of rotation is calculated for all container vessels and container liner services.

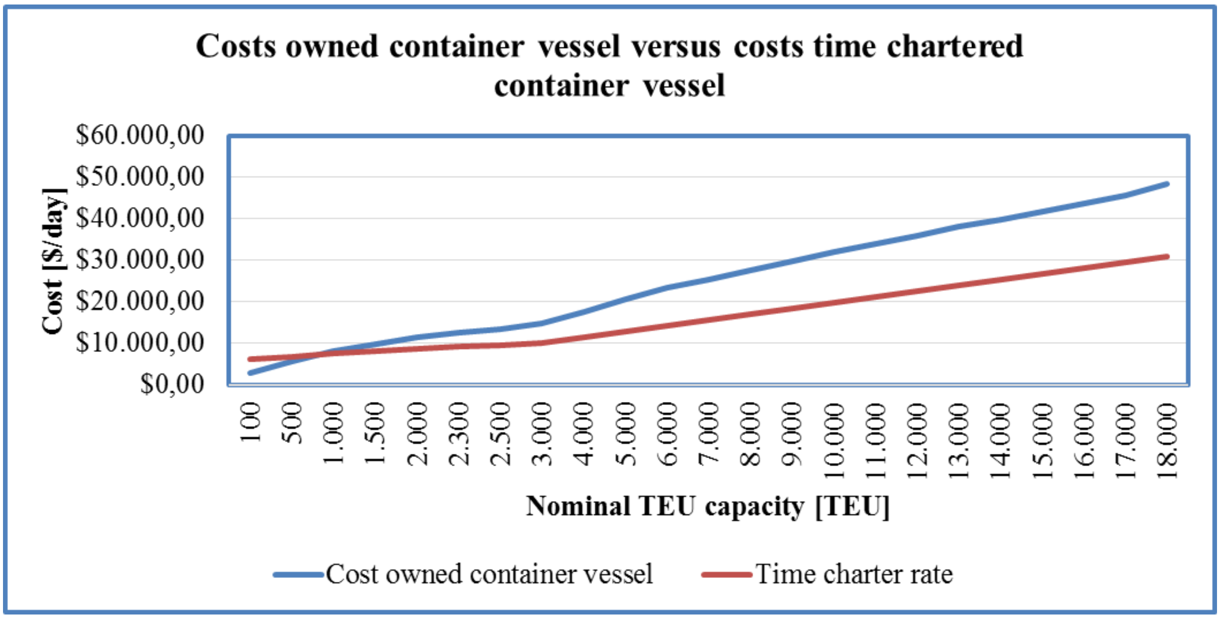
Amount of container vessels per container liner service

The amount of container vessels active per container liner service is determined by deriving the duration of the voyage by 7 days. These seven days represent the weekly sailing frequency that is required for each container liner service.

$$\#\ \text{container vessels} = \frac{\text{Duration of voyage}}{7} \qquad (41)$$

Important in determining to use an extra owned or charter container vessels in case an odd number of container vessels are needed in a container liner service, is the switch point in costs for 2015. The evolution of the costs for an owned container vessel (capital costs + operation costs) and the charter costs of a time chartered container vessels can be seen in Figure 91 for 2015. The data about the capital cost and time chartered cost per nominal TEU capacity used in this graph are the output values of the container vessel tool which is described in paragraph 3.5.9.1 on page 101. The container vessels tool uses forecasts for the time charter rates for 2015. These results can be found in paragraph 3.6.2.1.4 on page 167. How the capital costs are obtained can be seen in paragraph 3.5.9.1.2.7 on page 123.In case the nominal TEU capacity of the container vessels is below 1.000TEU, the costs for an owned container vessel are lower in comparison with a time charter container vessel. In case the nominal TEU capacity of the container vessels is higher than 1.000TEU, the costs for time chartered container vessels are lower in comparison with owned container vessels. As the time charter market fluctuates it is important to re-evaluete this switch point from time to time. NileDutch calculation department (2015) provided a cost for an owned and time chartered container vessels having an nominal TEU capacity of 3.500TEU in 2014. NileDutch newly built container vessel was 16.000 $/day A time charter container vessel with the same size had a time charter rate of 9.000$/day. These values are very comparable to the values in the graph obtaind by the tool. 16.681,70$/day for an owned container vessel and 10.908,90$/day for a time chartred container vessel.

Figure 91: Costs owned container vessel versus time chartered container vessel



Revenue per voyage

According to NileDutch's calculation department (2011) multiplying the total amount of transported full TEUs per voyage by the net freight rate[26] per TEU obtained from the forecast, gives the revenue per voyage[27].

$$R_F = \#TEU \cdot p_F \qquad (42)$$

- R_F : Revenue coming from freight per voyage $[\$ \text{ or } €]$
- $\#TEU$: Amount of TEUs $[TEU]$
- p_F : Net freight rate $[\$/\text{TEU or } €/\text{TEU}]$

Paragraph 3.6.2 shows the input data for amount of transported full TEUs and for the net freight rates per trade and trade lane.

[26] Net freight rate: NileDutch uses this denomination to indicate the rate which represents the ocean freight and the additional freight.
[27] Demurrage and detention revenue are not included in the revenue calculation.

Voyage calculations for net result

Voyage calculations for the net result are done is United States dollar. The voyage calculation for the net result are done by Stopford (2009) as next:

+ *Total Net freight*
  - Ocean freight
  - Additional freight
- *Voyage costs*
  - Vessel hire / costs owned vessel
  - Bunker costs
  - Port costs
  - General vessel expenses
- *Cargo Costs*
  - Stevedoring
  - Commissions
  - Container costs
  - Transshipment
- *General expenses*

Net result

In case costs or revenue requires to be converted this is done by next exchange rates form Oanda (09/11/2013):

EUR – USD: 1,32565

USD – EUR: 0,75427

Appendix L describes each element of the net result calculation.

To calculate the container vessel's hire costs in the voyage calculation, the container vessel's hire prices obtained from the forecasts is multiplied by the turnaround time.

$$C_{v_{T/C}} = C_{T/C} \cdot T_{voyage} \qquad (43)$$

- $C_{v_{T/C}}$:Costs time chartered container vessel per voyage $[\$]$
- $C_{T/C}$: Time charter rate $\left[\frac{\$}{day}\right]$
- T_{voyage} : Duration voyage $[days]$

Paragraph 3.6.2.1.4 on page 167 shows the estimation results of the time charter rates per container vessel type for 2015.

The calculation for the duration of the voyage are explained further in this paragraph.

$$C_{v_{co}} = C_{co} \cdot T_{voyage} \qquad (44)$$

- $C_{v_{co}}$: Costs owned container vessel per voyage $[\$]$
- C_{co} : Costs owned container vessel per day $\left[\frac{\$}{day}\right]$
- T_{voyage} : Duration voyage $[days]$

Paragraph 3.5.9.1.2.7 on page 123 explains more into depth the costs on owned container vessels.

Bunker costs

Multiplying the bunkered fuel by the bunker price results in the bunker costs:

$$C_B = \dot{M}_f \cdot p_B \qquad (45)$$

- C_B : Bunker costs $[\$]$
- $\dot{M}_f$: Fuel consumption $[tons]$
- p_B : Bunker price $\left[\frac{\$}{ton}\right]$

The calculation for the fuel consumption is described further in this paragraph. Paragraph 3.6.2.1.5 on page 173 shows the bunker price estimation results for 2015. Appendix M shows the remaining costs of the voyage calculation.

Voyage calculations for time

The computer model calculates how long it takes a container vessel to complete its voyage. This calculation is based on NileDutch's operations department calculations methods (2011) This calculation looks as follows when for example, there are two ports in the turnaround schedule, and offshore bunkering takes place.

+ Loading & discharging time port A
+ Average manoeuvring time port A
+ Transition time[28]
+ Sea passage time between port A and B
+ Transition time
+ Average congestion time Port B
+ Average manoeuvring time port B
+ Loading & discharging time port B
+ Average manoeuvring time port B
+ Transition time
+ Sea passage time between port B and A
+ Average manoeuvring time port B
+ Average transition time
+ Sea passage time before bunkering between port B and A
+ Preparation time before bunkering
+ Bunker time
+ Finalizing bunkering time
+ Sea passage time after bunkering between port B and A
+ Transition time
+ Average congestion time Port A
+ Average manoeuvring time port A

Duration voyage (T_{voyage})

Appendix N shows the input values for the calculation of the duration of a voyage.

[28] Transition time: time the container vessels needs to go from service speed during sea passage to maneuvering speed during maneuvering or the other way around.

Voyage calculation for the minimum required freight rate

The computer model needs to carry out a break-even analysis to calculate the minimum required freight rate. The break-even point is the point where the total costs equals the turnover. When wanting to calculate the break-even point for NileDutch in 2015, the total costs for 2015 need to be collected and derived by the total amount of transported containers.

The total costs involve:

+*Voyage costs*

Vessel hire / costs owned vessel

Bunkers

Port costs

General vessel expenses

+*Cargo Costs*

Stevedoring

Commissions

Container costs

Transshipment

+*General expenses*

Total costs

The minimum required freight rate can be obtained as next:

$$MRFR1 = \frac{\text{Total costs}}{\text{Total transported TEU}} \quad (46)$$

The minimum required freight rate per mile can be obtained as next:

$$MRFR2 = \frac{\text{Total costs}}{\text{Total transported TEU/mile}} \quad (47)$$

This calculation can be carried out per voyage, per trade, and for the entire market.

Time calculation of the total time a TEU is at the disposal of the shipper

The time calculation to observe where which TEU is out of the container fleet is done as follows as for example a full TEU is transhipped, so the time is calculated for which the full TEU was at the disposal of the shipper. This calculation is based on NileDutch's calculation department (2011):

+ Average stuffing time port A
+ Loading and discharge time in port A for container vessel 1
+ Average manoeuvring time port A
+ Transition time
+ Sea passage time
+ Transition time
+ Average manoeuvring time port B
+ Loading and discharge time in port B for container vessel 1
+ Waiting time for transshipment
+ Loading and discharge time in port B for container vessel 2
+ Sea passage time before bunkering between port B and C
+ Preparation time before bunkering
+ Bunker time
+ Finalizing bunkering time
+ Sea passage time after bunkering between port B and C
+ Transition time
+ Average manoeuvring time port C
+ Loading and discharge time in port C for container vessel 2
+ Average Stripping time port C

Total time for the TEU being in at the disposal of the shipper

The average stuffing and stripping time is not included in the calculation in case of an empty transhipped TEU. In that case, the TEU would also be at the disposal of NileDutch.

Appendix O shows the input values for the calculation of the total time a TEU is at the disposal of the shipper.

3.6.2 Forecasting data for 2015

This paragraph first explains what a forecast is. Next, the selected forecast method is described. Finally the per forecasted subject the literature on previous work, the available data, determination of prediction intervals, and the forecast results are described. In case the forecasted results are unrealistic, an alternative is described.

3.6.2.1 Forecast

Forecast methods are used to estimate future values. However, what exactly is a forecast? According to Clements and Hendry (2004:2): "A forecast is any statement about the future. Such statements may be well founded, or lack any sound basis; they may be accurate or inaccurate on any given occasion, or on average; precise or imprecise; and models based or informal. Forecasts are produced by methods as diverse as well-tested systems of hundreds of econometrically-estimated equations, through methods which have scarcely any observable basis" When it comes to how certain we can be about a forecast Singer (1997:39) tried to put this into words: "Because of the things we don't know [that] we don't know, the future is largely unpredictable. But some developments can be anticipated, or at least imagined, on the basis of existing knowledge." However, the randomness of outcomes within the field is understandable. This is called measurable uncertainty. This can be an interval around a point from the forecast or a probability density distribution of the forecasted outcomes as obtained with density forecasts.

3.6.2.1.1 Selected forecasting method, data, and results

Data that needs to be estimated with a forecast method are: The NileDutch trip Matrix per week for 2015, the net freight rates for 2015, the time charter rates for 2015, and the bunker prices for 2015. Forecasting is done by the use of an econometric ARIMA model. A Monte Carlo simulation using a Weibull probability density function is used for the prediction. The prediction indicated the interval in which the forecast results are considered realistic and acceptable. Next, per subject the literature research about forecasting methods per subject is treated, the available data are described, and the final estimated results by the use of econometric ARIMA models for the forecast and Monte Carlo simulation with a Weibull probability density distribution for the prediction are displayed. Appendix R explains the method to forecast with econometric ARIMA models and Monte Carlo simulation with a Weibull probability density distribution. The total net freight rates, time charter prices, and bunker prices needs to be deflated. Deflation is done by the use of the world inflation of the consumer prices provided by the International monetary fund (24/02/2014).

3.6.2.1.2 NileDutch trip Matrix of 2015

Literature

Literature on previous work to forecast the NileDutch trip matrix is non-existing. It also none exists for the West African container shipping market. However Kuroda et al. (2004) studied certain Asian, European, and American ports. They used the Durbin-Watson test to estimate factors influencing the container cargo movements. The AutoRegressive Integrated Moving Averages (ARIMA) forecast models executed forecast and the Fratar method together with distribution pattern to benchmark the trip matrix of 2000. The models estimated the 2015 and 2020 trip matrix. Their results showed good accuracy and it showed to be suitable for empirical use.

Available data

Monthly data from NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011). The data provides times series per trade and trade lane in NileDutch West African container shipping market as well as times series about the imported and exported TEU volumes per region. So time series of the container volumes for Asia – West Africa: East bound (Import Asia), Asia – West Africa: West bound (Export Asia), Europe – West Africa: North bound (Import Europe), Europe – West Africa: South bound (Export Europe), South America – West Africa: East bound (Export South America), Inter West Africa, Export West Africa, and Import West Africa are used for the forecast and prediction. With the outcome, two trip matrixes are made. The first trip matrix uses the forecasted TEU volumes per trade and trade lane. Next per region, the forecasted TEU volumes are divided over the ports in the same proportion, as this was the case in 2011.

The second trip matrix uses the imported and exported TEU volumes per region. Next, a trip distribution method obtains the TEU volumes per trade and trade lane. As mentioned in paragraph 2.3.4 on page 30. Trip distribution can be done by the use of the same market shares, growth factor methods or via synthetic methods. Examples of growth factor methods are the uniform growth factor method, average growth factor method, Fratar growth method, Furness growth method, and Detroit growth factor method. Examples of synthetic methods are the gravity model, Tanner model, intervening opportunities model, and competing opportunities model. In this case equal staying market share are used, as there are columns with zero values. These columns cause errors in the calculations of other methods. After having obtained the TEU volumes per trade and trade lane, further distribution over the ports is done in the same proportion, as this was the case in 2011.

Prediction interval

The prediction intervals per times series on which the Weibull probability density function used in a Monte Carlo simulation is based can be seen in Table 34. Worst-case scenario no container volumes would be transported in 2015 on a certain trade and trade lane. Therefore, for each times series the lower prediction interval is zero. The upper prediction interval is determined by using a multiplier of 2,6 from McKinsey & Company (2011). When the multiplier is multiplied by the annual GDP growth of a region the container volumes growth of that region is obtained. Spurrier (2014) gives an annual economic growth of over 5% for the Sub-Saharan region for 2014-2016. IMF (15/04/2014) gives annual GDP growth of 4,883% for 2012, 4,8860% for 2013, estimates 5,395% for 2014, and estimates 5,522% for 2015. Taking an extra margin by assuming an annual economic growth of 6% between 2011 until 2015 results in a container volume growth of 15,6% annually between 2011 and 2015 or an increase in 78,6% more containers for 2015 in comparison with 2011. This gives the upper prediction intervals per time series as can be seen in Table 34.

Table 34: Prediction intervals for the TEU volumes time series

Time series TEU volumes	Lower prediction interval (TEU)	Upper prediction interval (TEU)
Asia - West Africa, East bound	0	901
Asia - West Africa, West bound	0	8.916
Europe - West Africa, North bound	0	430
Europe - West Africa, South bound	0	8.155
South America - West Africa, East bound	0	2.432
Inter West Africa	0	1.995
Export West Africa	0	21.497
Import West Africa	0	3.326

Results

For all time series, an econometric ARIMA model is found together with a prediction interval. The results of both trip matrices are next compared with the estimates of McKinsey & Company (2011) and the agency questionnaire (2011).

McKinsey & Company (2011) made an estimation of the West African TEU volumes of 2015 based on data from 2009 for a low (+60%), medium (+80%), and high (+130%) scenario. Table 35 shows their results and how much they deviate from the results of both trip matrices. McKinsey & Company's low scenario does not deviate larger than the acceptable 10% margin. Its medium scenario falls within the 10% acceptable margin for trip matrix one. Trip matrix two deviates by 12,06%. This falls outside the 10% acceptable margin. The high scenario falls outside the acceptable margin. The results for both trip matrixes fall between the low and medium scenarios of McKinsey & Company.

Table 35:TEU volumes for 2015, comparison to McKinsey & Company

Trade + trade lane	TEU volumes 2011	TEU volumes 2015 (1)	TEU volumes 2015 (2)	McKinsey & Company 2015 (low scenario)	McKinsey & Company 2015 (medium scenario)	McKinsey & Company 2015 (high scenario)
Total West Africa	153.396	224.639	218.280	212.300	244.600	320.500
Trip matrix 1				-5,49%	8,89%	42,67%
Trip matrix 2				-2,74%	12,06%	46,83%

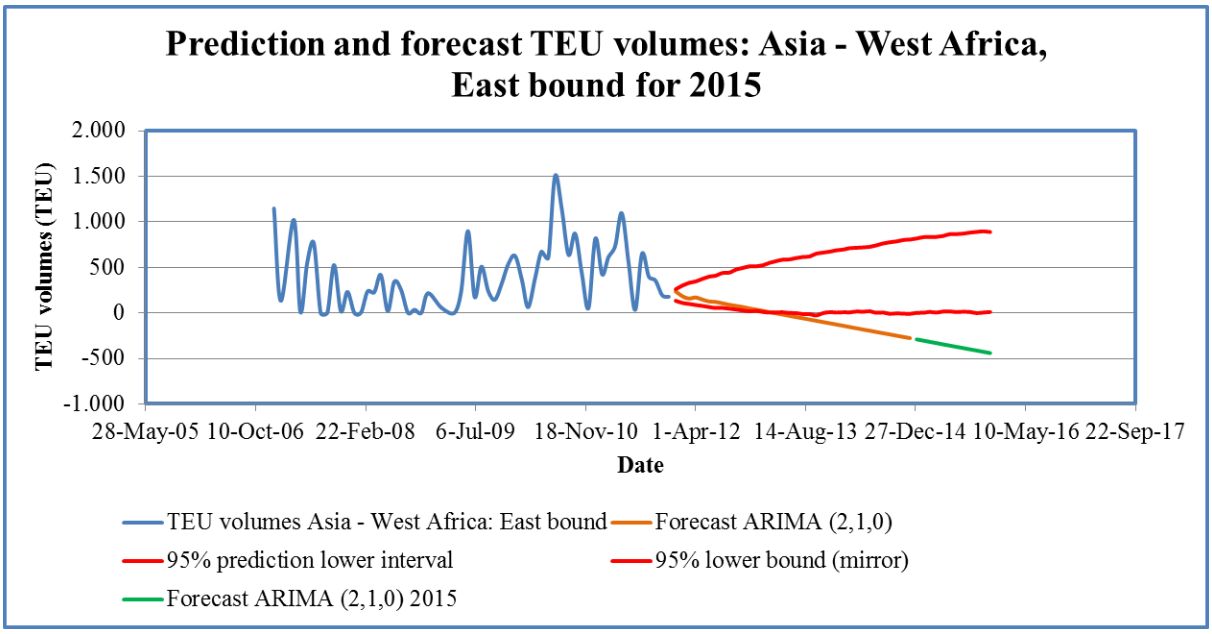
The agency questionnaire report can be seen in Appendix F. All agencies who participated in the questionnaire believe the West African container shipping market is to grow. The percentage of growth that was most named in the questionnaire is an annual growth of 10%. Table 36 shows the results of the forecasts and the results in case the West African container shipping market annually grows by 10% per trade and trade lane for 2015. Table 36 shows deviations less than 10% except for the Asia - West Africa East bound and Europe - West Africa North bound trade and trade lane. These deviations are acceptable. Table 36 also shows a difference in total TEU volumes of 0,02% and 2,81%. These differences also fall within the 10% acceptability margin. As the Asia - West Africa East bound and Europe - West Africa North bound trade and trade lane are outbound trade lanes with a low share in the total TEU volumes and the total TEU volumes fall within the acceptable margin these forecasting results are also be used in the computer model.

Table 36: TEU volumes for 2015, comparison to questionnaire

Trade + trade lane	TEU volumes 2011	TEU volumes 2015 (1)	TEU volumes 2015 (2)	TEU volumes agency survey 2015	Difference with agency survey 2015 (1)	Difference with agency survey 2015 (2)
Asia - West Africa, East bound	6.054	0	2.043	8.864	/	76,95%
Asia - West Africa, West bound	59.913	91.690	89.282	87.719	4,33%	-1,78%
Europe - West Africa, North bound	2.889	3.572	975	4.230	-18,42%	76,95%
Europe - West Africa, South bound	54.797	83.860	81.658	80.228	4,33%	-1,78%
South America - West Africa, East bound	16.339	25.005	24.348	23.922	4,33%	-1,78%
Inter West Africa	13.404	20.513	19.975	19.625	4,33%	-1,78%
Total	**153.396**	**224.639**	**218.280**	**224.587**	**0,02%**	**2,81%**

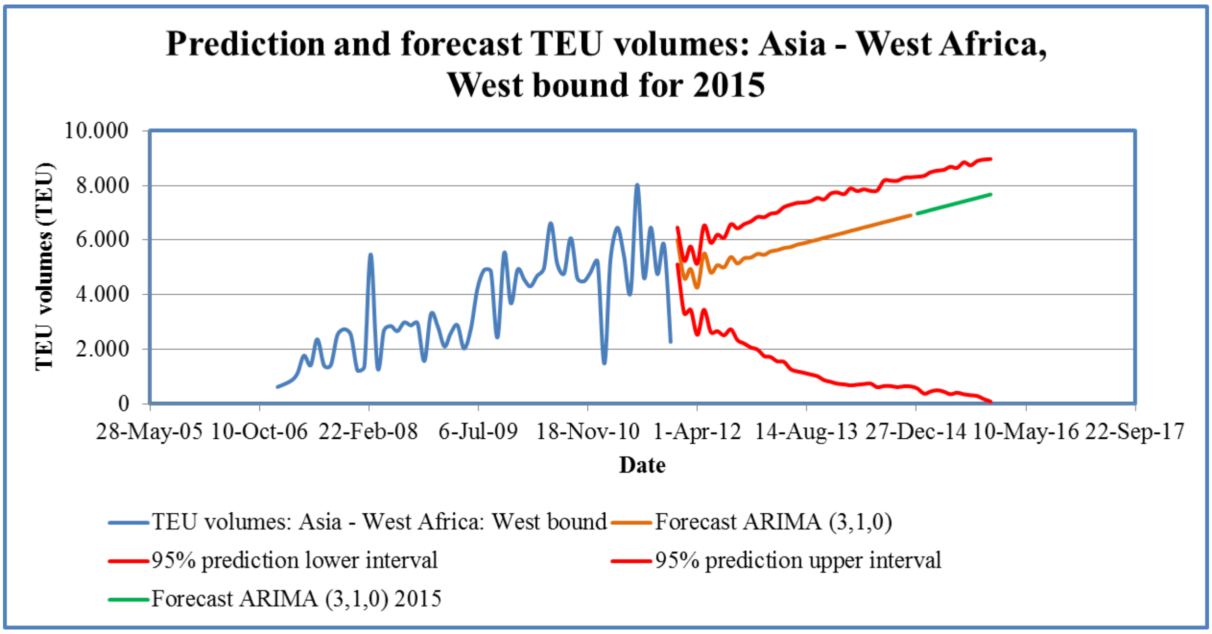
The results of the forecast and predictions can be seen in Figure 92 to Figure 99. More into detail results can be seen in Paragraph R.3 of Appendix R. When verifying if the forecasted results are realistic the results for the Asia – West Africa, East bound TEU volumes show a negative TEU volume. This indicates that on this trade and trade lane the TEU volumes diminishes to zero by 2015.

Figure 92: Evolution of the Asia – West Africa: East bound TEU volumes, predictions and forecast until 2015



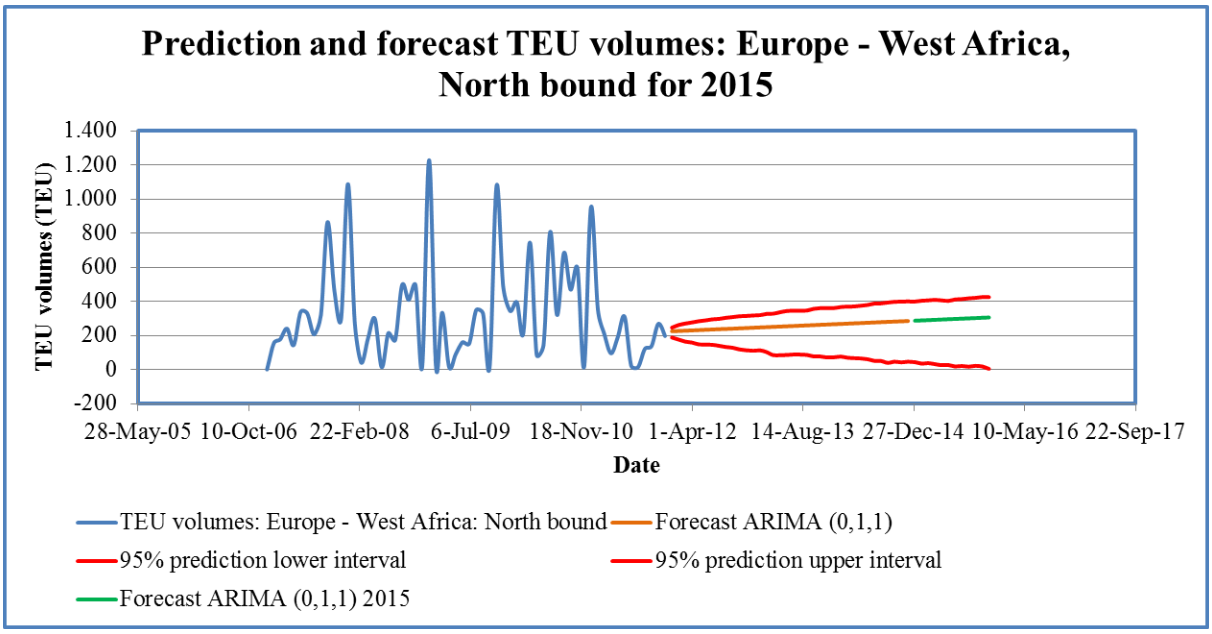
NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011) and own calculations on the predictions and forecast until 2015

Figure 93: Evolution of the Asia – West Africa: West bound TEU volumes, predictions and forecast until 2015



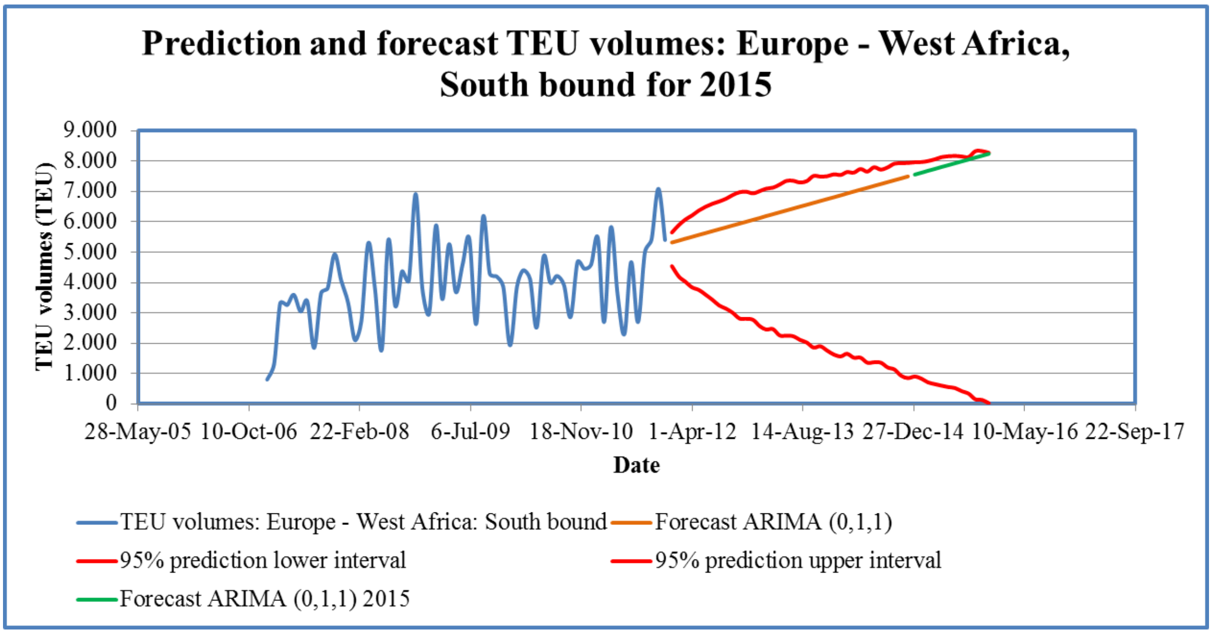
NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011) and own calculations on the predictions and forecast until 2015

Figure 94: Evolution of the Europe – West Africa: North bound TEU volumes, predictions and forecast until 2015



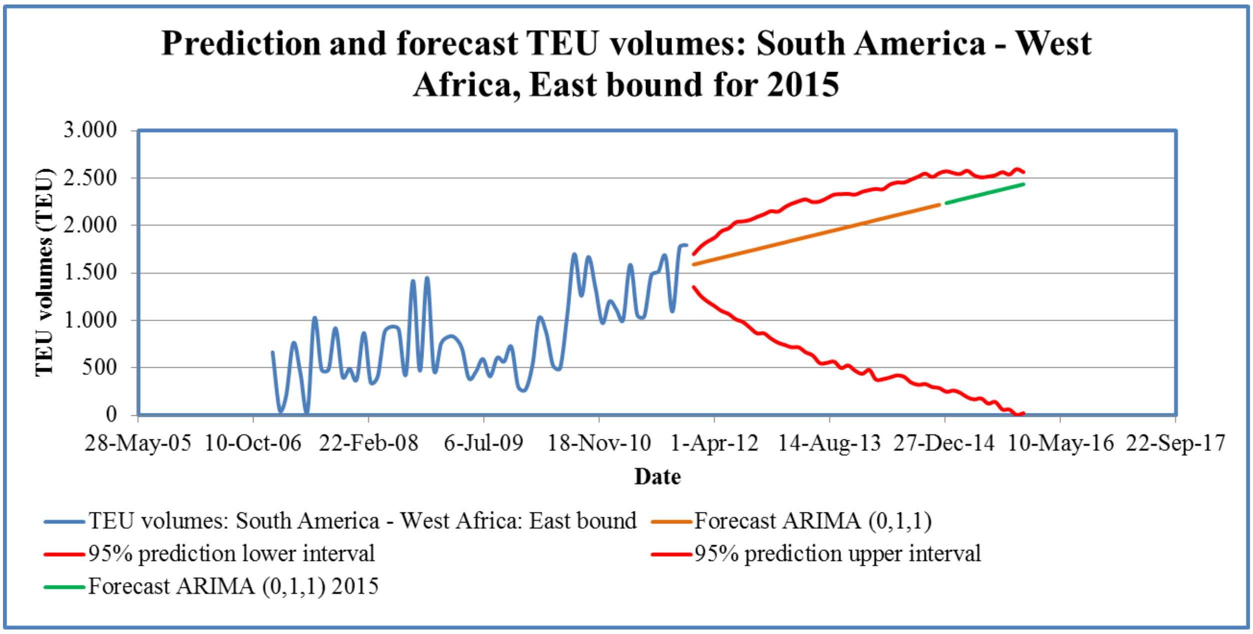
NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011) and own calculations on the predictions and forecast until 2015

Figure 95: Evolution of the Europe – West Africa: South bound TEU volumes, predictions and forecast until 2015



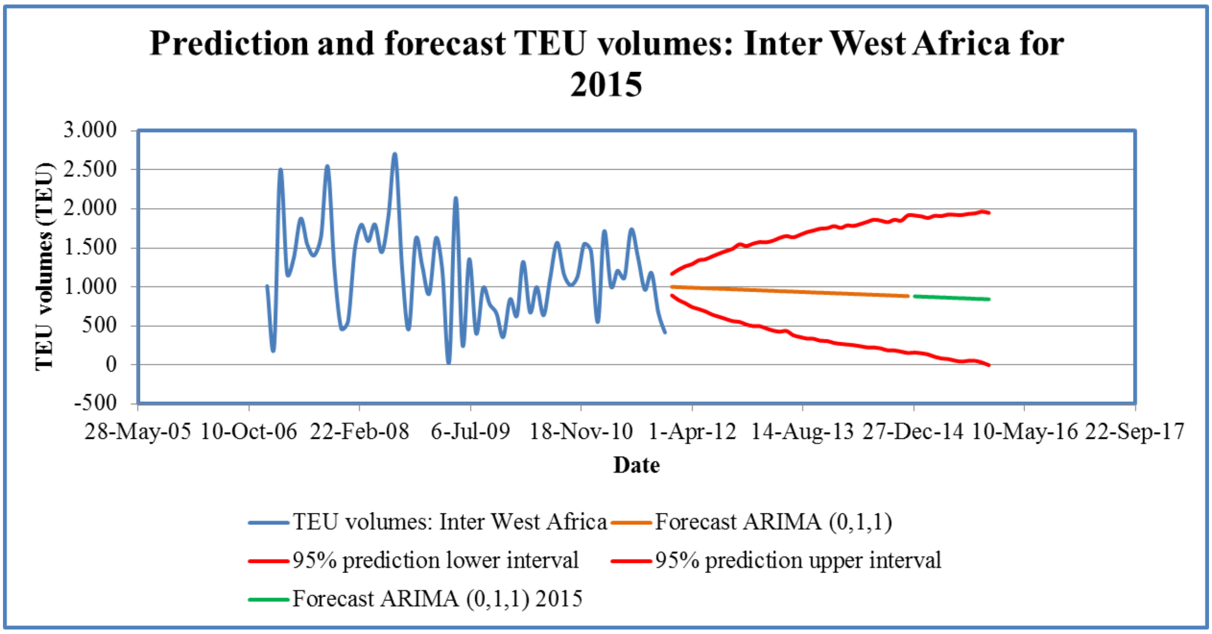
NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011) and own calculations on the predictions and forecast until 2015

Figure 96: Evolution of the South America – West Africa: East bound TEU volumes, predictions and forecast until 2015



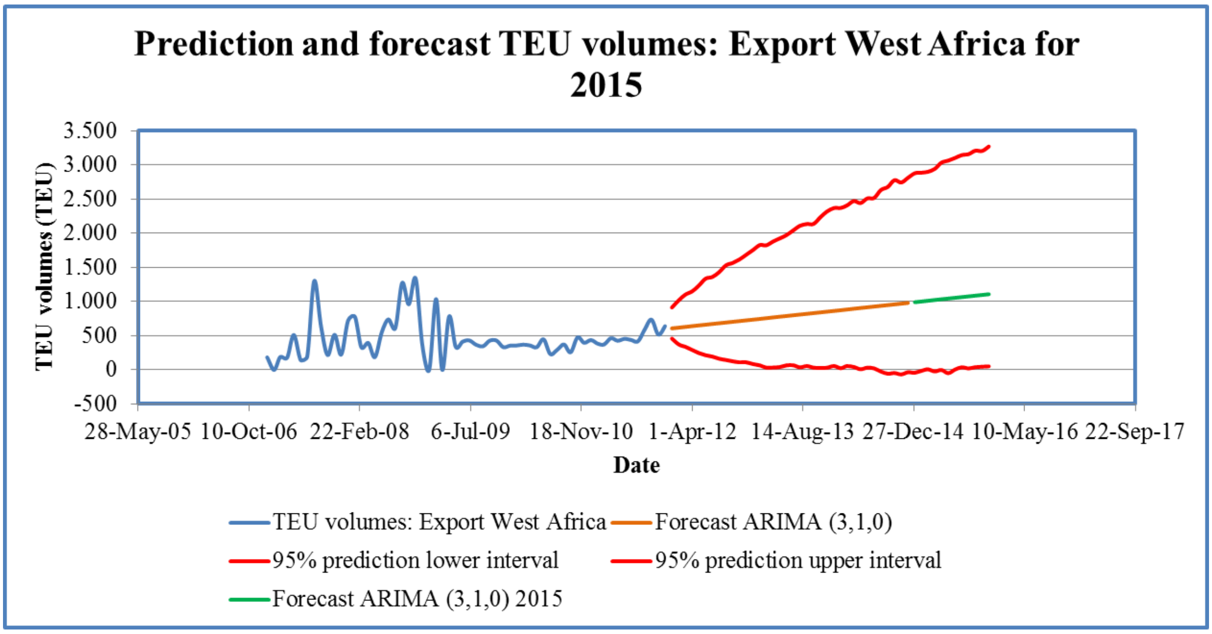
NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011) and own calculations on the predictions and forecast until 2015

Figure 97: Evolution of the Inter West Africa TEU volumes, predictions, and forecast until 2015



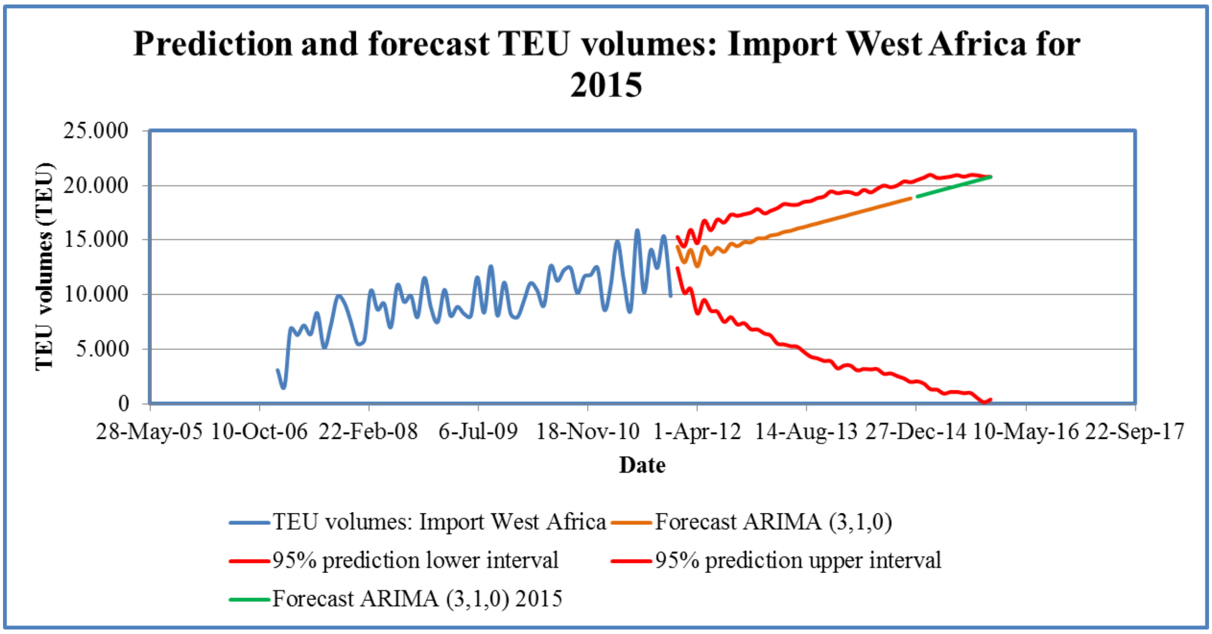
NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011) and own calculations on the predictions and forecast until 2015

Figure 98: Evolution of the Exported West Africa TEU volumes, predictions, and forecast until 2015



NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011) and own calculations on the predictions and forecast until 2015

Figure 99: Evolution of the Imported West Africa TEU volumes, predictions, and forecast until 2015



NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 to 01/04/2011) and NileDutch's Soft Ship Line database (01/04/2011 to 31/12/2011) and own calculations on the predictions and forecast until 2015

The forecast results of the TEU volumes make it possible to obtain two different trip matrixes for 2015.

The first trip matrix uses the forecasts of the imported and exported TEU volumes time series per region. Table 37, a trip matrix per region, is the result of these forecasts. Table 37 shows no TEU volumes from West Africa to Asia. Recall that Figure 92 shows a prediction with a negative value as an outcome. This can be interpreted, as no TEUs going from West Africa to Asia in 2015. To obtain the trip matrix per port trip distribution is needed. Trip distribution is done by the use of equal staying market shares. Meaning, the import and export total per region are divided over the ports per region in the same proportion, as this was the case in 2011. However, the proportions between the totals of the ports and the imports and exports totals per region are different in 2015 in comparison with 2011. Because import in West Africa is more important than export the same proportion of the import of 2011 are used to divide the TEU imported volumes over the ports. Table 119 in paragraph G.2 of Appendix G shows this trip matrix per port. Do remark that the export totals per region in Table 119 differ from those in Table 37. This due to the difference in proportions between the totals of the ports and the imports and exports totals per region in 2015 in comparison with 2011. Paragraph 5.7 on page 191 uses this information when comparing the changes in demand and supply between 2008 and 2014.

Table 37: Forecasted NileDutch 2015 trip matrix per region based on forecasts per trade and trade lane

Origen / Destination	Asia	Europe	South America	West Africa	Total TEU original	
Asia				87.863	87.863	Export
Europe				94.826	94.826	
South America				28.050	28.050	
West Africa		3.572		10.328	13.900	
Total TEU original	0	3.572	0	221.068	224.639	
	Import					

The second trip matrix uses the forecasts of the imported and exported TEU volume time series per region. Table 38 , a trip matrix per region, is the result of these forecasts. To obtain the trip matrix per port trip distribution is needed. Trip distribution is done by the use of equal staying market shares. Meaning, the import and export totals per region are divided over the ports per region in the same proportion, as this was the case in 2011. However, the proportions between the totals of the ports and the imports and exports totals per region are different in 2015 in comparison with 2011. Because export to West Africa is more important than importing from West Africa the same proportions of the export of 2011 are used to divide the TEU exported volumes over the ports. Table 120 in paragraph G.2 of Appendix G shows this trip matrix per port. Do remark that the export totals per region in Table 120 differ from those in Table 38. This due to the difference in proportions between the totals of the ports and the imports and exports totals per region in 2015 in comparison with 2011. Paragraph 5.7 on page 191 uses this information when comparing the changes in demand and supply between 2008 and 2014.

Table 38: Forecasted NileDutch 2015 trip matrix per region based on forecast of import and export totals

Origen / Destination	Asia	Europe	South America	West Africa	Total TEU original	
Asia				87.863	87.863	Export
Europe				94.826	94.826	
South America				28.050	28.050	
West Africa	2.043	975		4.523	7.541	
Total TEU original	2.043	975	0	215.262	218.280	
	Import					

3.6.2.1.3 Net freight rates of 2015

Literature

Literature on previous work to forecast the NileDutch total net freight rates[29] does not exist. Manzanero (2009) studied forecasting freight rates on Asia- United states, United sated – Asia, Europe – United States, United States – Europe, Asia – Europe, and Europe- Asia trades. He used the AutoRegressive Integrated Moving Averages (ARIMA) forecasting method to find the best fit econometric ARIMA model for each trade. Weimar-Rasmussen (2010) studied forecasting freight rates on Asia – Europe, Europe – Asia, Asia – United States, United States Asia, Europe – United States, and United States – Europe trades. He used ARIMA, AutoRegressive Fractionally Integrated Moving Averages (ARFIMA), and vector AutoRegressive (VAR). His findings were that the econometric ARIMA models fitted the data best.

Available data

The data of NileDutch on the average total net freight rate evolution are obtained from the NileDutch's Shipnet Agency liner System (SNALS) database (01/01/2007 – 01/04/2011) and NileDutch's Soft Ships Line database (01/04/2011 – 31/12/2011). These data are sorted per trade lane. Per month, the average net freight rates are calculated by deriving the total net freight rate by the total TEU value. Only data are used from the trades: Asia – West Africa: West and East bound, Europe – West Africa North and South bound, South America – West Africa East bound, and inter West Africa. The time series need to be adjusted for inflation. Deflation is done by the use of the world inflation of the consumer prices provided by the International monetary fund (24/02/2014).

Prediction intervals

The upper and lower prediction intervals are obtained by multiplying the net freight rates of 2011 by extrapolation to 2015 of the average increase in inflation between 2011 and 2013. Around the outcome of this calculation, 20% is added and substracted[30]. The resulting lower and upper prediction interval can be seen in Table 39.

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[29] Net freight rate: NileDutch uses this denomination to indicate the rate which represents the ocean freight and the additional freight.

[30] The maxima values of the price elasticity values of the time series can also give the upper and lower prediction interval. For the computer model there is opted for a more safe interval. Namely the 20% added and substracted interval.

Table 39: Prediction intervals for the average total net freight rates

Time series average net freight rates	Lower prediction interval ($)	Upper prediction interval ($)
Asia - West Africa, East bound	441	661
Asia - West Africa, West bound	1.509	2.264
Europe - West Africa, North bound	504	757
Europe - West Africa, South bound	1.604	2.405
South America - West Africa, East bound	1.428	2.142
Inter West Africa	1.196	1.794

Results

For all but one time series, an econometric ARIMA model is found together with a prediction interval. No econometric ARIMA model was found for the net freight rates of the Europe – West Africa, North bound time series. Tests[31] to check if a suggested econometric ARIMA model is a good model rejected all econometric ARIMA models, which were suggested by the Smallest Canonical Correlation Method (SCAN), Extended Sample Autocorrelation Function method (ESACF), and the Minimum Information Criterion Method (MINIC). Alternatively, the net freight rates for the Europe – West Africa times series for 2015 can be obtained by multiplying the net freight rates of 2011 by the extrapolation to 2015 of the average increase in inflation between 2011 and 2013. Figure 100 to Figure 105 show the times series together with the forecast and prediction intervals. More into detail results can be seen in Paragraph R.3 of Appendix R.

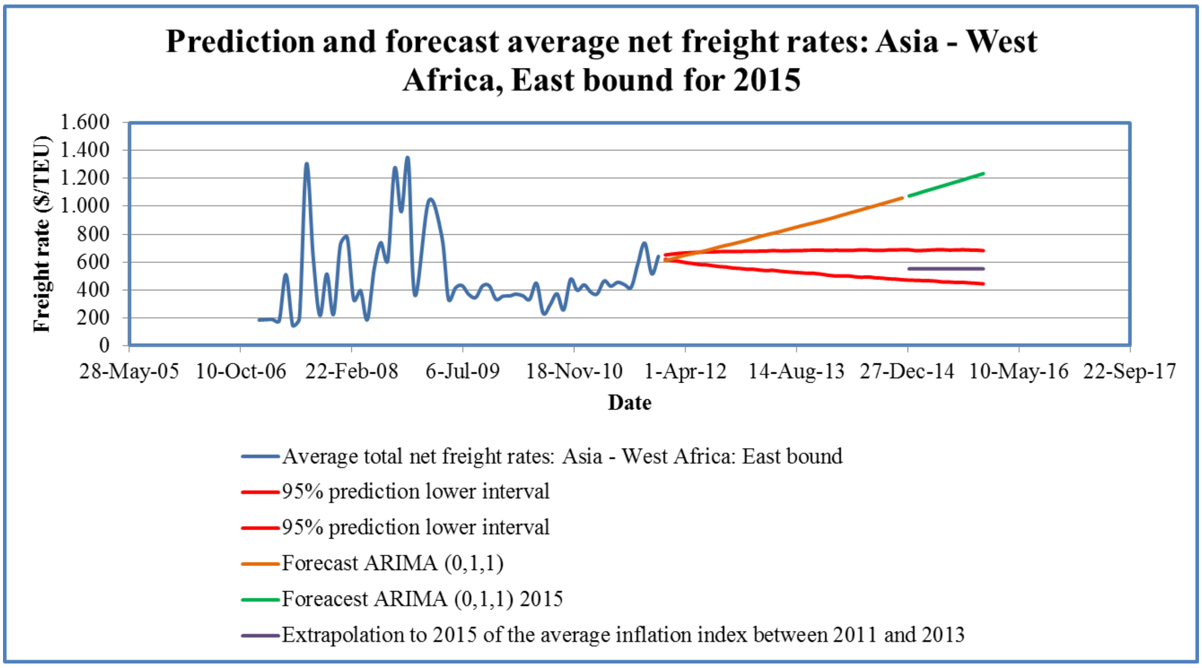
When checking if the forecast results fall within the upper and lower prediction interval it becomes clear that this is not the case for the . The Asia – West Africa East bound, Asia – West Africa West bound, and Europe – West Africa South bound times series. By consequence, these results are not realistic. These values are replaced by the net freight rates obtained by multiplying the net freight rates of 2011 by the extrapolation to 2015 of the average inflation between 2011 and 2013. These results can be seen in Table 40.

Table 40: Average net freight rate per TEU for 2015 per trade and trade lane

Trade + Trade lane	Results forecast 2015	Results 2015 (extrapolation to 2015 of average inflation index between 2011 and 2013)	Value used in calculation model
Asia - West Africa, East bound	$1.153,71	$551,17	$551,17
Asia - West Africa, West bound	$1.272,97	$1.886,61	$1.886,61
Europe - West Africa, North bound	/	$630,60	$630,60
Europe - West Africa, South bound	$1.393,28	$2.004,39	$2.004,39
South America - West Africa, East bound	$1.489,04	$1.785,17	$1.489,04
Inter West Africa	$1.761,15	$1.494,71	$1.761,15

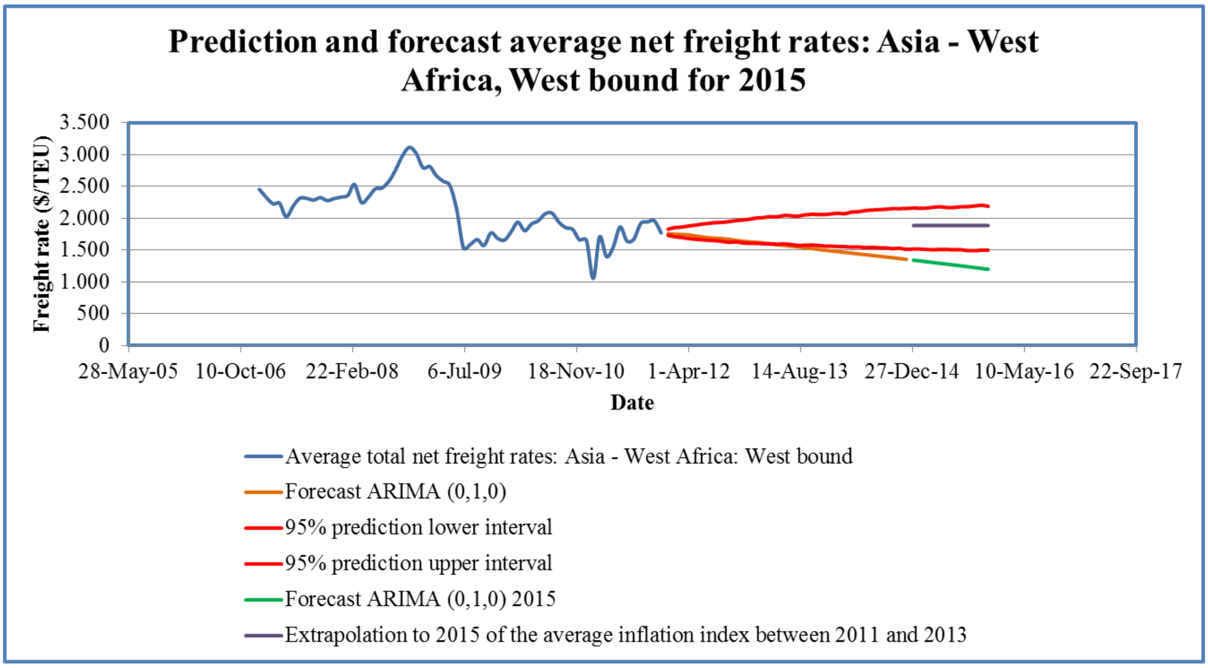
[31] These tests involve the augmented Dickey-Fuller unit root test, t value test, conditional least squares estimation test, correlations of parameters test, and the autocorrelation of residuals (white noise) test.

Figure 100: Evolution of NileDutch's Asia – West Africa: East bound average total net freight rates, predictions and forecast until 2015



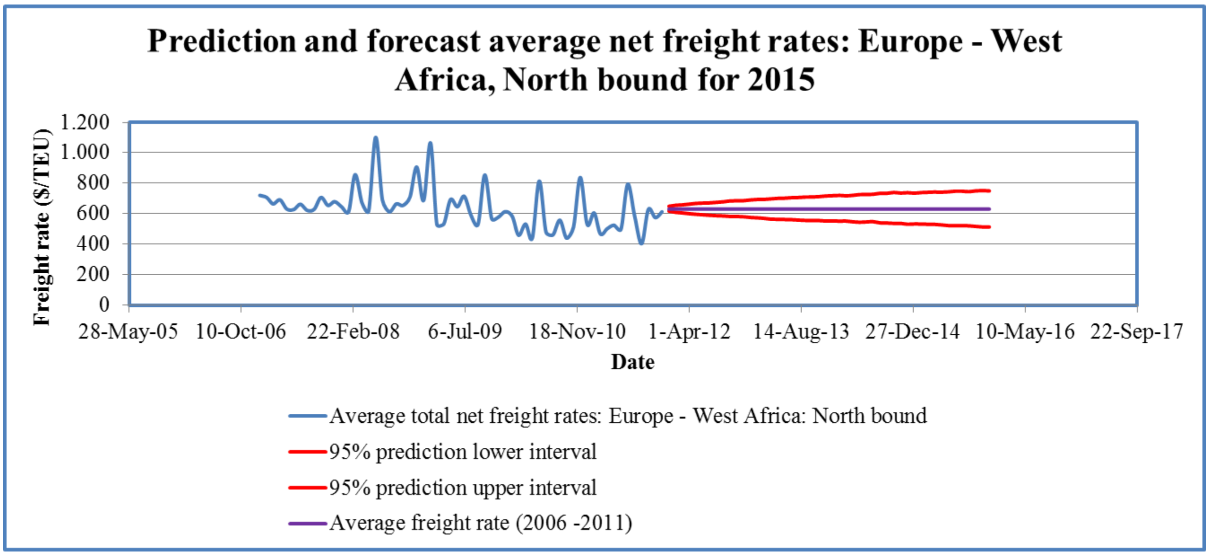
Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011 and own calculations on the predictions and forecast until 2015

Figure 101: Evolution of NileDutch's Asia – West Africa: West bound average total net freight rates, predictions and forecast until 2015



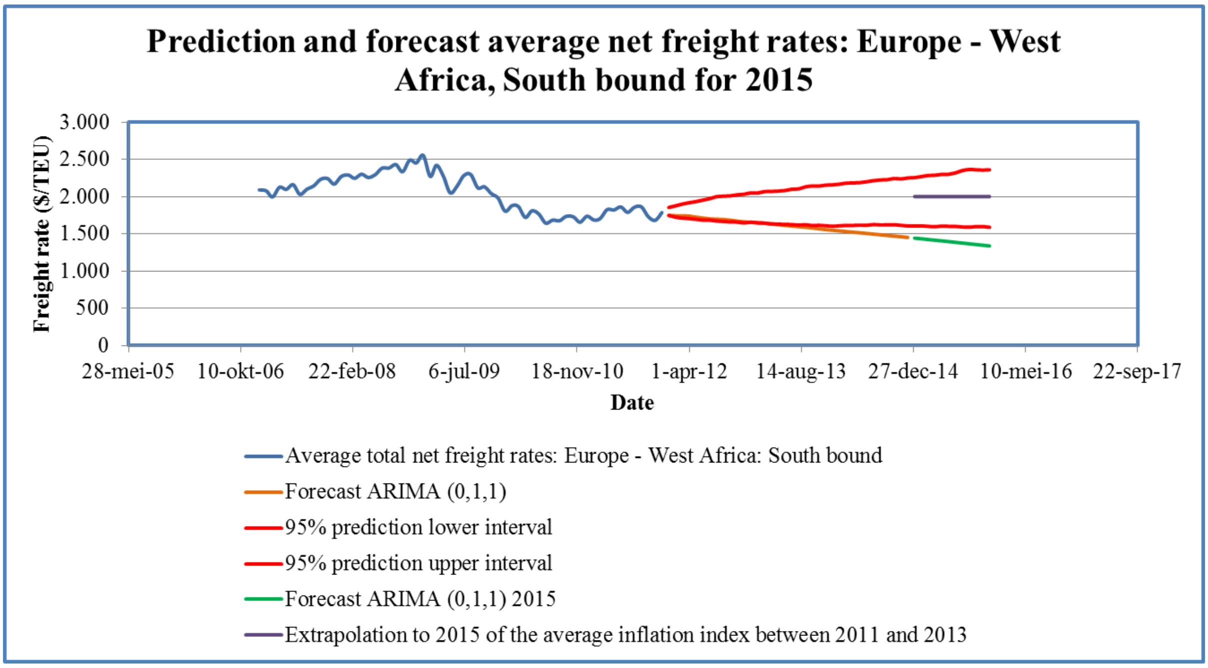
Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011 and own calculations on the predictions and forecast until 2015

Figure 102: Evolution of NileDutch's Europe – West Africa: North bound average total net freight rates, predictions and forecast until 2015



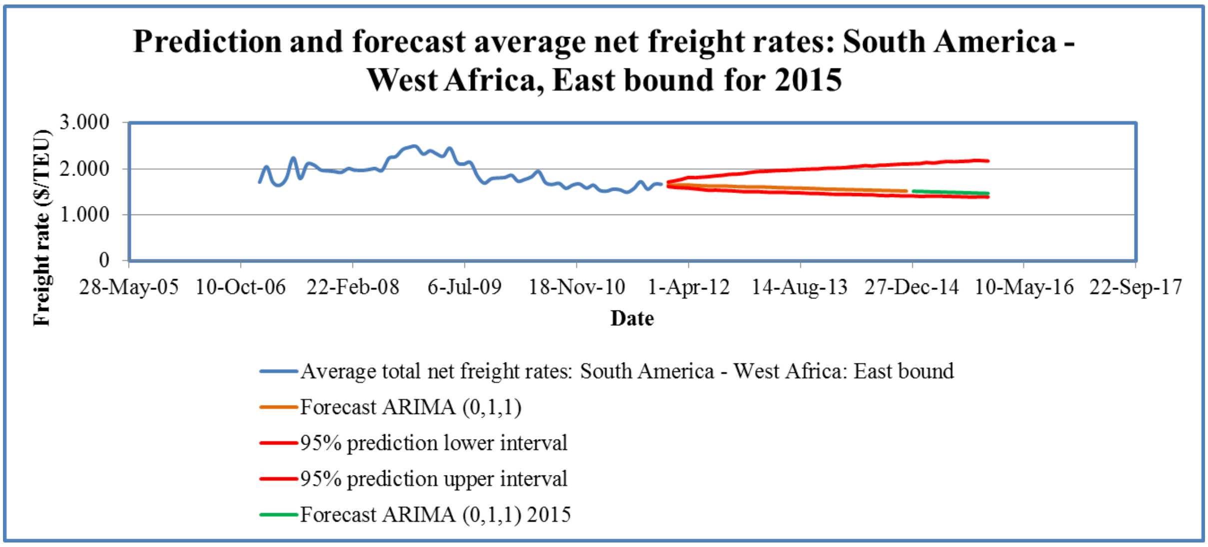
Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011 and own calculations on the predictions and forecast until 2015

Figure 103: Evolution of NileDutch's Europe – West Africa: South bound average total net freight rates, predictions and forecast until 2015



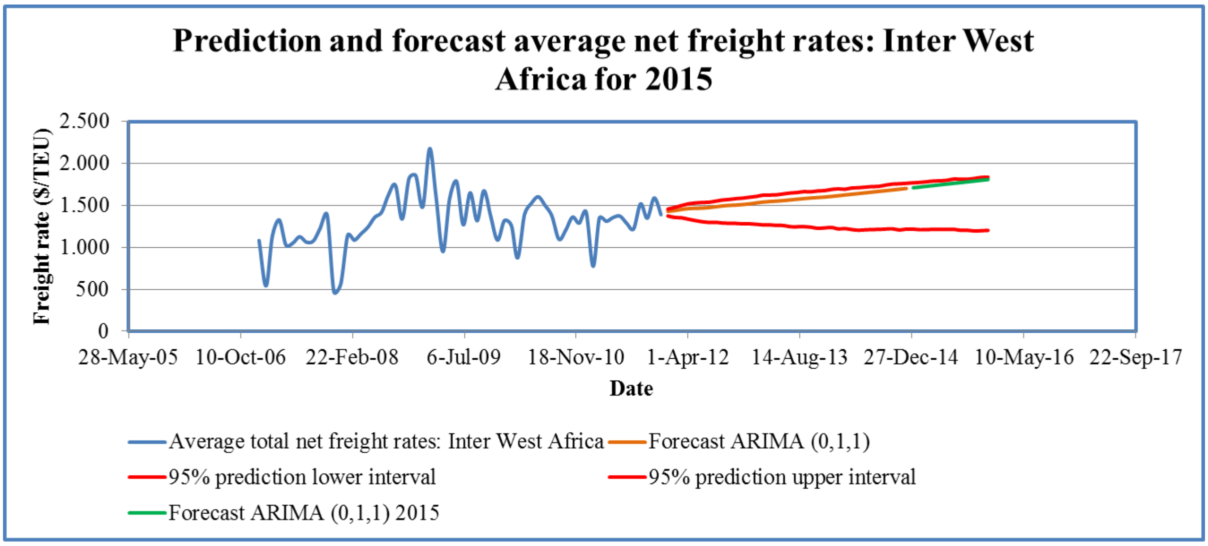
Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011 and own calculations on the predictions and forecast until 2015

Figure 104: Evolution of NileDutch's South America – West Africa: East bound average total net freight rates, predictions and forecast until 2015



Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011 and own calculations on the predictions and forecast until 2015

Figure 105: Evolution of NileDutch's Inter West Africa average total net freight rates, predictions, and forecast until 2015



Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011 and own calculations on the predictions and forecast until 2015

3.6.2.1.4 Time charter rates of 2015

Literature

Literature on forecasting methods applied to container vessel time charter rates is very limited. Chen and Zhang (2008) used VAR models in their forecasts. Their conclusion was that it is difficult to obtain reliable forecasts with the VAR model

Available data

Die Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V. (23/07/2012) provides data from the charter price evolution. They provide for 1.100TEU, 1.700TEU, 2.500TEU, 2.700TEU, 3.500TEU, and 4.250TEU container vessels. The 1.100TEU, 1.700TEU, and 2.500TEU container vessel data ranges from 11/10/2007 until 19/07/2012. The 2.700TEU, 3.500TEU, and 4.250TEUcontainer vessel data ranges from 25/02/2010 until 19/07/2012. The time series need to be adjusted for inflation. Deflation is done by the use of the world inflation of the consumer prices provided by the International monetary fund (24/02/2014).

Prediction intervals

Lower prediction intervals of the charter prices time series are based on the time charter rates the moment it becomes interesting to lay up a container vessel when the charter market is low. During the financial crisis, many container vessels are laid up when this point was reached. This to diminish the variable costs of the container vessel as much as possible. Looking at the lowest charter prices in 2009 provided by Alphaliner (15/04/2014) results in the lower prediction interval as can be seen in Table 41. The upper prediction interval is based on the switch points when it becomes more interesting to charter a larger container vessel[32]. For each provided time series, the average difference in percentage between the next time series is calculated. Together with the average charter prices of the time series the upper prediction intervals are obtained for each time series. The results can be seen in Table 41.

Table 41: Prediction intervals for the charter prices

Time series charter prices	Lower prediction interval ($/day)	Upper prediction interval ($/day)
1.100 geared	4.000	8.706
1.700 geared	4.000	10.551
2.500 geared	5.000	10.936
2.700 gearless	5.000	11.204
3.500 gearless	6.000	12.824
4.250 gearless	7.000	14.105

[32] The maxima values of the price elasticity values of the time series can also give the upper and lower prediction interval. For the computer model there is opted for a more safe interval. Namely the 20% added and substracted interval.

Results

For all time series, an econometric ARIMA model is found together with a prediction interval. When comparing these results with the estimates of Roeland from Howe Robinson Shipbrokers (27/01/2014) as can be seen in Table 42 it shows quite large deviations. As Howe Robinson has extensive knowledge about the charter market and Howe Shipbroker's estimates are made in 2014 instead of with data from 2011 and before, the Howe Robinson Shipbroker results are used in the computer model.

Table 42: Time charter prices for 2015 per container vessel type

Container vessel	Average charter price 2015 forecast ($/day)	Howe Robinson Shipbroker estimate for 2015 ($/day)
1.100 geared	$5.102	$7.500
1.700 geared	$2.589	$8.250
2.500 geared	$9.125	$10.250
2.700 gearless	$23.516	$9.750
3.500 gearless	$53.873	$10.500
4.250 gearless	$17.404	$12.000

The computer model uses the linear interpolated values as any size container vessels can be used in the computer model. The linear function, which is used for interpolation, is based on regression analysis with the estimation method of least squares for a linear function. In this way, the relationship between the nominal TEU capacity and the average charter price of a container vessel could be determined. The regression analysis with the estimation method of least squares for a linear function is explained in Appendix I. The results are found below and in Figure 106. The standard error value is 428,0 and the t test value 2,23.

$$y = 1,3722 \cdot x + 6.106,2 \quad (48)$$

- x : Nominal TEU capacity of the container vessel
- y : Average charter price

The results of the forecasts and predictions per time series together with the Howe Robinson Shipbroker's estimates can be seen in Figure 107 to Figure 112. More into detail results can be seen in Paragraph R.3 of Appendix R.

Figure 106: Relationship between the average charter price and the nominal TEU capacity of a container vessel.

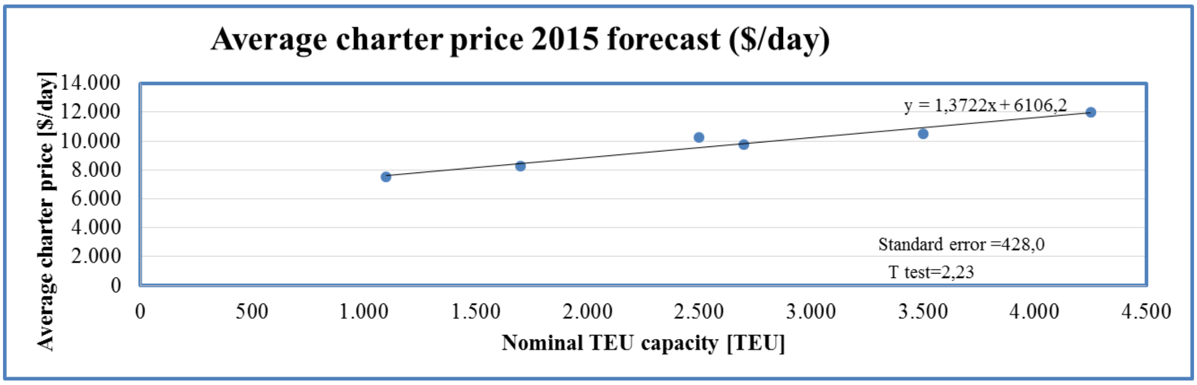
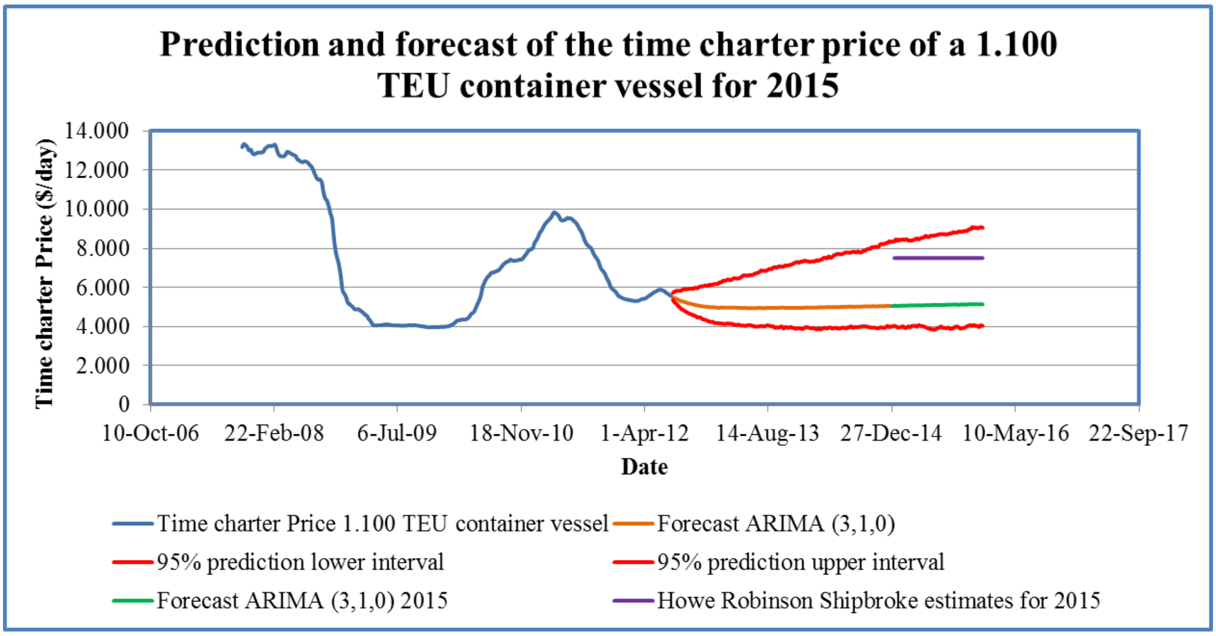
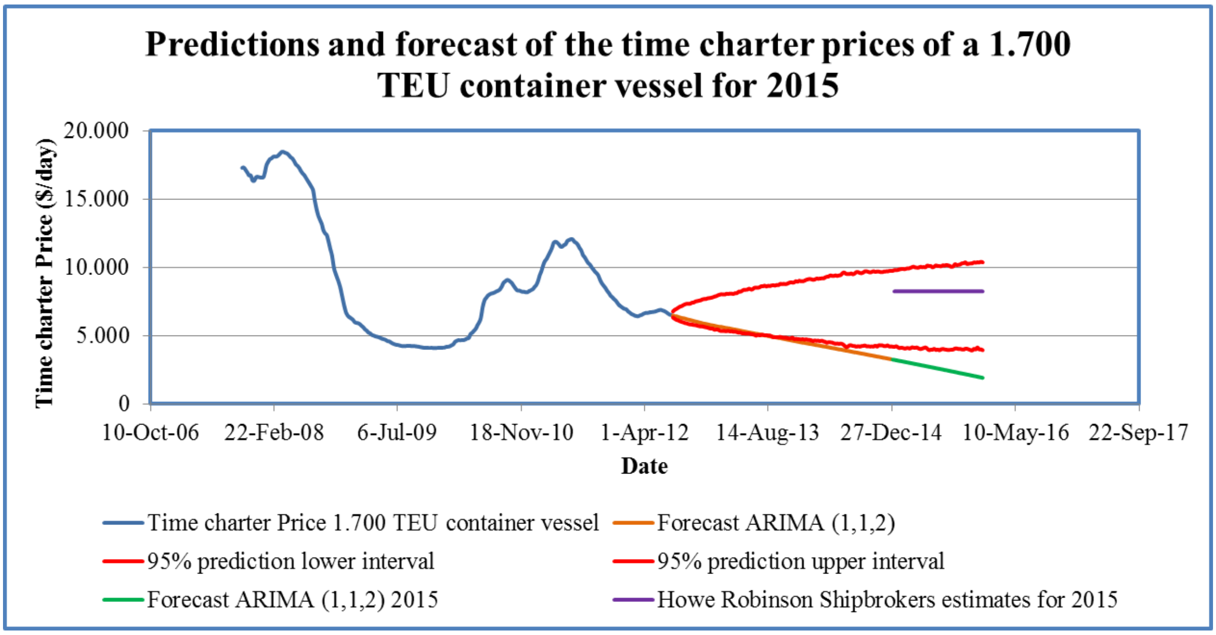


Figure 107: Evolution of the time charter prices or a 1.100TEU container vessel, predictions and forecast until 2015



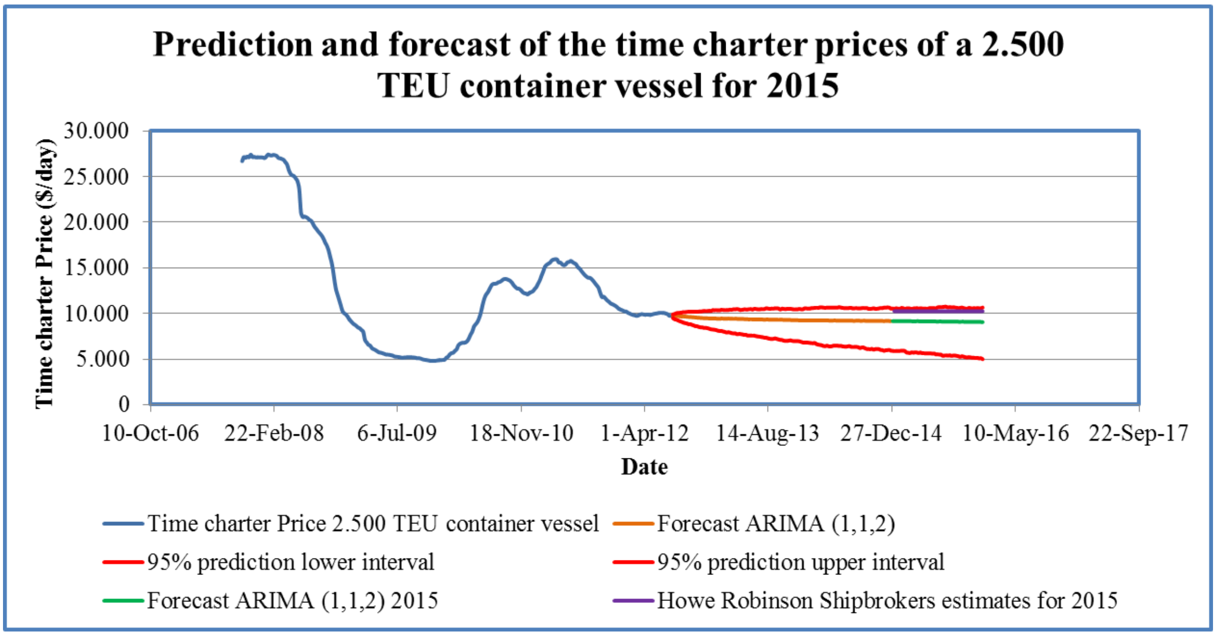
Source: Die Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V. (23/07/2012), data from 11/10/2007 to 19/07/2012 and own calculations on the predictions and forecast until 2015

Figure 108: Evolution of the time charter prices or a 1.700TEU container vessel, predictions and forecast until 2015



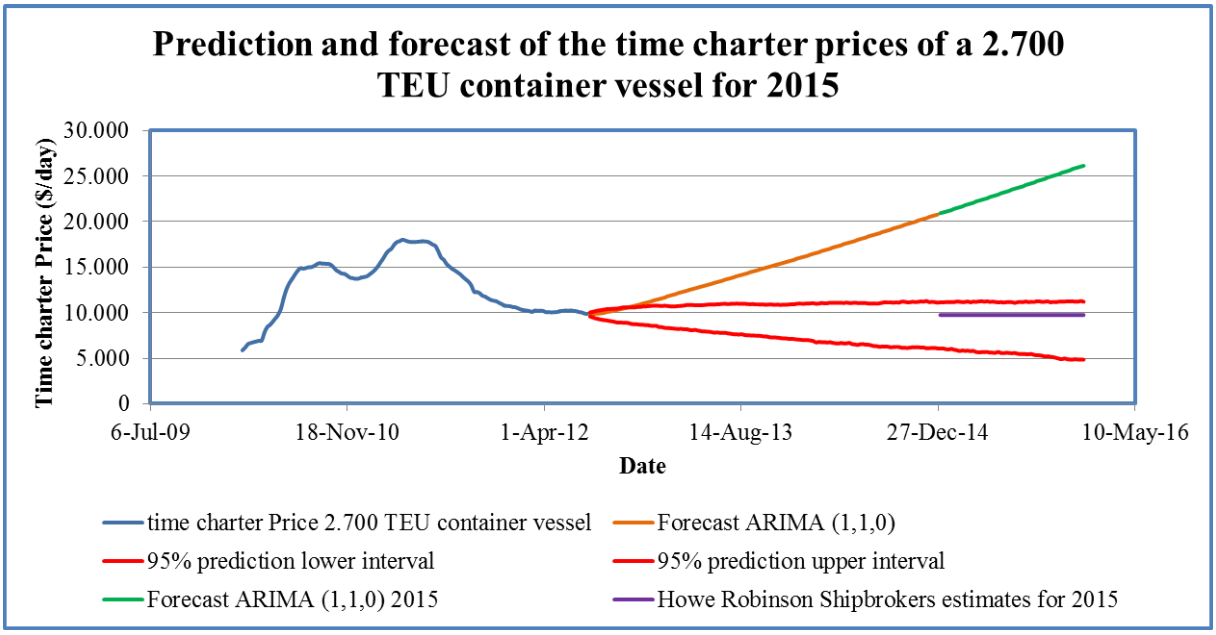
Source: Die Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V. (23/07/2012), data from 11/10/2007 to 19/07/2012 and own calculations on the predictions and forecast until 2015

Figure 109: Evolution of the time charter prices or a 2.500TEU container vessel, predictions and forecast until 2015



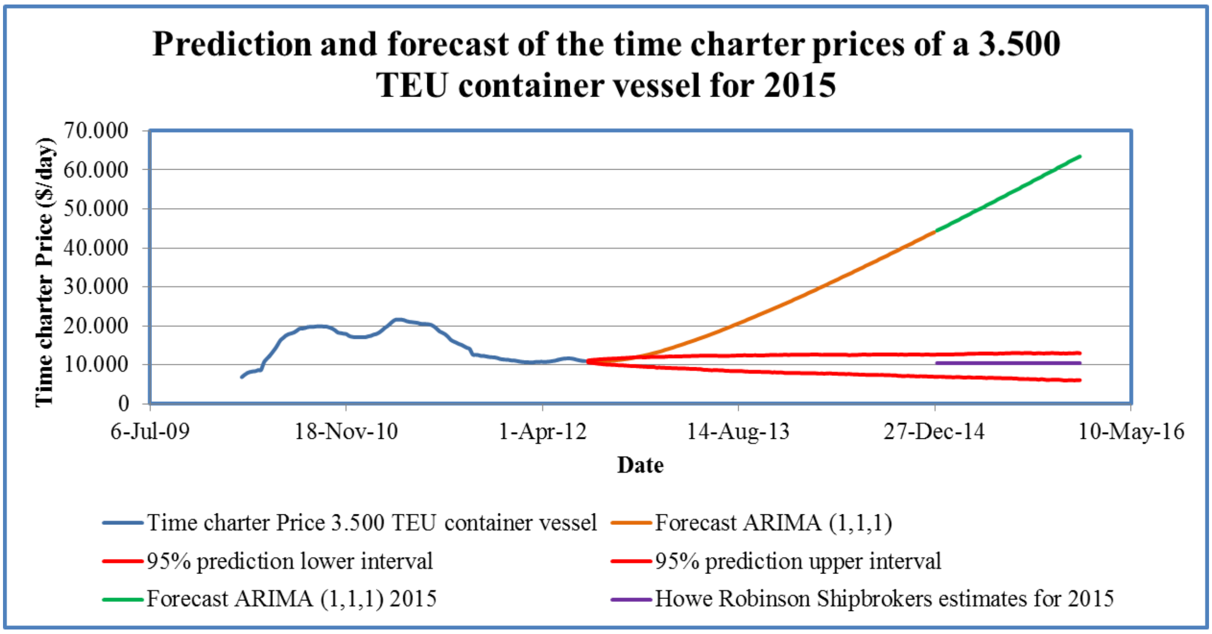
Source: Die Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V. (23/07/2012), data from 11/10/2007 to 19/07/2012 and own calculations on the predictions and forecast until 2015

Figure 110: Evolution of the time charter prices or a 2.700TEU container vessel, predictions and forecast until 2015



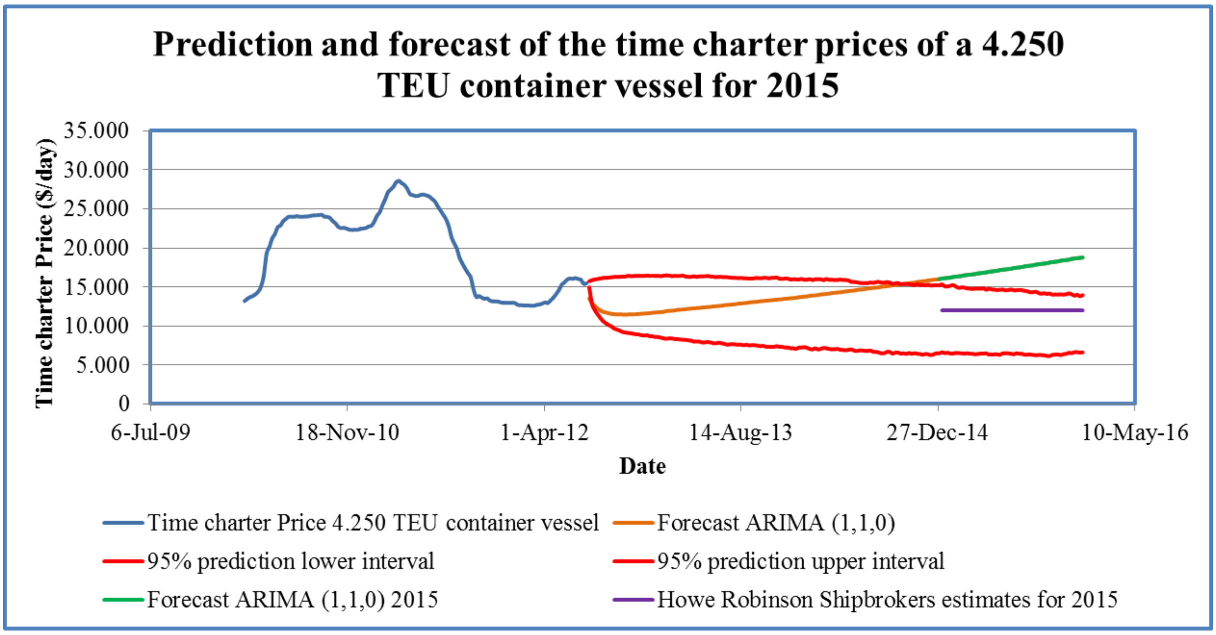
Source: Die Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V. (23/07/2012), data from 11/10/2007 to 19/07/2012 and own calculations on the predictions and forecast until 2015

Figure 111: Evolution of the time charter prices or a 3.500TEU container vessel, predictions and forecast until 2015



Source: Die Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V. (23/07/2012), data from 11/10/2007 to 19/07/2012 and own calculations on the predictions and forecast until 2015

Figure 112: Evolution of the time charter prices or a 4.250TEU container vessel, predictions and forecast until 2015



Source: Die Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V. (23/07/2012), data from 11/10/2007 to 19/07/2012 and own calculations on the predictions and forecast until 2015

3.6.2.1.5 Bunker prices of 2015

Literature

The literature on forecasting methods on bunker prices has been non-accessible.

Available data

The forecast of the bunker prices are based on the bunker price evolution for Antwerp (380 CTS), Durban (180 CST), and Singapore (380 CST). Obtained from Bunker World services. The data ranges from 01/01/2002 until 31/05/2012. The time series used in the forecast is the average bunker price per day taken from these three locations. The time series needs to be adjusted for inflation. Deflation is done by the use of the world inflation of the consumer prices provided by the International monetary fund (24/02/2014).

Prediction intervals

The prediction intervals for the bunker prices times series are based on the Brent crude oil price ($/barrel) forecast of 2015 obtained from the Economist Intelligence Unit (2014) multiplied by the multiplier 5.8 obtained from SwizStick (2011) to obtain an estimated bunker price ($/ton) for 2015. The forecasted Brent crude oil price is 107.3 $/barrel. Multiplied by 5.8 gives a bunker price estimation of 622 $/ton for 2015. Applying a margin of 20% results in the lower and upper prediction interval[33] as can be seen in Table 43. IEA (2011) forecasts a Brent crude oil price between 100 – 105 $/barrel for 2011 – 2016. Multiplied by 5,8 gives a bunker price estimation between 580$/ton and 609$/ton. They show to have a similar value for their 2015 forecast as SwizStick (2011).

Table 43: Prediction intervals for the bunker prices

Time series bunker price	Lower prediction interval ($)	Upper prediction interval ($)
Bunker price	498	747

Results

On average, the bunker prices for 2015 are estimated to be $797,18. Which falls outside the prediction interval. Because the bunker price estimation falls outside the prediction interval this means the estimated value is not a realistic bunker price value to expect in 2015. As an alternative an average bunker price of 622 $/ton is used in the computer model. Recall that this value is based on the Brent crude oil price ($/barrel) forecast of 2015 obtained from the Economist Intelligence Unit (2014) multiplied by the multiplier 5,8 obtained from SwizStick (2011). Figure 113 shows predictions and forecast of the bunker prices together with the 622 $/ton alternative bunker prices value for 2015. More into detail results can be seen in Paragraph R.3 of Appendix R.

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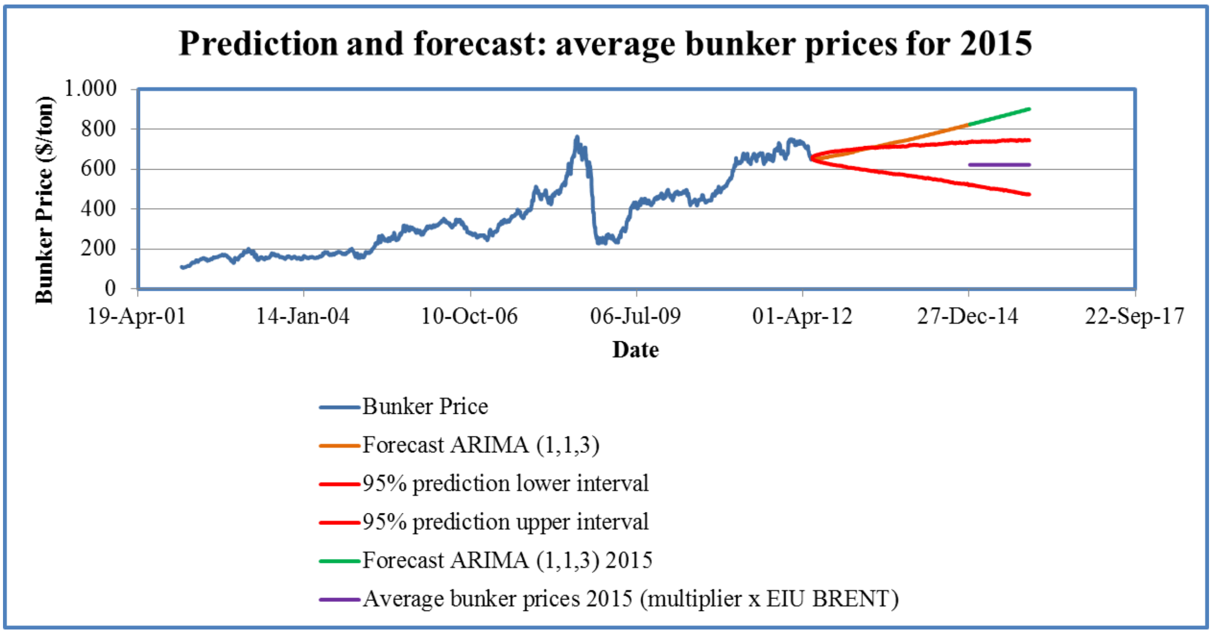
[33] The maxima values of the price elasticity values of the time series can also give the upper and lower prediction interval. For the computer model there is opted for a more safe interval. Namely the 20% added and substracted interval.

Figure 113: Average bunker price evolution, prediction, and forecast until 2015



Source: Platts Bunkerwire (31/05/2012), data: from 01/01/2002 to 31/05/2012 and own calculations on the predictions and forecast until 2015

3.6.3 Container fleet

NileDutch's container fleet is obtained of NileDutch Container Stats database (04/06/2012). The database is sorted per container type and per category. The total amount of containers and TEU per category has been calculated as well. An overview can be found in Table 44. A presentation about the container types can be found in Appendix S.

Table 44: Container fleet

Container type	Owned containers	Long term lease containers
20DC	22.736	10.055
40DC	150	132
40HC	11.728	7.868
20RF	85	29
40HR	1.126	773
20OT	6	60
40OT	50	253
20FF	8	24
40FF	10	95
20FR	1	0
40FR	1	1
40PF	7	0
Total Containers	**35.908**	**19.290**
Total TEU	**48.980**	**28.412**

Source: NileDutch Container Stats (01/08/2012)

4 Verification and validation of the computer program

The computer model needs to be verified and validated in order to become reliable.

The verification of the computer model is done by including calculations that check and double check if no irregularities have entered the sub calculations. The results of the computer model are verified by interpreting if the results are realistic or not. Both K. Janssens and M. Van Hengst interpreted these results to identify irregularities and removed them from the computer program.

The validation of the computer model is done by comparing its output results to an existing voyage made in August 2014 of a container vessel in the WEWA container liner service. This container vessels is time chartered. NileDutch's calculations department (20/10/2014) provides these data. Input values of the computer model that are normally set for 2015 have been adjusted to data for 2014. In order to have a positive validation of the computer model, the results of the computer model cannot differ more than 10% from NileDutch's voyage calculation of that voyage. The voyage calculation shows the Total net freight, voyage costs, cargo costs, general expenses, minimum required freight rate per TEU, and the minimum required freight rate per TEU/mile. These results cannot differ more than 10%.

Table 45 shows the percentual differences in total net freight, voyage costs, cargo costs, general expenses, total costs, and net result. The overview shows differences below 10%. This results in a positive validation of the model.

Table 45: Valudation computer model

	Total net freight [$]	Voyage costs [$]	Cargo costs [$]	General expenses [$]	Total costs [$]	Net result [$]
NileDutch calculations	$3.530.554,82	$1.502.005,22	$2.247.123,09	$146.892,37	$3.896.020,68	-$365.465,85
Computer model	$3.530.554,82	$1.580.749,43	$2.149.166,67	$146.892,37	$3.876.808,47	-$346.253,64
Percentual difference	0,00%	5,24%	-4,36%	0,00%	-0,49%	-5,26%

The validations show no difference in total net freight as the freight rates input values are the same. The voyage costs show a difference of 5,24%. The difference can be explained by the average congestion time taken into account in the computer model. That particular voyage did not have much congestion delays in reality. Cargo costs differ by 4,36%. This difference can be explained by changes in costs between 2011 and 2014 as tariffs from 2011 are used in the computer model. Another reason why the cargo costs of NileDutch's calculation are higher than the computer model, is restowing of containers in ports. For a better stability of the container vessel containers are restowed in ports by putting heavier containers lower in the container vessel instead of putting them on top of the container stacks. These restows are extra container costs which are not included in the computer model. The general expensens are the same as the annual 14 million overhead costs are equally spread over the transported containers. The total costs show a difference of 0,49%. The total costs show a difference of only 0,49%. This is a very low difference. The positive difference of the voyage costs more or less neutralizes the negative difference of the cargo costs. The validation showes a difference of 5,26% in net result. This difference is the result of the changes in voyage costs and cargo costs.

The container vessel in this voyage is a time chartered container vessel. Thus no validation can be given about the costs for an owned container vessel by the use of this voyage. However NileDutch calculations department (11/02/2015) does provide data about all voyage done in the past. In 2014 one of NileDutch's newbuilt vessels has been delivered. The costs for this owned container vessels can be compared to the costs for the same size container vessels generated by the container vessel tool in the model. Table 46 shows these results for a container vessel with a nominal TEU capacity of 3.500TEU. The percentual difference is 6,12%. This falls within the 10% acceptability margin and thus results in a positive validation of the costs for owned container vessels and the model.

Table 46: Validation costs owned container vessel

	Costs owned container vessel [$/day]
NileDutch newbuilt 3.500TEU	$16.000,00
Computer model 3.500TEU	$15.020,70
Percentual difference	**-6,12%**

5 Results computer model

This chapter describes the results of the computer model per scenario. The chapter only treats the results about the total costs, net results, the minimum required freight rate per TEU (MRFR1), and minimum required freight rate per TEU/mile (MRFR2). The container vessel fleet used per scenario and container liner service is described in terms of their nominal TEU capacity, 14 ton TEU capacity, the speed at which the container vessels sail in each container liner service, and the amount of chartered and owned container vessels used. More elaborate results per scenario and container liner service can be found in Appendix T. The last paragraph of this chapter compares the supply of NileDutch of 2011 to the supply results per scenario of 2015.

5.1 Scenario 1

Table 47 shows the computer model results for scenario 1. It shows negative net results for all container liner services of scenario 1. It shows that the optimum vessel speed to obtain as low as possible total costs, is between 11 and 11,5 knots. At higher vessel speeds, container costs increase while the bunker costs decrease without needing less container vessels. The decrease of the bunker costs is higher than the increasement of the container costs which leads to higher total costs when the vessels speed is higher than 11 or 11,5 knots. The MRFR2 results show higher values for Feeder 1 and Feeder 2 container liner service. Both container liner services have significantly shorter voyage distances in comparison with the other container liner services (FEWA: 21.190 miles, SWAX: 21.564 miles, WEWA: 10.801 miles, and ECSA 9.095 miles. Feeder 2 container liner service even has a voyage distance that it significantly shorter than Feeder 1 container liner service. 342 miles compared with 1275 miles. This results in a higher MRFR2 value for Feeder 2 container liner service in comparison with Feeder 1 container liner service.

Table 47: Results computer model scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel	14 ton TEU capacity per container vessel	Vessel speed [kn]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	2.092	1.551	11,0	18	9	9	$3.967.132,65	-$1.353.972,14	$2.385,53	$0,11
	FEWA voyage owned container vessel	2.092	1.551	11,0	18	9	9	$4.336.151,49	-$1.722.990,98	$2.607,43	$0,12
	Total FEWA [Annual]	**2.092**	**1.551**	**11,0**	**18**	**9**	**9**	**$206.586.878,85**	**-$70.702.532,60**	**$2.388,95**	**$0,12**
	SWAX voyage chartered container vessel	765	558	11,0	16	8	8	$1.973.272,85	-$900.259,16	$3.288,79	$0,15
	SWAX voyage owned container vessel	765	558	11,0	16	8	8	$1.938.528,22	-$865.514,53	$3.230,88	$0,15
	Total SWAX [Annual]	**765**	**558**	**11,0**	**16**	**8**	**8**	**$95.572.257,62**	**-$39.775.545,55**	**$3.063,21**	**$0,15**
Total Asia - West Africa [Annual]					**34**	**17**	**17**	**$302.159.136,48**	**-$110.478.078,15**	**$2.567,72**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	2.537	1.883	11,0	12	6	6	$3.564.056,89	-$516.748,68	$2.000,03	$0,19
	WEWA voyage owned container vessel	2.537	1.883	11,0	12	6	6	$3.877.468,05	-$830.159,84	$2.175,91	$0,20
Total Europe - West Africa [Annual]		**2.537**	**1.883**	**11,0**	**12**	**6**	**6**	**$187.999.011,22**	**-$29.538.984,20**	**$2.028,82**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	11,5	8	4	4	$1.357.910,46	-$719.360,93	$2.721,26	$0,30
	ECSA voyage owned container vessel	1.063	781	11,5	8	4	4	$1.400.802,20	-$762.252,66	$2.807,22	$0,31
Total South America - West Africa [Annual]		**1.063**	**781**	**11,5**	**8**	**4**	**4**	**$68.292.132,58**	**-$35.087.556,55**	**$2.631,88**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	11,0	3	2	1	$449.986,01	-$249.194,87	$2.284,19	$1,79
	Feeder 1 voyage owned container vessel	209	142	11,0	3	2	1	$403.998,43	-$203.207,30	$2.050,75	$1,61
	Total Feeder 1 [Annual]	**209**	**142**	**11,0**	**3**	**2**	**1**	**$21.314.534,21**	**-$10.873.395,08**	**$2.080,68**	**$1,67**
	Feeder 2 voyage chartered container vessel	1.074	789	11,0	5	3	2	$1.410.801,75	-$738.869,42	$1.970,39	$5,76
	Feeder 2 voyage owned container vessel	1.074	789	11,0	5	3	2	$1.439.046,07	-$767.113,74	$2.009,84	$5,88
	Total Feeder 2 [Annual]	**1.074**	**789**	**11,0**	**5**	**3**	**2**	**$71.417.748,11**	**-$36.477.267,06**	**$1.918,18**	**$5,83**
Total Inter West Africa [Annual]					**8**	**5**	**3**	**$92.732.282,32**	**-$47.350.662,13**	**$1.953,25**	**$4,27**
Grand Total [Annual]					**62**	**32**	**30**	**$651.182.562,59**	**-$222.455.281,03**	**$2.294,80**	**$0,70**

5.2 Scenario 2

Table 48 shows the computer model results for scenario 2. It shows negative net results for all container liner services of scenario 2. It shows that the optimum vessel speed to obtain as low as possible total costs is between 11 and 11,5 knots. The significantly higher MRFR2 values for Feeder 1 and Feeder 2 container liner service can be explained in the same way as this is done in scenario 1.

Table 48: Results computer model scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel	14 ton TEU capacity per container vessel	Vessel speed [kn]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.219	1.645	11,5	18	9	9	$4.126.947,80	-$1.398.852,00	$2.384,14	$0,11
	FEWA 2 voyage owned container vessel	2.219	1.645	11,5	18	9	9	$4.524.639,03	-$1.796.543,23	$2.613,89	$0,12
	Total FEWA [Annual]	**2.219**	**1.645**	**11,5**	**18**	**9**	**9**	**$216.471.637,75**	**-$74.610.656,08**	**$2.404,92**	**$0,12**
	SWAX voyage chartered container vessel	765	558	11,0	16	8	8	$1.971.883,82	-$898.870,13	$3.286,47	$0,15
	SWAX voyage owned container vessel	765	558	11,0	16	8	8	$1.937.139,19	-$864.125,50	$3.228,57	$0,15
	Total SWAX [Annual]	**765**	**558**	**11,0**	**16**	**8**	**8**	**$95.500.028,08**	**-$39.703.316,00**	**$3.060,90**	**$0,15**
Total Asia - West Africa [Annual]						**17**	**17**	**$311.971.665,83**	**-$114.313.972,08**	**$2.573,77**	**$0,13**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.612	1.939	11,5	12	6	6	$3.744.122,58	-$582.586,31	$1.995,80	$0,18
	WEWA 2 voyage owned container vessel	2.612	1.939	11,5	12	6	6	$4.080.449,56	-$918.913,29	$2.175,08	$0,20
Total Europe - West Africa [Annual]		**2.612**	**1.939**	**11,5**	**12**	**6**	**6**	**$196.297.076,23**	**-$31.897.190,14**	**$2.012,23**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	11,5	8	4	4	$1.357.306,85	-$718.757,31	$2.720,05	$0,30
	ECSA voyage owned container vessel	1.063	781	11,5	8	4	4	$1.400.198,58	-$761.649,04	$2.806,01	$0,31
Total South America - West Africa [Annual]		**1.063**	**781**	**11,5**	**8**	**4**	**4**	**$68.260.744,37**	**-$35.056.168,34**	**$2.630,67**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	11,0	3	2	1	$449.705,68	-$248.914,55	$2.282,77	$1,79
	Feeder 1 voyage owned container vessel	209	142	11,0	3	2	1	$403.718,11	-$202.926,97	$2.049,33	$1,61
	Total Feeder 1 [Annual]	**209**	**142**	**11,0**	**3**	**2**	**1**	**$21.299.957,32**	**-$10.858.818,18**	**$2.079,26**	**$1,67**
	Feeder 2 voyage chartered container vessel	1.074	789	11,0	5	3	2	$1.409.783,30	-$737.850,97	$1.968,97	$5,76
	Feeder 2 voyage owned container vessel	1.074	789	11,0	5	3	2	$1.438.027,62	-$766.095,29	$2.008,42	$5,87
	Total Feeder 2 [Annual]	**1.074**	**789**	**11,0**	**5**	**3**	**2**	**$71.364.788,70**	**-$36.424.307,65**	**$1.916,76**	**$5,83**
Total Inter West Africa [Annual]					**8**	**5**	**3**	**$92.664.746,02**	**-$47.283.125,83**	**$1.951,82**	**$4,27**
Grand Total [Annual]					**28**	**32**	**30**	**$669.194.232,46**	**-$228.550.456,40**	**$2.290,29**	**$0,70**

5.3 Scenario 3

Table 49 shows the computer model results for scenario 3. It shows negative net results for all container liner services of scenario 3. It shows that the optimum vessel speed to obtain as low as possible total costs is between 11 and 12 knots. The significantly higher MRFR2 values for Feeder 1 and Feeder 2 container liner service can be explained in the same way as this is done in scenario 1.

Table 49: Results computer model scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel	14 ton TEU capacity per container vessel	Vessel speed [kn]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	2.054	1.522	11,0	18	9	9	$3.945.795,33	-$1.385.774,36	$2.388,50	$0,11
	FEWA voyage owned container vessel	2.054	1.522	11,0	18	9	9	$4.307.249,49	-$1.747.228,53	$2.607,29	$0,12
	Total FEWA [Annual]	**2.054**	**1.522**	**11,0**	**18**	**9**	**9**	**$205.389.364,74**	**-$72.268.274,40**	**$2.390,92**	**$0,12**
	SWAX voyage chartered container vessel	781	570	11,0	16	8	8	$2.002.987,24	-$935.358,59	$3.215,07	$0,15
	SWAX voyage owned container vessel	781	570	11,0	16	8	8	$1.975.318,83	-$907.690,18	$3.170,66	$0,15
	Total SWAX [Annual]	**781**	**570**	**11,0**	**16**	**8**	**8**	**$97.189.137,30**	**-$41.672.447,42**	**$3.000,04**	**$0,15**
Total Asia - West Africa [Annual]						**17**	**17**	**$302.578.502,04**	**-$113.940.721,81**	**$2.557,72**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	2.410	1.788	12,0	11	5	6	$3.462.352,74	-$515.135,71	$2.049,94	$0,19
	WEWA voyage owned container vessel	2.410	1.788	12,0	11	5	6	$3.739.182,76	-$791.965,73	$2.213,84	$0,20
Total Europe - West Africa [Annual]		**2.410**	**1.788**	**12,0**	**11**	**6**	**5**	**$180.819.093,88**	**-$27.563.808,39**	**$2.058,79**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	11,5	8	4	4	$1.340.497,58	-$718.327,47	$2.758,23	$0,30
	ECSA voyage owned container vessel	1.035	760	11,5	8	4	4	$1.378.286,51	-$756.116,40	$2.835,98	$0,31
Total South America - West Africa [Annual]		**1.035**	**760**	**11,5**	**8**	**4**	**4**	**$67.327.631,25**	**-$34.974.785,50**	**$2.664,12**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	146	11,0	3	2	1	$441.857,61	-$245.377,94	$2.350,31	$1,84
	Feeder 1 voyage owned container vessel	214	146	11,0	3	2	1	$396.796,67	-$200.316,99	$2.110,62	$1,66
	Total Feeder 1 [Annual]	**214**	**146**	**11,0**	**3**	**2**	**1**	**$20.939.180,72**	**-$10.722.237,56**	**$2.141,90**	**$1,72**
	Feeder 2 voyage chartered container vessel	1.042	765	11,0	5	3	2	$1.377.062,24	-$725.009,04	$1.981,38	$5,79
	Feeder 2 voyage owned container vessel	1.042	765	11,0	5	3	2	$1.400.981,15	-$748.927,95	$2.015,80	$5,89
	Total Feeder 2 [Annual]	**1.042**	**765**	**11,0**	**5**	**3**	**2**	**$69.749.362,34**	**-$35.842.595,98**	**$1.929,98**	**$5,85**
Total Inter West Africa [Annual]					**8**	**5**	**3**	**$90.688.543,06**	**-$46.564.833,54**	**$1.975,10**	**$4,30**
Grand Total [Annual]					**27**	**32**	**29**	**$641.413.770,23**	**-$223.044.149,24**	**$2.312,93**	**$0,71**

5.4 Scenario 4

Table 50 shows the computer model results for scenario 4. It shows negative net results for all container liner services of scenario 4. It shows that the optimum vessel speed to obtain as low as possible total costs is between 11 and 12 knots. The significantly higher MRFR2 values for Feeder 3, Feeder 4, and Feeder 5 container liner service can be explained in the same way as this is done in scenario 1.

Table 50: Results computer model scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel	14 ton TEU capacity per container vessel	Vessel speed [kn]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.496	1.853	11,0	19	9	10	$3.826.496,35	-$1.335.717,02	$2.023,53	$0,08
	SWAX 2 voyage owned container vessel	2.496	1.853	11,0	19	9	10	$4.311.089,73	-$1.820.310,40	$2.279,79	$0,09
Total Asia - West Africa [Annual]		**2.496**	**1.853**	**11,0**	**19**	**10**	**9**	**$202.675.667,52**	**-$73.155.142,63**	**$2.061,14**	**$0,08**
Europe - West Africa	WEWA voyage chartered container vessel	2.387	1.771	12,0	11	5	6	$3.325.529,84	-$412.537,53	$2.024,06	$0,19
	WEWA voyage owned container vessel	2.387	1.771	12,0	11	5	6	$3.591.293,55	-$678.301,23	$2.185,81	$0,20
Total Europe - West Africa [Annual]		**2.387**	**1.771**	**12,0**	**11**	**6**	**5**	**$174.071.169,75**	**-$22.595.569,23**	**$2.037,45**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	11,5	8	4	4	$1.311.570,65	-$689.400,53	$2.698,71	$0,30
	ECSA voyage owned container vessel	1.035	760	11,5	8	4	4	$1.349.468,78	-$727.298,67	$2.776,68	$0,31
Total South America - West Africa [Annual]		**1.035**	**760**	**11,5**	**8**	**4**	**4**	**$65.761.677,91**	**-$33.408.832,17**	**$2.602,16**	**$0,30**
Inter West Africa	Feeder 3 voyage chartered container vessel	204	138	11,0	3	2	1	$301.975,26	-$175.878,48	$2.126,59	$4,69
	Feeder 3 voyage owned container vessel	204	138	11,0	3	2	1	$256.434,85	-$130.338,07	$1.805,88	$3,99
	Total Feeder 3 [Annual]	**204**	**138**	**11,0**	**3**	**2**	**1**	**$13.723.876,91**	**-$7.166.844,25**	**$1.858,60**	**$4,22**
	Feeder 4 voyage chartered container vessel	287	201	11,0	4	2	2	$530.978,06	-$143.511,14	$1.930,83	$1,00
	Feeder 4 voyage owned container vessel	287	201	11,0	4	2	2	$476.714,49	-$89.247,56	$1.733,51	$0,90
	Total Feeder 4 [Annual]	**287**	**201**	**11,0**	**4**	**2**	**2**	**$25.701.774,43**	**-$5.553.494,37**	**$1.797,33**	**$0,95**
	Feeder 5 voyage chartered container vessel	1.036	761	11,0	6	3	3	$912.553,77	-$260.164,45	$1.320,63	$2,16
	Feeder 5 voyage owned container vessel	1.036	761	11,0	6	3	3	$938.775,03	-$286.385,71	$1.358,57	$2,22
	Total Feeder 5 [Annual]	**1.036**	**761**	**11,0**	**6**	**3**	**3**	**$46.895.572,27**	**-$12.971.327,68**	**$1.305,12**	**$2,19**
	Feeder 6 voyage chartered container vessel	1.040	764	11,0	7	4	3	$1.229.715,50	-$313.830,43	$1.407,00	$0,29
	Feeder 6 voyage owned container vessel	1.040	764	11,0	7	4	3	$1.262.005,33	-$346.120,26	$1.443,94	$0,30
	Total feeder 6 [Annual]	**1.040**	**764**	**11,0**	**7**	**4**	**3**	**$62.096.405,33**	**-$14.470.381,44**	**$1.366,32**	**$0,29**
Total Inter West Africa [Annual]					**20**	**11**	**9**	**$148.417.628,95**	**-$40.162.047,73**	**$1.440,05**	**$1,58**
Grand Total [Annual]					**58**	**31**	**27**	**$590.926.144,13**	**-$169.321.591,76**	**$1.893,36**	**$0,65**

5.5 Comparison supply NileDutch and link to demand between 2011 and 2015

Table 51 shows NileDutch's supply and demand of 2011 and for four scenarios of 2015. The demand fand supply or full TEUs for 2011 are already described in paragraph 2.3.4.1 on page 34 and paragraph 2.3.5.2 on page 45. The results of NileDutch's demand for full TEUs is used to explain the results of the supply. Table 51 only shows the demand of the trade lanes important to the supply as container trade with West Africa is imbalanced. Meaning more full TEUs are imported into West Africa than full TEUs are exported out of West Africa.

On the Asia West Africa trade, supply has increased by 44,1% in scenario 1, by 50,5% in scenario 2, by 42,9% in scenario 3, and by 26,6% in scenario 4 in comparison with the supply of 2011. Scenario 4 shows a lower supply of about 20% in comparison with the three other scenarios. One container liner service is serving this segment of NileDutch's container shipping market instead of two container liner services in the three other scenarios. Therefore larger container vessels could be selected in the computer models, which show to have a more efficient intake in comparison with having two but smaller container vessels. The supply results on the Europe – West Africa trade show increases. 61,3% for scenario 1, 66,1% for scenario 2, 53,2% for scenario 3 and 51,7% for scenario 4 in comparison with 2011. The supply results on the South America – West Africa trade supply have significantly increased. The supply in scenario 1 and scenario 2 show an increase of 96,6%. Scenario 3 and scenario 4 show an increase of 91,4%. These increases are significantly higher due to the larger weight of a TEU on this trade. Recall Table 31 on page 121. On the outbound voyage, the weight of a full TEU is on average 18,8 ton. On the inbound voyage, the average weight per full TEU is 21 ton. This is significantly higher than on the other trades. Asia –West Africa has an average full TEU weight of 14,6ton on the inbound voyages and 18,6 ton on the outbound voyages. Europe – West Africa has an average full TEU weight of 15,4ton on the inbound voyages and 17,3 ton on the outbound voyages. The inter West Africa trade has an average full TEU weight of 14,6ton. Because full TEUs are significantly higher, lager container vessels needed to be selected in the computer so the deadweight tonnage boundary would not be overstepped. Larger container vessels result in larger nominal TEU capacities and thus higher increases of the supply. Supply on the inter West Africa trade shows decreases. 26% for scenario 1 and scenario 2, 23,3% for scenario 3, and 152,1% for scenario 4. Scenario 4 shows a significantly higher increase in supply. The reasons for this are four container liner services serving this segment of NileDutch's container shipping market in comparison with two container liner services in scenario 1, scenario 2 and scenario 3. The total supply in the West African container shipping market shows increases. 51,4% for scenario 1, 55,4% for scenario 2, 47,4% for scenario 3, and 65,8,1% for scenario 4.

Table 51: Comparison supply NileDutch 2011 to 2015 plus link to demand

Trade	full TEU capacity 2011	full TEU capacity 2015 scenario 1	full TEU capacity 2015 scenario 2	full TEU capacity 2015 scenario 3	full TEU capacity 2015 scenario 4
Supply Asia - West Africa[a/b] [full TEU]	76.113	109.645	114.584	108.790	96.339
Difference supply compared to 2011	100,0%	144,1%	150,5%	142,9%	126,6%
Demand Asia - West Africa West bound [full TEU]	59.913	91.690	94.690	89.282	89.282
Difference demand compared to 2011	100,0%	153,0%	158,0%	149,0%	149,0%
Supply Europe - West Africa [full TEU]	60.716	97.933	100.845	92.994	92.100
Difference supply compared to 2011	100,0%	161,3%	166,1%	153,2%	151,7%
Demand Europe - West Africa South bound [full TEU]	54.797	83.860	85.860	81.658	81.658
Difference demand compared to 2011	100,0%	153,0%	156,7%	149,0%	149,0%
Supply South America - West Africa[c] [full TEU]	20.650	40.608	40.608	39.519	39.519
Difference supply compared to 2011	100,0%	196,6%	196,6%	191,4%	191,4%
Demand South America - West Africa East bound [full TEU]	16.339	25.005	25.005	24.348	24.348
Difference demand compared to 2011	100,0%	153,0%	153,0%	149,0%	149,0%
Supply Inter West Africa [full TEU]	38.431	48.431	48.431	47.381	96.901
Difference supply compared to 2011	100,0%	126,0%	126,0%	123,3%	252,1%
Demand Inter West Africa [full TEU]	22.347	24.085	24.085	22.960	22.960
Difference demand compared to 2011	100,0%	107,8%	107,8%	102,7%	102,7%
Total supply [full TEU]	**195.910**	**296.618**	**304.469**	**288.684**	**324.859**
Difference supply compared to 2011	**100,0%**	**151,4%**	**155,4%**	**147,4%**	**165,8%**
Total demand [full TEU]	**153.396**	**224.640**	**229.640**	**218.248**	**218.248**
Difference demand compared to 2011	**100,0%**	**146,4%**	**149,7%**	**142,3%**	**142,3%**

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011. Results for 2015 are the outcome of the computer model.

a: Numbers are based on the vessel sharing agreement of the consortium in the SWAX container liner service between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. In the agreement, NileDutch can use maximum 952 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 952 (applied to data from 01/01/2011-29/08/2011)

b: Numbers are based on the slot agreement of the consortium of the SWAX container liner service between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. In the agreement, NileDutch can use maximum 100 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 100 (applied to data from 30/08/2011-31/12/2011)

c: Numbers are based on the vessel sharing agreement between Delmas and NileDutch. In the agreement, the nominal TEU capacity is 970 and the 14 ton TEU capacity is 700.

The results of the market research concerning 2015 are based on data of 2011 and earlier. These data are snapshots of certain moments in time or sometimes data based on averages. The 2015 market research results are based on the assumption that the market keeps on evolving to 2015 in the same way it did up to 2011. Out of the ordinary changes of the variables in the West African container shipping market between 2011 and 2015 could also not be taken into account for the results of the market research of 2015. These variables in the shipping market are described by Stopford (2009). He mentions variables for the shipping market, the freight rates, demand, and supply. He identifies fifteen variables for the shipping market: globalisation, dispersed manufacturing, increased global demands for commodities & consumer goods, world trade, demographic shifts, uneven economic growth & turbulence, geopolitical scene, terrorism, technology, environmental & safety concerns, rebalancing the competitive edge: develop versus emerging shipping nations, a more capital-intensive industry, financial markets, accelerated professionalism, and overall implications for shipping. There are five variables for the freight rates: commodities, trade development, availability of finished goods, port congestion & delays, and new building, second hand vessels & scrapping. The demand for container shipping depends of five subjects: the world economy, seaborne commodity trade, average haul, random chocks, and transport costs. The supply for container shipping depends on five subjects: The world fleet, the fleet productivity, shipbuilding production, scrapping & losses, and freight revenue.

Demand and supply can change in a market. Demand can increase or decrease and supply can increase and decrease as well. These changes in demand and supply results in a new market price and its corresponding quantity of for example commodities. In what kind of way the price and amount of commodities change depends the change in demand and/or supply.

In case the demand increases, the new market situation slides more up to the right on the supply curve which results in higher quantities and a higher market price. This can be seen in Figure 114. In case demand decreases, the new market situation slides down to the left on the supply curve which results in lower quantities and a lower market price. This can be seen in Figure 115. In case supply increases, the new market situation slides more up to the left on the demand curve which results in higher quantities but a lower market price. This can be seen in Figure 116. In case supply decreases, the new market situation slides more down to the right on the demand curve which results in lower quantities, but a higher market price. This can be seen in Figure 117 In a market often a combination of a changes in demand and supply occurs. Depending on the size of the changes the quantities increase or decrease and the new market price increases or decreases as well.

Figure 114: Demand versus supply curves: increase in demand

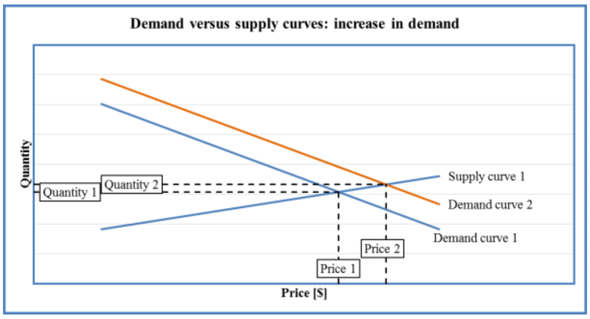


Figure 116: Demand versus supply curves: increase in supply

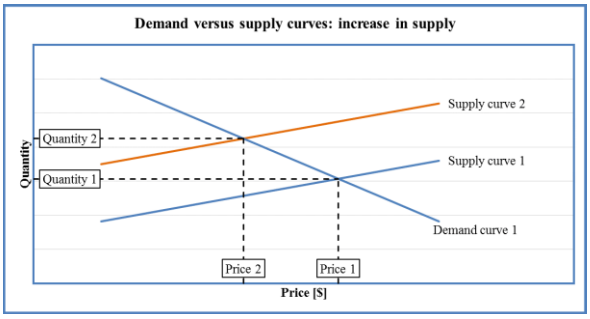


Figure 115: Demand versus supply curves: decrease in demand

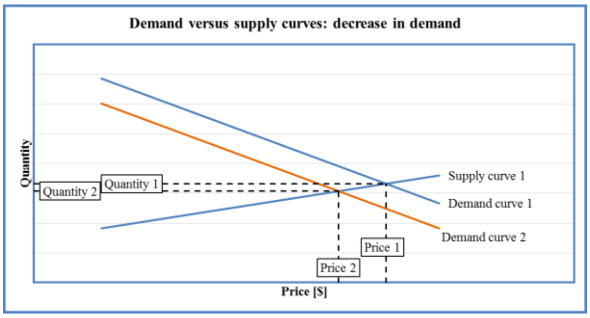


Figure 117: Demand versus supply curves: decrease in supply

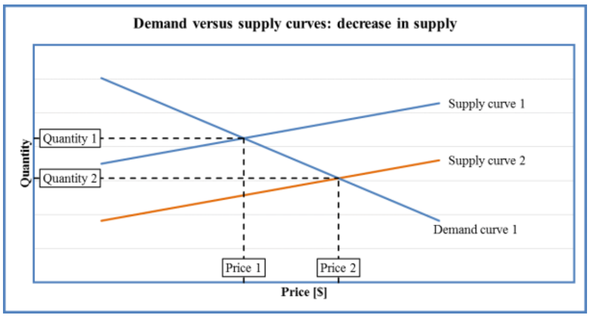
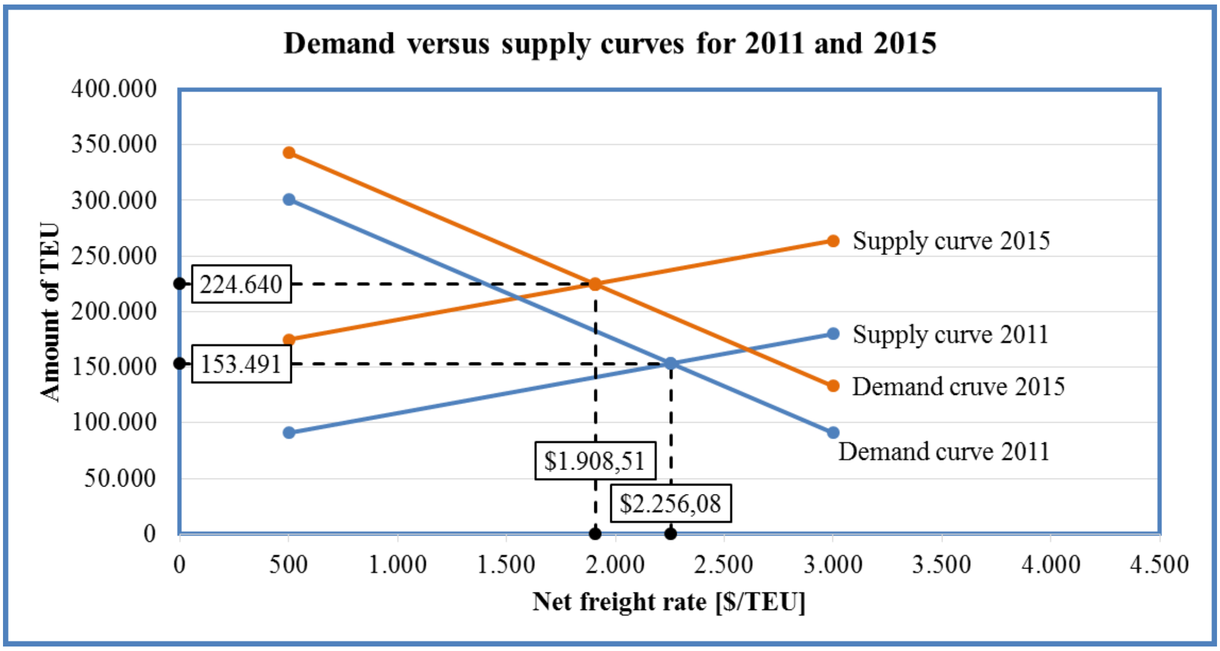


Figure 118 shows the change in demand and supply between 2011 and 2015. The average net freight rate per TEU of 2015 has decreased in comparison with 2011. 1.908,51 $/TEU for scenario 1 for 2015 and 2.256,08 $/TEU for 2011. The demand and supply curves are illustrative. No statement can be given about what the demand and supply curves might look like in reality as no research has been done about the price elasticity and thus shape of the demand and supply curves. Table 31 shows increases in demand and supply. The supply however increased more in comparison with the demand, which is also illustrated in Figure 118.

Figure 118: Demand versus supply curves for 2011 and 2015



Note: The crossing point of 2015 is based on data from scenario 1 for 2015. The demand and supply curves are illustrative. No statement can be given about how they would really look like as no research has be done about this subject.

5.6 Comparing variables from 2011 – 2014 to estimations for 2015

NileDutch calculations department (11/02/2015) provided data about the most important variables in the market. These variables are average time charter price, average net freight rate, and TEU volumes for 2008 until 2014. Bunker Index (11/02/2015) provided data about the average yearly bunker prices. As NileDutch does not purchase bunker daily their averages differ from the market averages. The estimations of these four variables for 2015 were previously obtained in paragraph 3.6.2.1 on page 152.

The average net freight rates for entire West Africa and per trade between 2008 and 2014 together with the estimation of 2015 can be seen in Table 52 and Figure 119 to Figure 123. Table 53 shows the transported TEU volumes corresponding to these average net freight rates. Except for the inter West African freight rates, all freight rates have gone down each year, while the quantity of TEUs has gone up. Between 2009 and 2010 there has been a big decrease in net freight rates. In case decrease continues in 2015 the estimated net freight rates for 2015 are slighty to high for al trades exept for the Inter West African trade. For this trade the estimated net freight rates would be quite high. From 2010 to 2014 the quantities of TEUs have been increasing significantly. The estimations for TEUs for the four scenarios for 2015 show slightly lower volumes in comparison with 2013 and/or 2014. The 2015 estimations for the various scenarios show an equal to slighty increase in net freight rates, while the TEU volumes show decrease in TEU volumes when comparing 2015 to 2014.

Table 52: Average net freight rate evolution per trade 2008 – 2014 and estimation of 2015

Net Freight / TEU per trade	2008	2009	2010	2011	2012	2013	2014	2015 scenario 1	2015 scenario 2	2015 scenario 3	2015 scenario 4
Asia - West Africa	$2.850,19	$2.509,84	$2.388,91	$2.416,02	$2.171,64	$1.940,81	$1.871,84	$1.886,61	$1.879,60	$1.872,22	$1.872,22
Europe - West Africa	$4.294,44	$3.687,08	$2.346,10	$2.420,10	$2.219,56	$2.197,78	$1.903,52	$1.948,26	$1.909,48	$1.971,34	$1.971,34
South America - West Africa	$3.319,87	$2.913,94	$2.207,55	$2.228,31	$2.298,21	$2.227,37	$1.937,76	$1.489,04	$1.489,04	$1.489,04	$1.489,04
Inter West Africa	$2.380,92	$2.304,70	$1.368,56	$1.441,79	$1.545,14	$1.342,87	$1.342,87	$1.761,15	$1.761,15	$1.761,15	$1.761,15
Entire West Africa	**$3.440,90**	**$2.999,08**	**$2.335,70**	**$2.256,08**	**$2.194,55**	**$2.063,01**	**$1.888,29**	**$1.908,53**	**$1.891,68**	**$1.916,96**	**$1.931,78**

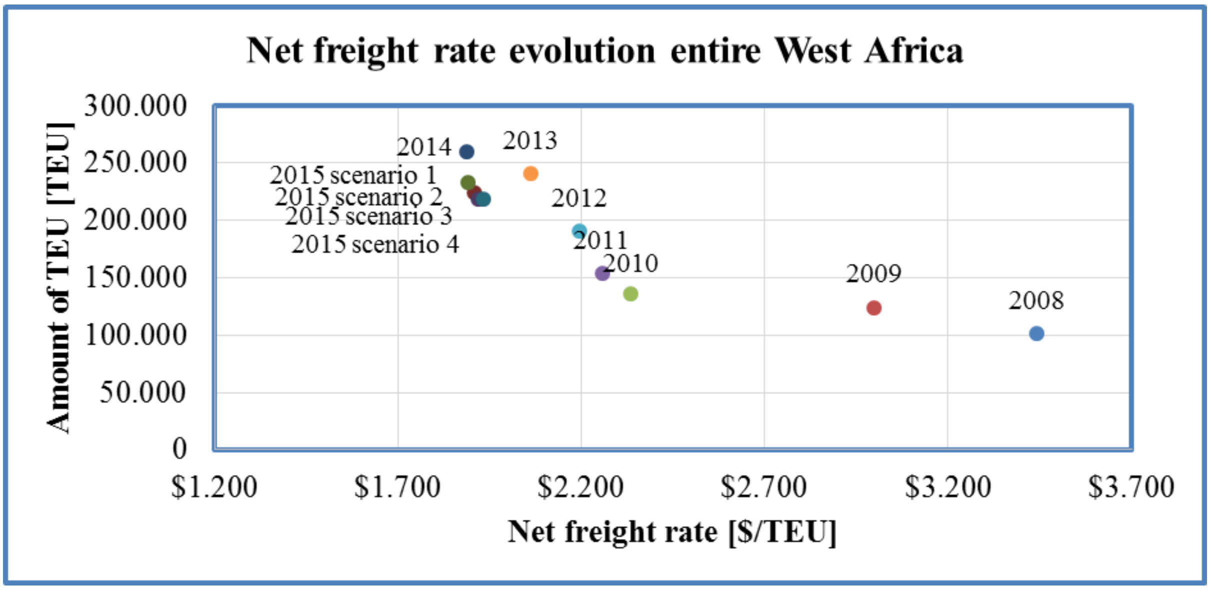
Source: NileDutch calculations department (11/02/2015)

Table 53: TEU evolution per trade 2008 – 2014 and estimation of 2015

Amount of TEU per trade	2008	2009	2010	2011	2012	2013	2014	2015 scenario 1	2015 scenario 2	2015 scenario 3	2015 scenario 4
Asia - West Africa	39.634	60.274	62.063	66.055	99.971	116.786	113.420	91.690	95.190	91.295	91.295
Europe - West Africa	41.778	49.306	59.438	57.690	64.969	84.104	94.960	87.432	92.232	82.631	82.631
South America - West Africa	6.969	7.175	11.959	16.342	20.692	25.725	28.997	25.005	25.005	24.348	24.348
Inter West Africa	12.901	7.260	2.457	13.404	4.956	13.957	23.049	20.512	20.512	19.973	19.973
Entire West Africa	**101.282**	**124.015**	**135.917**	**153.491**	**190.588**	**240.572**	**260.426**	**224.638**	**232.938**	**218.247**	**218.247**

Source: NileDutch calculations department (11/02/2015)

Figure 119: NileDutch's net freight rate evolution entire West Africa

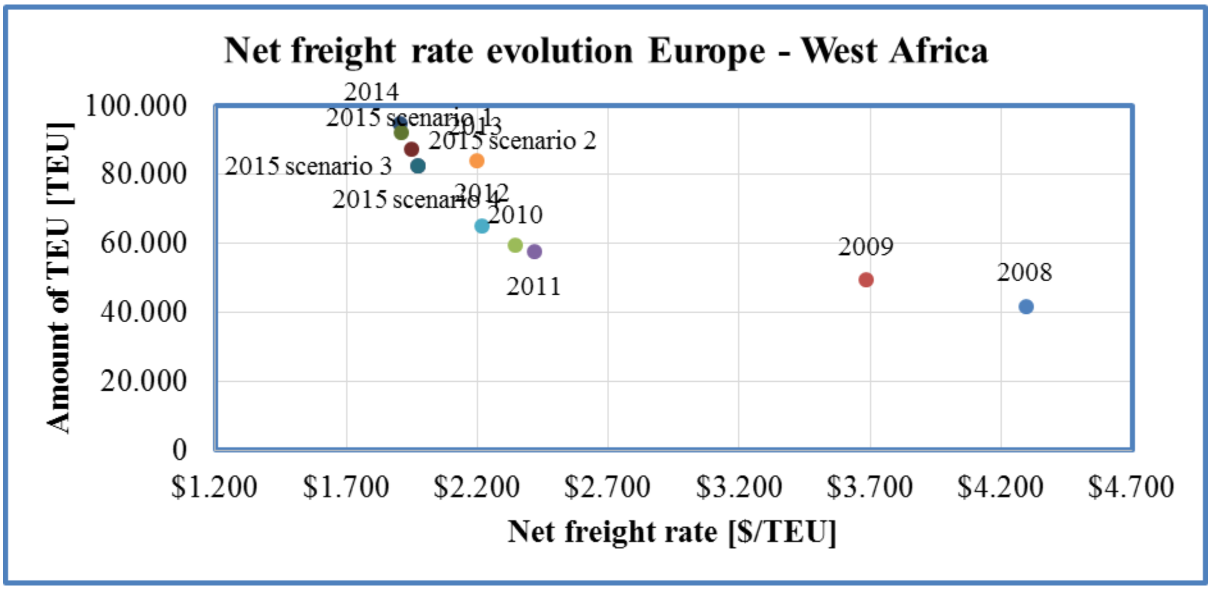


Source: NileDutch calculations department (11/02/2015)

Figure 120: NileDutch's net freight rate evolution Asia – West Africa

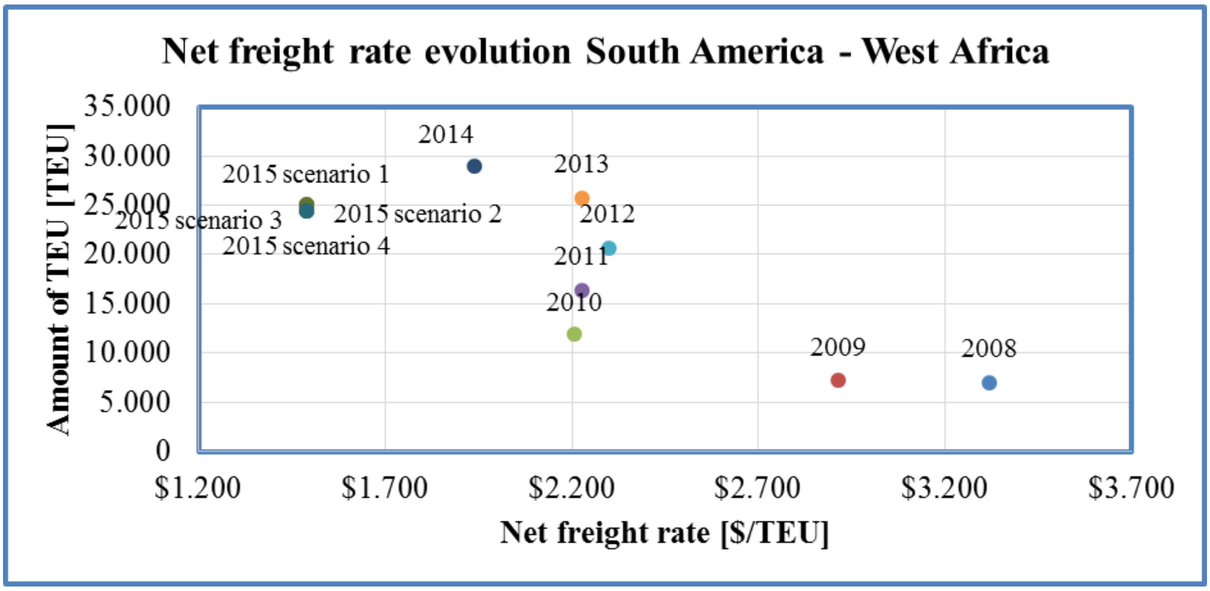
Source: NileDutch calculations department (11/02/2015)

Figure 121: NileDutch's net freight rate evolution Europe – West Africa



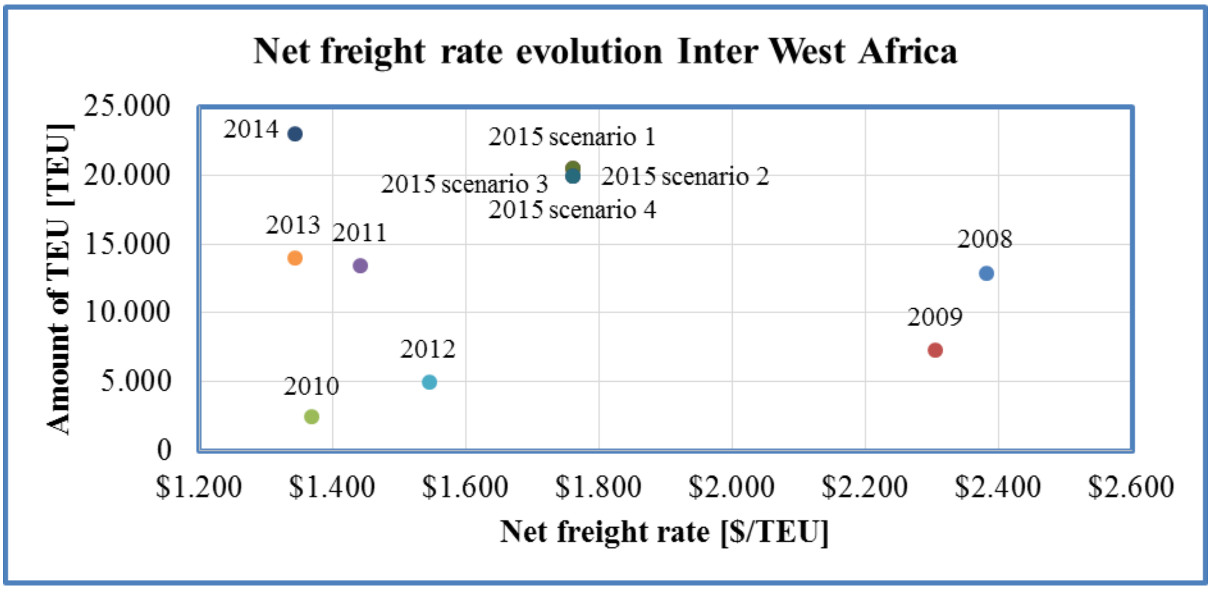
Source: NileDutch calculations department (11/02/2015)

Figure 122: NileDutch's net freight rate evolution South America – West Africa



Source: NileDutch calculations department (11/02/2015)

Figure 123: NileDutch's net freight rate evolution Inter West Africa



Source: NileDutch calculations department (11/02/2015)

The average bunker prices per year are shown in Table 54. Looking at the 2009 – 2013 bunker prices there is an inscrease noticeable which is higher than the estimation of 622 $/ton for 2015. In 2014 there has been a drop to 579,13$/ton. Depending on an increase or decrease in 2015 the estimated 622 $/ton for the bunker prices is likely to be a good estimation or overestimated.

Table 54: Average bunker price evolution per trade 2008 – 2014 and estimation of 2015

Average bunker price ($/ton)	2008	2009	2010	2011	2012	2013	2014	2015
Bunker price	$507,91	$374,33	$468,46	$650,59	$681,09	$640,85	$579,13	$622,00

Source: Bunker Index (11/02/2015)

The time charter price per container vessels size between 2008 and 2014 as can be seen in Table 55. Table 55 shows quite some fluctuations over the years. Some time charter prices increase while others decrease and visa versa. Due to this unsteady behaviour no statement can be given about the 2015 estimations. The average charter price for scenario 1 of the computer model is $8.245,87. In case the charter prices decrease in comparison with 2014, the estimations for 2015 might be realistic. In case the charter pricesincrease in comparison with 2014, the estimations for 2015 are not so realistic.

Table 55: Average time charter rate evolution 2008 - 2014 and estimation of 2015

Time charter rate ($/day)	2008	2009	2010	2011	2012	2013	2014	2015
700 TEU				$4.683,00				
1.100 TEU	$12.933,33	$4.362,03	$6.566,67					$7.500,00
1.200 TEU	$8.604,25	$7.542,86						
1.300 TEU	$12.566,42	$11.593,75	$12.312,50	$11.500,00		$11.500,00	$11.500,00	
1.700 TEU	$15.237,58	$10.912,61	$6.396,45	$8.774,26	$7.756,25	$6.854,17	$6.500,00	$8.250,00
2.000 TEU				$11.177,43	$7.039,40	$6.990,00	$7.000,00	
2.500 TEU		$5.329,17	$7.534,87	$12.646,11	$7.933,56	$7.614,99	$8.083,10	$10.250,00
2.700 TEU				$16.000,00	$7.250,00			$9.750,00
3.000 TEU					$9.526,23	$8.700,49	$11.173,60	
3.100 TEU				$14.212,67	$11.410,00			
3.500 TEU					$9.123,75	$8.700,12	$11.875,00	$10.500,00
4.250 TEU								$12.000,00
4.300 TEU							$8.171,28	
Average	**$13.803,48**	**$9.598,51**	**$7.804,26**	**$10.967,08**	**$8.124,35**	**$7.817,05**	**$8.580,13**	**$8.245,87**

Source: NileDutch calculations department (11/02/2015)

5.7 Changes in variables between 2008 and 2014

NileDutch calculations department (11/02/2015) provided data about the supply, revenue, result, and costs together with the most important variables in the market coming from their container liner services. These variables are average time charter price, average net freight rate, and TEU volumes for 2008 until 2014. Bunker Index (11/02/2015) provided data about the average yearly bunker prices per trade in case NileDutch calculation department had no data about this.

Table 56 gives an overview of these data for the Asia – West Africa trade.

Looking at the Asia – West Africa trade for 2008 - 2014, decreasing average freight rates, while TEU volumes increase resulted in more revenue but lower result margins. Supply has also increased over the years. Sometimes supply is lower than the demand this because coastal transhipped TEUs could not be filtered out these data. Increased average bunker prices did result into lower average bunker costs per TEU. This is due to the economies of scale advantage of the larger container vessels for 2012 to 2014. Lower average time charter rates did results in lower time charter costs per TEU. Economies of scale due to the deployment of larger container vessels also contributed to a lower time charter cost per TEU between 2012 and 2014. NileDutch had a negative results in 2011 in the Asia – West Africa trade. In comparison with 2010 the TEU volumes were slightly lower as well as the average net freight rates, but the average time chater rate and average bunker prices increased significantly, which resulted in a negative result.

Table 56: NileDutch's revenue, results, costs, plus variables 2008 – 2014: Asia – West Africa trade

Year	Average nominal TEU capacity vessel [TEU]	Amount of voyages	Supply TEU [14 ton TEU]	Demand TEU [TEU]	Total revenue [$]	Average net freight rates / Revenue per TEU [$/TEU]	Result per TEU [$/TEU]	Result margin on revenue	Costs per TEU [$/TEU]	Costs margin in revenue	Voyage costs per TEU [$/TEU]	Voyage costs margin in costs	Average bunker price [$/ton]	Bunker costs per TEU [$/TEU]	Bunker costs margin in costs	Average time charter rate [$/day]	Time charter costs per TEU [$/TEU]	Time charter costs margin in costs	Cargo costs per TEU [$/TEU]	Cargo cost margin is costs
2008	1.891	18	26.646	26.321	$98.159.254	$3.729	$798	21%	$2.931	79%	$1.983	68%	*$508*	$904	31%	$15.599	$845	29%	$948	32%
2009	2.059	36	54.799	48.788	$122.737.937	$2.516	$379	15%	$2.137	85%	$1.398	65%	*$374*	$694	32%	$9.471	$580	27%	$739	35%
2010	2.305	51	70.876	70.514	$166.726.682	$2.364	$262	11%	$2.102	89%	$1.272	61%	$358	$778	37%	$8.276	$455	22%	$830	39%
2011	2.464	58	76.113	59.913	$159.779.992	$2.667	-$75	-3%	$2.742	103%	$1.744	64%	$478	$982	36%	$12.448	$719	26%	$998	36%
2012	2.883	76	86.129	95.785	$219.088.026	$2.287	$215	9%	$2.073	91%	$1.199	58%	$657	$709	34%	$8.719	$330	16%	$874	42%
2013	3.230	83	101.013	121.395	$235.705.875	$1.942	$109	6%	$1.833	94%	$977	53%	$608	$530	29%	$8.511	$289	16%	$853	47%
2014	3.905	70	131.811	122.975	$229.053.075	$1.863	$210	11%	$1.653	89%	$822	50%	$585	$439	27%	$8.668	$230	14%	$831	50%

Source: NileDutch calculations department (11/02/2015)

Data in italics is provided by Bunker Index (11/02/2015) as no data was available from NileDutch calculations department (11/02/2015)

The Europe – West Africa trade results can be seen in Table 57. Looking at the data between 2011 and 2014, the table shows decreasing average freight rates while TEU volumes increase, which resulted in more revenue. Supply has also increased over the years. Sometimes supply is lower than the demand this because coastal transhipped TEUs could not be filtered out these data. Increased average bunker prices did result into lower average bunker costs per TEU. This is due to the economies of scale advantage of the larger container vessels deployed between 2011 to 2014. The average time charter rates fluctuate between 2011 and 2014. They did results in lower time charter costs per TEU. Economies of scale due to the deployment of larger container vessels also contributed to a lower time charter cost per TEU between 2011 and 2014. NileDutch had a negative results in 2010. In comparison with 2011 the TEU volumes and average net freight rates were lower, which results in an lower revenue. The lower average bunker price did not results in an lower bunker price per TEU. The significantly lower average time chater rate did not result in an lower time charter cost per TEU. The difference in total costs, voyage costs per TEU, and cargo costs per TEU are not remarkably different. A drop in demand and too high average net freight rate did not generate enough revenue to cover the costs.

Table 57: NileDutch's revenue, results, costs, plus variables 2008 – 2014: Europe – West Africa

Year	Average nominal TEU capacity vessel [TEU]	Amount of voyages	Supply TEU [14 ton TEU]	Demand TEU [TEU]	Total revenue [$]	Average net freight rates / Revenue per TEU [$/TEU]	Result per TEU [$/TEU]	Result margin on revenue	Costs per TEU [$/TEU]	Costs margin in revenue	Voyage costs per TEU [$/TEU]	Voyage costs margin in costs	Average bunker price [$/ton]	Bunker costs per TEU [$/TEU]	Bunker costs margin in costs	Average time charter rate [$/day]	Time charter costs per TEU [$/TEU]	Time charter costs margin in costs	Cargo costs per TEU [$/TEU]	Cargo cost margin is costs
2008	1.334	46	53.410	39.386	$159.829.935	$4.058	$943	23%	$3.115	77%	$2.037	65%	*$508*	$920	30%	$14.039	$786	25%	$735	24%
2009	1.268	77	81.967	57.385	$191.665.864	$3.340	$614	18%	$2.726	82%	$1.644	60%	*$374*	$584	21%	$10.287	$686	25%	$789	29%
2010	1.530	54	75.351	50.616	$112.807.811	$2.229	-$33	-1%	$2.261	101%	$1.178	52%	$502	$541	24%	$8.748	$410	18%	$817	36%
2011	2.059	41	60.716	54.797	$136.671.245	$2.494	$211	8%	$2.284	92%	$1.131	50%	$566	$551	24%	$10.612	$412	18%	$828	36%
2012	2.539	38	72.481	64.277	$145.913.949	$2.270	$323	14%	$1.947	86%	$937	48%	$644	$525	27%	$8.048	$287	15%	$791	41%
2013	2.500	48	88.831	86.212	$189.472.815	$2.198	$259	12%	$1.938	88%	$836	43%	$638	$408	21%	$7.740	$275	14%	$836	43%
2014	2.543	53	100.022	100.055	$190.456.312	$1.904	$69	4%	$1.835	96%	$754	41%	$673	$345	19%	$8.396	$256	14%	$814	44%

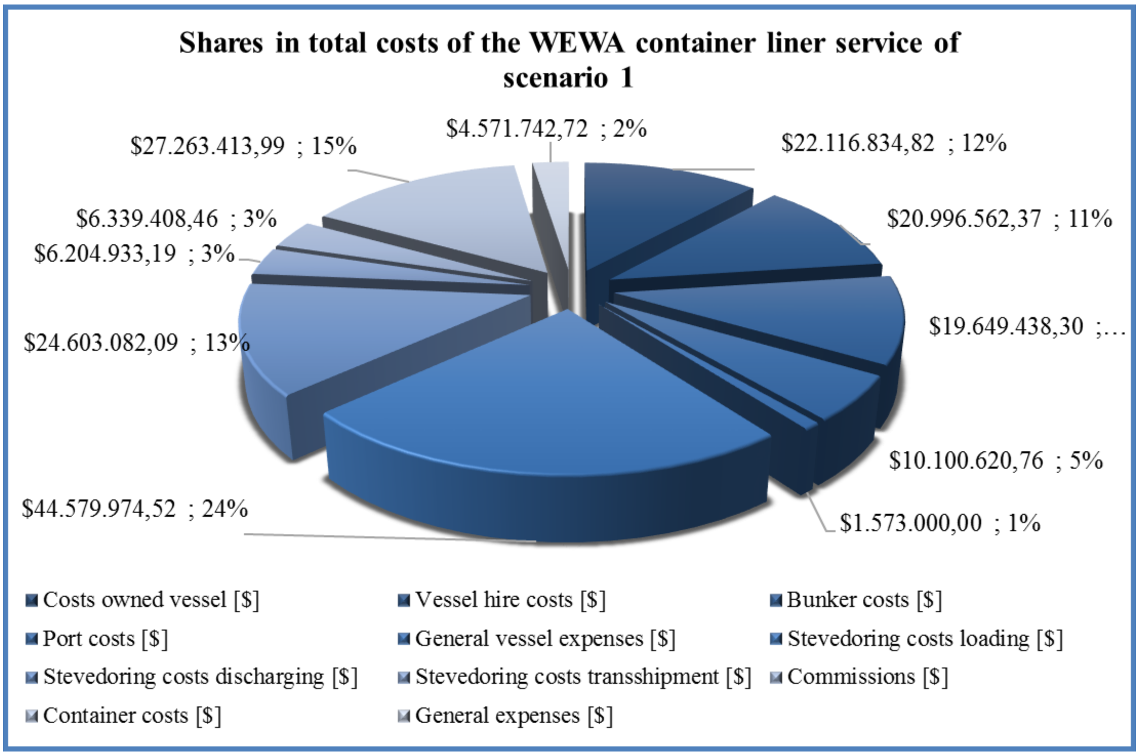
Source: NileDutch calculations department (11/02/2015)

Data in italics is provided by Bunker Index (11/02/2015) as no data was available from NileDutch calculations department (11/02/2015)

6 Sensitivity analysis

The sensitivity analysis determines the influence of the variation of certain input parameters on the vessel's speed, the voyage time, the amount of container vessels (time chartered and owned), the size of container vessels, the fuel consumption, freight rate, and various costs types. The parameters, which are varied, are the trip matrix, the bunker price, the time charter rate, and the net freight rates. The variation is done by increasing and decreasing 20% to the original value of the WEWA container liner service of scenario 1 as can be seen in Table 131. Table 131 also shows the share of each cost type in tot total costs. The extensive results for each scenario and container liner service can be found in Appendix T. The summary of these results and the explanation of these results for the WEWA container liner service of scenario 1 is as follows.

Figure 124: Shares in total costs of the WEWA container liner service of scenario 1



6.1 Trip matrix

Varying the TEUs of the trip matrix by increasing and decreasing it by 20% results in the utilization of a different size of container vessels of each container liner service in each scenario. When the trip matrix increases/decreases by 20%, larger/smaller size container vessels are required to obtain a weekly sailing. Table 58 illustrates these increases/decreases for the container liner services in scenario 1. The table shows increases/decreased between 15% and 20% in comparison with the normal results.

Table 58: Comparison nominal TEU capacity container vessels when varying the trip matrix

Scenario	Liner service	Nominal TEU capacity normal results	Nominal TEU capacity (-20% TEUs)	Change (%)	Nominal TEU capacity (+20% TEUs)	Change (%)
Scenario 1	FEWA	2.092	1.686	80,59%	2.487	118,88%
	SWAX	765	619	80,92%	904	118,17%
	WEWA	2.537	2.043	80,53%	3.036	119,67%
	ECSA	1.063	860	80,90%	1.264	118,91%
	Feeder 1	209	176	84,21%	241	115,31%
	Feeder 2	1.074	868	80,82%	1.272	118,44%

Table 59 and Table 60 show the results of optimum vessels speed and amount of container vessels when varying the TEUs in the trip matrix by 20% for the WEWA container liner service of scenario 1. The tables show an increase/decrease by about 20% of the capacity of the container vessels (nominal and 14 ton TEU), the annual capacity (TEU and 14 ton TEU), and the voyage capacity (full, empty and total) are The small deviations from 20% are due to rounding off TEU numbers when the annual trip matrix assigns its contents to the weekly container liner services. In case of a 20% increase of TEUs in the trip matrix, more TEUs need to be stevedored in the ports, the duration of the voyage becomes longer, the stevedoring costs lower and the commissions higher. Because the duration of the voyage is longer, the container costs are higher as well. Larger container vessels also result in higher costs for owning and chartering container vessels. Larger container vessels require more engine power, which leads to more fuel consumption and by consequence higher bunker costs. The general vessel expenses increase in case the container vessels nominal TEU capacity has become larger than 2.900TEU. Larger container vessels also pay higher port costs due to their size.

Table 59 and Table 60 also show higher total costs by 17% and a lower net results by 1%. Table 59 shows an optimum vessels speed of 11 knots in case of an 20% decrease in TEUs of the trip matrix. 12 knots for the base situations and 12 knots for the situation of 20% increase of the TEUs in the trip matrix. It shows lower vessels speeds are required in a container liner service to obtain the optimum point where costs are as low as possible.

When looking at the MRFR1 and MRFR2 the effect of economies of scale become clear. Larger size container vessels result in a lower required freight rate per TEU and TEU/mile, both 2% lower. When the trip matrix is decreased by 20% these cost effects are reversed. The total costs are 16% lower, the net result is 1% lower. The MRFR1 and MRFR2 are 4% and 5% higher.

Table 59: Results variation trip matrix WEWA container liner service and grant total scenario 1

	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Vessel speed [kn]	Duration of voyage [days]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption [mt]	Total full TEU	Total empty TEU	Total TEU	Revenue [$]	Costs owned vessel [$]	Vessel hire costs [$]	Bunker costs [$]
WEWA [Annual] [-20%]	81%	80%	81%	80%	105%	94%	92%	100%	83%	97%	81%	81%	81%	80%	86%	77%	97%
WEWA [Annual] [-20%]	2.043	1.514	106.236	78.721	11,5	76,54	11	6	5	30.752	74.620	74.620	149.240	$127.323.633,53	$18.990.398,52	$16.260.028,40	$19.127.769,87
WEWA [Annual] [basis]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$158.460.027,02	$22.116.834,82	$20.996.562,37	$19.649.438,30
WEWA [Annual] [+20%]	3.036	2.257	157.872	117.340	11,5	82,23	12	6	6	37.403	110.968	110.968	221.936	$190.016.330,15	$24.783.753,30	$22.496.116,25	$23.264.383,23
WEWA [Annual] [+20%]	120%	120%	120%	120%	105%	101%	100%	100%	100%	118%	120%	120%	120%	120%	112%	107%	118%

Table 60: Results variation trip matrix WEWA container liner service and grant total scenario 1 (2)

	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
WEWA [Annual] [-20%]	95%	100%	80%	81%	81%	80%	78%	100%	84%	101%	104%	105%
WEWA [Annual] [-20%]	$9.550.615,00	$1.573.000,00	$35.869.511,05	$19.820.083,42	$5.027.922,33	$5.093.952,72	$21.193.298,34	$4.570.063,69	$157.076.643,34	-$29.753.009,80	$2.105,02	$0,203
WEWA [Annual] [basis]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$6.339.408,46	$27.263.413,99	$4.571.742,72	$187.999.011,22	-$29.538.984,20	$2.028,82	$0,193
WEWA [Annual] [+20%]	$10.656.193,39	$3.146.000,00	$53.439.048,80	$29.460.880,60	$7.401.239,30	$7.601.660,58	$33.067.647,49	$4.599.137,93	$219.916.060,88	-$29.899.730,72	$1.981,80	$0,189
WEWA [Annual] [+20%]	106%	200%	120%	120%	119%	120%	121%	101%	117%	101%	98%	98%

6.2 Bunker price

Table 61 and Table 62 show the results when increasing and decreasing the bunker price by 20% for the optimum vessel speed. Table 61 shows an optimum vessels speed of 11 knots in case the bunker costs are decreased by 20% and an optimum vessels peed of 11 knots in case the bunker price has increased. Note that the base situation indicates a vessels speed of 11 knots as well. The bunker costs have changed by 20%. These differences in bunker costs results in a 2% change in total costs, a 13% change net result. The MRFR1 and MRFR2 changed by 2%.

Table 61: Results variation bunker price WEWA container liner service and grant total scenario 1

	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Vessel speed [kn]	Duration of voyage [days]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption [mt]	Total full TEU	Total empty TEU	Total TEU	Revenue [$]	Costs owned vessel [$]	Vessel hire costs [$]	Bunker costs [$]
WEWA [Annual] [-20%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%
WEWA [Annual] [-20%]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$158.460.027,02	$22.116.834,82	$20.996.562,37	$15.719.550,64
WEWA [Annual] [basis]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$158.460.027,02	$22.116.834,82	$20.996.562,37	$19.649.438,30
WEWA [Annual] [+20%]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$158.460.027,02	$22.116.834,82	$20.996.562,37	$23.579.325,96
WEWA [Annual] [+20%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	120%

Table 62: Results variation bunker price WEWA container liner service and grant total scenario 1 (2)

	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
WEWA [Annual] [-20%]	100%	100%	100%	100%	100%	100%	100%	100%	98%	87%	98%	98%
WEWA [Annual] [-20%]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$6.339.408,46	$27.263.413,99	$4.571.742,72	$184.069.123,56	-$25.609.096,54	$1.986,41	$0,189
WEWA [Annual] [basis]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$6.339.408,46	$27.263.413,99	$4.571.742,72	$187.999.011,22	-$29.538.984,20	$2.028,82	$0,193
WEWA [Annual] [+20%]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$6.339.408,46	$27.263.413,99	$4.571.742,72	$191.928.898,88	-$33.468.871,86	$2.071,23	$0,197
WEWA [Annual] [+20%]	100%	100%	100%	100%	100%	100%	100%	100%	102%	113%	102%	102%

6.3 Time charter rate

Table 63 and Table 64 show the results of increasing and decreasing the time charter rates by 20%. The tables show a vessels speed of 11 knots. The 20% change in time charter prices also shows in the table. By consequence the total costs are changed by 2%. The net results is changed by 14%. The MRFR1 and the MRFR have change by 2%.

Table 63: Results variation time charter rate WEWA container liner service and grant total scenario 1

	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Vessel speed [kn]	Duration of voyage [days]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption [mt]	Total full TEU	Total empty TEU	Total TEU	Revenue [$]	Costs owned vessel [$]	Vessel hire costs [$]	Bunker costs [$]
WEWA [Annual] [-20%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	100%
WEWA [Annual] [-20%]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$158.460.027,02	$22.116.834,82	$16.797.249,89	$19.649.438,30
WEWA [Annual] [basis]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$158.460.027,02	$22.116.834,82	$20.996.562,37	$19.649.438,30
WEWA [Annual] [+20%]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$158.460.027,02	$22.116.834,82	$25.195.874,84	$19.649.438,30
WEWA [Annual] [+20%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	120%	100%

Table 64: Results variation time charter rate WEWA container liner service and grant total scenario 1 (2)

	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
WEWA [Annual] [-20%]	100%	100%	100%	100%	100%	100%	100%	100%	98%	86%	98%	98%
WEWA [Annual] [-20%]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$6.339.408,46	$27.263.413,99	$4.571.742,72	$183.799.698,74	-$25.339.671,73	$1.983,51	$0,189
WEWA [Annual] [basis]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$6.339.408,46	$27.263.413,99	$4.571.742,72	$187.999.011,22	-$29.538.984,20	$2.028,82	$0,193
WEWA [Annual] [+20%]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$6.339.408,46	$27.263.413,99	$4.571.742,72	$192.198.323,69	-$33.738.296,67	$2.074,14	$0,197
WEWA [Annual] [+20%]	100%	100%	100%	100%	100%	100%	100%	100%	102%	114%	102%	102%

6.4 Net Freight rates

Table 65 and Table 66 sow the results for the 20% increase and decrease of the net freight rates. They do not show a different vessels speed or amount of container vessels in comparison with the base situation of 11 knots. The revenue is changed by 20%. As commissions are based on the net freight rates these are also changed by 20%. This results in totals costs, which are changed by 1%. A net result, which is changed by 3%. The MRFR1 and MRFR2 are changed by 1%.

Table 65: Results variation net freight rates WEWA container liner service and grant total scenario 1

	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Vessel speed [kn]	Duration of voyage [days]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption [mt]	Total full TEU	Total empty TEU	Total TEU	Revenue [$]	Costs owned vessel [$]	Vessel hire costs [$]	Bunker costs [$]
WEWA [Annual] [-20%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	80%	100%	100%	100%
WEWA [Annual] [-20%]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$126.768.021,61	$22.116.834,82	$20.996.562,37	$19.649.438,30
WEWA [Annual] [basis]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$158.460.027,02	$22.116.834,82	$20.996.562,37	$19.649.438,30
WEWA [Annual] [+20%]	2.537	1.883	131.924	97.933	11	81,13	12	6	6	31.591	92.664	92.664	185.328	$190.152.032,42	$22.116.834,82	$20.996.562,37	$19.649.438,30
WEWA [Annual] [+20%]	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	120%	100%	100%	100%

Table 66: Results variation net freight rates WEWA container liner service and grant total scenario 1 (2)

	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
WEWA [Annual] [-20%]	100%	100%	100%	100%	100%	80%	100%	100%	99%	203%	99%	99%
WEWA [Annual] [-20%]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$5.071.526,77	$27.263.413,99	$4.571.742,72	$186.731.129,53	-$59.963.107,91	$2.015,14	$0,192
WEWA [Annual] [basis]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$6.339.408,46	$27.263.413,99	$4.571.742,72	$187.999.011,22	-$29.538.984,20	$2.028,82	$0,193
WEWA [Annual] [+20%]	$10.100.620,76	$1.573.000,00	$44.579.974,52	$24.603.082,09	$6.204.933,19	$7.607.290,15	$27.263.413,99	$4.571.742,72	$189.266.892,91	$885.139,51	$2.042,51	$0,195
WEWA [Annual] [+20%]	100%	100%	100%	100%	100%	120%	100%	100%	101%	-3%	101%	101%

Conclusions and recommendations

Market knowledge about the carriers and operators together with their container liner services, fleet, supply for full TEUs, strategy and NileDutch's demand for full TEUs in the West African container shipping market of 2011 is obtained and expanded by the use of new research methodologies to NileDutch. Three new research methodologies to NileDutch are:

- The knowledge about West African container shipping market of 2011 is obtained by applying partly Dynamars market research approach to data from Alphaliner. In addition to Dynamars approach, data about the vessels used in the West African container shipping market are added to the research. The knowledge about the vessels in the West African container shipping market is thus new to NileDutch
- The strategy of the competitors are determined based on the conceptual model and portfolio model of Lorange (2005). The strategy information about the competitors is new to NileDutch.
- The demand for full TEUs is modelled by the use of the four-stage model (FSM) which results in a trip matrix.

Market knowledge about demand and supply for full TEUs by NileDutch for 2015 are estimated for four scenarios. The fleet of container vessels which provides these supplies are specified. A statement about the evolution of NileDutch's 2015 net freight rates in comparison with 2011 due to the changes in supply and demand is given. This market knowledge is obtained by research methodologies who are new to NileDutch. This is achieved by modelling NileDutch's container shipping market by use of next methodologies:

- The process interaction modelling method which resulted in a successful computer model. The computer model is positively validated. This computer model is new to NileDutch.
- The econometric ARIMA model and a Monte Carlo simulation with Weibull probability density function for the predictions and forecasting is used to estimate input data for the computer model for 2015. Finding econometric ARIMA models was done with varying success for nineteen time series representing TEU volumes (six time series), net freight rates (six time series), time charter rates (six time series) and bunker prices (one time series). The estimations made for 2015 are new to NileDutch.
    - The forecast of the TEU volumes fall within the prediction intervals and thus these forecasts are used in the computer model.
    - The forecasts of the net freight rates were successful for two time series, namely the South America East bound and inter West Africa trade lane and trade. For the net freight rates of the Europe – West Africa, North bound trade lane no econometric ARIMA model was found. The forecasts of the three other time series do not fall within the prediction interval. These values are replaced by the net freight rates obtained by multiplying the net freight rates of 2011 by the extrapolation to 2015 of the average inflation between 2011 and 2013.

- The forecasts of the time charter rates were successful for two time series, namely, the 1.000TEU and 2.500TEU time series. The forecasts of the four other time series do not fall within the prediction interval. These values are replaced by data provided by Howe Robinson Shipbroker. As Howe Robinson has extensive knowledge about the charter market, the Howe Robinson Shipbroker results are decided to be more realistic forecasts in comparison with the ARIMA forecasts. Therefore, these data are also used to replace the successful forecasted 1.000TEU and 2.500TEU values.
- The forecast of the bunker prices is unsuccessful as it falls outside the prediction interval. The value used in the computer model is based on the Brent crude oil price forecast of 2015 multiplied by the multiplier 5,8 to obtain an estimated bunker price for 2015.

- The tool integrated in the computer model, which designs a container vessel in the preliminary stages of container vessel design, is mainly based on a computer model from Aalbers (2008), but is extended and altered. Aalbers (2008) used a database of 75 container vessels. Five of these container vessels have been replaced to obtain a database with also container vessels built in 2010, 2011 and 2014. The weight estimate of ship and machinery from Aalbers (2008) is based on Watson and Gilfillan (1977). This weight estimation method is replaced by a weight estimate based on regression analysis on the database. Aalbers (2008) resistance calculations to determine the required engine power are based on the Holtrop & Mennen resistance calculations method. Next Aalbers (2008) resistance calculations have been adjusted to calculate the appendages by the use of formulas found in Visch (2007), the vessel's propeller diameter with a formula found in Watson (1998), and calculation of the vessel's fuel consumption for a specified engine power by the use of Klein Woud & Stapersma (2003). By adding the admiralty coefficient, the engine power for a specific loading condition could be obtained. Calculation about the capital costs for a container vessels are added to Aalbers (2008) by the use of Aalbers (1997). Aalbers (1997) calculations about the capital costs are based on Benford (1965) and Carreyette (1977). These calculations are modified for calculating the capitals costs for a container vessel that is built at a Chinese shipyard by using Chinese steelworkers wage prices. The installed generator power is based on Gorski and Giernalczyk (2011). Schneekluth and Bertram (1998) is used to determine the equipment weight. The weight for the cargo systems can be based on the weight of a Liebherr CBW ship crane and the amount of cranes on a container vessel is determined by data of 345 container vessels from Alphaliner (2011) database. Calculations about the daily running costs are added based on Evans and Marlos (1990). Combining all these methods and data to Aalbers (2008) resulted in a more elaborate tool to design a container vessel in the early stages of container vessel design.

Market research and strategy

A recommendation about the market research and strategy is to set up a market research department inside NileDutch headquarters in Rotterdam, The Netherlands and to use consultancy firms every two to five years to carry out market research and advice NileDutch on strategy. This is important for three reasons:

- Firstly, currently NileDutch does not have a market research department which makes their market information come with a delay as they use reports from Dynamar and Alphaliner. In addition, the available market information is distributed throughout various departments within NileDutch and each person interprets and processes this information for its own opportune reasons. It is not clear which person has which information and if, in case data are processed, reliable methodologies are used.
- Secondly, NileDutch in general is a first mover, but a fast follower when it comes to its commercial department. To become a first mover commercially fast access to data about changes in the market is required. Having an in-house market research department provides this market information quickly.
- Thirdly, even though consultancy companies are pricey, their experience, methodologies about market research, advice on strategy, and access to sources to which NileDutch does not have access outweigh the costs. Their work provides insights, which would not become clear in market research done by an in-house market research department. They are also good advisors when a company is in the process of determining or altering its company's future strategy. Consultancy firms might also ask thought-provoking questions the company had not considered previously.

For these three reasons, it is advisable for NileDutch to set up a market research department inside NileDutch headquarters in Rotterdam, The Netherlands and to use consultancy firms every two to five years to carry out market research and advice NileDutch on strategy.

To elaborate more about the in-house market research department. A group of two or three people specialized in market research is advised to carry out market research about the competitors and their strategy in the West African container shipping market. A group of two or three people are to do this work. Collecting, processing, and analysing these data are time-consuming work. This market research is advised to be executed by the use of data from Alphaliner for the West African container shipping market on a regular basis. This is preferably done quarterly and annually. Next, is it advisable to compare these data to each other and give statements about the movements in the market compared with the previous quarter or the previous year. These statements provide valuable information about the changes in the West African container shipping market. Quarterly and annually market research reports enables NileDutch's managers and directors to pick up on changes quickly in the market and to respond to them. The annual market research reports should be compared with the data and findings in the Dynamar reports. Dynamar does not provide as much detailed information as Alphaliner. However, it is advisably be used to verify the rough movements in the market.

To do market research it is important to have access to reliable and up-to-date sources. Containerisation international and Clarksons are an addition to the information from Dynamar and Alphaliner as they provide time series about the freight rates of the container shipping trades with West Africa. Containerisation international and Clarksons' data are likely to be used in the quarterly and annually market research reports to verify the movements in the market.

NileDutch's in-house market knowledge can further be expanded by research about price elasticity of supply and demand. It is advisable to know the price elasticity of the demand and supply as it determines the shape of the supply and demand curves. Knowing the shape of these curves quarterly and annually aids in following the movements in the West African container shipping market and how they would likely move in the future. These demand and supply curves are important to know for the global container shipping market, per trade in the West African container shipping market, and per trade lane related to the West African container shipping market.

NileDutch's in-house knowledge about shipping can further be expanded by research of various markets of container shipping and related to container shipping. It is advisable to observe the movements of the cycles in markets. The most important markets are the container shipping market and the West African container shipping market. Markets that are influenced by this market are the bunker market, time charter market, the newly built market, the second hand container vessel market and the scrap market. Changes in the container shipping market have cascading effects on the other markets, which make it possible to anticipate these markets. The position of a market in a cycle has advantages and disadvantages for the costs and decisions about entering new markets, time chartering container vessels, ordering new container vessels, sell old container vessels or even give up old container vessels for scrap. For the same reason as for the freight rates, it is advisable to determine the price elasticity of the supply and demand curves to determine the shape of the curves. Knowing the shape of these curves quarterly and annually aids in following the movements in these markets and how they would likely move in the future. Containerisation international and Clarksons provide these data.

When comparing the costs for owning and time chartering the same size container vessel in 2015 there is a switch point where one has lower costs than the other one. When a container vessel's nominal TEU capacity is lower than 1.000TEU an owned container vessel built in China is cheaper than a time chartered container vessel. When the nominal TEU capacity of the container vessels is higher than 1.000TEU the time chartered container vessel is cheaper than the owned container vessel, which is built in China. With the aim of keeping the costs for container vessels as low as possible it is advisable to keep on determining this switch point in the future and to determine also the steepness of the slopes which represent the costs for an owned container vessels and a time chartered container vessel per ship size. The fluctuation in the time charter market are important in determining this switch point. When knowing these data for different moments, these data can be compared with each other to determine the markets movements.

Due to the cycles in the time charter market of container vessels and the West African container shipping market, owning a container vessel is cheaper in the long run. Smart use of time chartered container vessels over short time spans can however give cost benefits when the time chartering market is in the down part of a cycle. Time chartered container vessels can also be put in or taken out of the container shipping market more quickly when demand increases or decreases. A good balance between owned and time chartered container vessels is therefore important for the vessel costs and dependable on the position of the charter market in the markets cycles. Therefore, it is important to keep track of the cycles in the time charter market.

Forecasting & predicting

A recommendation for estimating future values by the use of forecasting models and predicting methods is to execute research about other forecasting models and prediction methods. This is important for three reasons:

- Firstly, up to now only two forecasting models are used to estimate values in the future. These are linear extrapolation and the ARIMA model. When comparing the results of different forecasting models the best model for a time series can be selected.
- Secondly, other forecasting models can give better estimation results.
- Thirdly, other probability density functions, which provides the predictions, might describe the behaviour of data better.

For these three reasons, it is important to carry out research about other forecasting models and prediction methods.

Forecasting models that are advisable to research are univariate and multivariate models. Examples of univariate models are the Analysis of Variance (ANOVA) model and the AutoRegressive eXogenous Moving Average (ARMAX) model. Examples of Multivariate models are the Vector AutoRegressive Moving Averages (VARMA) and the exogenous input variable version VARMAX.

It is recommended to examine the behaviour of data to determine the best-suited probability density function to use in the Monte Carlo simulations, which provides the predictions. The Weibull probability density function is flexible to use but other probability density functions might describe the behaviour of data better. Examples of probability density functions that are advisable to research are the log normal distribution, beta distribution, Rayleigh distribution, normal distribution, shifted exponential distribution, and uniform distribution, etc.

Modelling recommendations

The recommendation about modelling are given about how the computer model can be improved and expanded to obtain a more precise and flexible model. The recommendations are about the computer model and the tool which generates container vessels.

Computer model recommendations

An extra variable that could be added to the computer model are estimation of future dollar/euro exchange rates done by an econometric model. NileDutch uses net freight rates in euro on the WEWA liner service. Certain cost types are also in euro and coverted to dollars or the other way around. Shifts in these exchange rates have financial consequences.

One advice is to convert the calculations into simulations to obtain a more realistic and flexible computer model. The results of the estimated values for TEU flows, net freight rates, time charter rates and bunker prices by the use of econometric ARIMA models for 2015 can be altered in the computer model by adding their Monte Carlo simulations with Weibull probability density function. Adding more simulating aspects to the computer model can be done by adjusting the stuffing and stripping time. Currently the average stuffing and stripping time is used. More realistic results can be obtained when working with Monte Carlo simulations. In that case the Monte Carlo simulation should use a probability density functions, which describe the stuffing and stripping behaviour per port.

The computer model can be adjusted with more precise data instead of general data.

For example time series about the bunker prices are advised to be collected about each place NileDutch takes bunkers and make forecasts with these time series. Next, adjust the computer model to use these estimates instead of the estimates based on the average bunker prices calculated from these ports.

Revenue coming from demurrage and detention are advised to be added to the computer model. More realistic results can be obtained when working with Monte Carlo simulations. In that case the Monte Carlo simulation should use a probability density functions, which describe the demurrage and detention behaviour per port.

In case it is desirable to do more research about sailing a different speeds to obtain lower bunker costs it is advised to alter the computer model so container vessels can sail at a different speed when they make their transition between two continents. Next, determine the optimum point where costs are as low as possible when calculating all combinations of these two vessel speeds.

Tropical draft, summer draft and winter draft are advised to be included in the computer model.

Expand the systems boundaries of the computer model. Including all movements, time data and cost data in the computer model so the entire NileDutch's container transport chain is modelled. To be able to add these data to the computer model, databases are advised to be expanded with more data about empty containers. Cleaning time, upgrading time, and the time a container spends in a container depot are advisably added. In addition, the costs of these activities are advisably added and used in the computer model. Empty TEUs flows are advised to be more closely observed and added to the computer model, as the computer model does not keep track of their location. Research about which ports of loading are most cost beneficial when sending an empty container to its desired port of discharge in West Africa can give cost benefits.

Container vessels tool

The tool which generates container vessels in the preliminary stages of container vessels design can be technically be improved in different ways.

The tool does not make stability calculations. It is advisable to add these calculations to the tool so stability of the container vessels in de computer model is safeguarded after calling each port. It is hereby advisable to make databases with the loading conditions of the vessels after having called each port in each voyage. These data should advisably include the loading condition of the TEUs, ballast tanks, fuel tank, water tank, and waste tank condition. These databases do not exist up to now and are an important source of information to use when calculating fuel consumption in future scenarios. In case this data is added to the tool the calculation of fuel consumption can be done more realistically. It is also advisable to alter the tool so container vessels can be limited in their draft and/or length on order to call a port. The possibility of a container vessel having a controllable pitch propeller can also be advised to be added to the tool. Varying the pitch of the propeller blades can generate more trust, which gives manoeuvrability benefits, but also lower to fuel consumption as a lower engine speed can results in more trust.

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Nomenclature

Roman variables

a	Coefficient	$[-]$
A_r	Relative atomic mass	$\left[\frac{kg}{mol}\right]$
$A(x)$	Atoms of element x	$[atoms]$
b	Coefficient	$[-]$
B	Beam	$[m]$
C_{ad}	Admiralty coefficient	$[-]$
C_{ADM}	Administration costs	$[\$]$
C_b	Block coefficient belonging to the length between perpendiculars	$[-]$
C_B	Bunker costs	$[\$]$
C_{co}	Costs owned container vessel per day	$\left[\frac{\$}{day}\right]$
$C_{oc_{14tonTEU/mile}}$	Costs owned container vessel per 14 ton TEU/mile	$\left[\frac{\$}{14tonTEU \cdot mile}\right]$
$C_{oc_{ton/mile}}$	Costs owned container vessel per ton/mile	$\left[\frac{\$}{t \cdot mile}\right]$
C_{crew}	Crew costs	$[\$]$
C_{INS}	Insurance costs	$[\$]$
C_m	Midship coefficient	$[-]$
$C_{M\&R}$	Maintenance & repair costs	$[\$]$
C_{op}	Operation costs	$[\$ / \text{day}]$
C_p	Prismatic coefficient	$[-]$

$C_{\sup}$	Supplies and lubricant oils costs	$[\$]$
$C_{T/C}$	Time charter rate	$\left[\frac{\$}{day}\right]$
$C_{v_{co}}$	Capital costs owned container vessel per voyage	$[\$]$
$C_{v_{T/C}}$	Costs time chartered container vessel per voyage	$[\$]$
C_0	Investment costs	$[\$]$
CN	Cubic number	$[m^3]$
$Cov[X]$	Covariance	$[-]$
d	Differentiating parameter (Order of differentiating) (integer)	
D	Depth	$[m]$
D_p	Diameter propeller	$[m]$
dwt	Deadweight tonnage	$[t]$
$E[X]$	Mean	$[-]$
EM	Engine margin	$[\%]$
F_n	Froude number	$[-]$
fcm	Fuel consumption per mile	$\left[\frac{kg}{mile}\right]$
g	Gravitational constant	$\left[9,81\frac{m}{s^2}\right]$
GT	Gross Tonnage	$[m^3]$
h_b	Position of the vertical centre of the transverse area	$[m]$
H_0	Null hypothesis	$[-]$
H_1	One hypothesis	$[-]$

k	Lag or time span between observations	$[-]$
K_j	Import on container in zone j	
L	Likelihood	$[-]$
L_{oa}	Length over all	$[m]$
L_{pp}	Length between perpendiculars	$[m]$
LCB_{pp}	Longitudinal centre of buoyancy as a percentage of L_{pp}	$[-]$
LCB_{wl}	Longitudinal centre of buoyancy as a percentage of L_{wl}	$[-]$
l_1	Length of hull width erections	$[m]$
m_B	Mass of bunkers	$[t]$
$\dot{m}$	Mass flow rate	$\left[\frac{kg}{s}\right]$
$\dot{m}_f$	Mass flow rate of fuel	$\left[\frac{kg}{s}\right]$
$\dot{m}_{fi}$	Mass flow rate of fuel per interval	$\left[\frac{t}{h}\right]$
$\dot{m}_{fi_{design}}$	Mass flow rate of fuel per interval for the design condition	$\left[\frac{t}{h}\right]$
$M(x)$	Molecular mass element x	$\left[\frac{kg}{mol}\right]$
M	Amount of paths	$[-]$
$\dot{M}_f$	Fuel consumption per period	$[t]$
n	Amount of samples	$[-]$
n	Number of residuals that can be computed for a time series	$[-]$
N_{crew}	Number of crew	$[-]$

n_e	Engine speed	$\left[\frac{rev}{s}\right]$
$N_{p_{design}}$	Propeller speed at design condition	$[rpm]$
$nTEU$	Nominal TEU capacity container vessel	$[TEU]$
p	Order of polynomial ϕ (integer)	
$\hat{p}$	Probability of a future event	
p_B	Bunker price	$\left[\frac{\$}{t}\right]$
P_B	Brake power	$[kW]$
$P_{B_{design}}$	Brake power design condition	$[W]$
$P_{B,Max}$	Brake power at maximum continuous rating	$[kW]$
P_{CSR}	Power continuous service rating	$[W]$
P_{gen}	Generator power	$[kW]$
P_{MCR}	Engine power at maximum continuous rating	$[kW]$
q	Order op polynomial θ (integer)	$[-]$
R_i	Export of containers in zone I	$[-]$
sfc	Specific fuel consumption	$\left[\frac{g}{kWh}\right]$
T	Draft	$[m]$
T_a	Draft aft	$[m]$
$T_{av_{ballast}}$	Average draft in ballast	$[m]$
T_B	Bunker time	$[h]$
T_f	Draft fore	$[m]$

T_s	Summer draft	$[m]$
T_t	Tropical draft	$[m]$
T_{total}	Total time	$[h]$
T_w	Winter draft	$[m]$
$\dot{V}_B$	Volume flow bunkers	$\left[\frac{t}{h}\right]$
v_{ds}	Vessel design speed	$[kn]$
v_i	Vessel speed for a period I	$[kn]$
v_s	Vessel speed	$\left[\frac{m}{s}\right]$
$Var[X]$	Variance	$[-]$
$W_{m_{\sin gle\ screw}}$	Weight machinery of a single screw vessel	$[long\ tons]$
W_{sm}	Weight ship and machinery (light weight ship)	$[t]$
W_{st}	Weight steel	[t]
W_{TEU}	Weight TEUs	$[t]$
$W_{ballast}$	Weight ballast	$[t]$
$W_{consumables}$	Weight consumables	$[t]$
X	Design parameter	$[-]$
$\overline{x}$	Mean observed data	
x_i	A sample	$[-]$
x_{ij}	Numbers of containers from zone i to zone j	$[-]$
x_i	Input value power function	$[-]$
x_j	Input value quadratic function	$[-]$

X_t	Actual value, t =0, 1, 2,…, T (integer)	$[-]$
y	Observation vector	$[-]$
y_i	Observation value power function	$[-]$
y_j	Observation value quadratic function	$[-]$
$\bar{y}_i$	Mean observed data	$[-]$
$\hat{y}_i$	Predicted value	$[-]$
$14tonTEU$	14 ton TEU capacity container vessel	$[14tonTEU]$

Greek variables

β	Scale parameter	$[-]$
β_0	Regression coefficient quadratic function	$[-]$
β_1	Regression coefficient quadratic function	$[-]$
β_2	Regression coefficient quadratic function	$[-]$
Δ	Displacement weight	$[t]$
Δt_i	Time intervals	$[h]$
ε_i	Residual value	$[-]$
ε_t	Series of errors	$[-]$
η_{GB}	Gearbox efficiency	$[\%]$
η_S	Shaft efficiency	$[\%]$
μ	Linear trend term, mean	$[-]$
ρ_k	Autocorrelation at lag k	$[-]$
$\dot{\rho}_k$	Inverse autocorrelation at lag k	$[-]$
ρ_{salt}	Density salty water	$\left[\frac{kg}{m^3}\right]$
υ	Kinematic viscosity	$\left[\frac{m^2}{s}\right]$
σ	Stoichiometric air-fuel ratio	$\left[\frac{kg\ air}{kg\ diesel\ oil}\right]$
ϕ	Autoregressive operator	$[-]$
θ	Moving averages operator	$[-]$

Symbol variables

∇	Displacement volume	$\left[m^3\right]$
$\#14\,\mathrm{ton}\,TEU$	Amount of 14 ton TEU	$\left[14tonTEU\right]$

Glossary

180 CTS	Kinematic viscosity υ of this fuel is 180 centistokes, $\left[\frac{m^2}{s}\right]$
20DC	20 feet dry cargo
20FF	20 feet flat rack folding ends
20FR	20 feet flat rack fixed ends
20OT	20 feet open top
20RF	20 feet reefer
380 CTS	Kinematic viscosity (υ) of this fuel is 380 centistokes, $\left[\frac{m^2}{s}\right]$
40DC	40 feet dry cargo
40FF	40 feet flat rack folding ends
40HC	40 feet high cube
40HR	40 feet high cube reefer
40OT	40 feet open top
40PF	40 feet platform
40RF	40 feet reefer
ACF	Autocorrelation Function
ACL	Atlantic Container Lines
AIC	Akaike Information Criterion
ANL	Australian National Line
ARIMA	Autoregressive Integrated Moving Averages
BAF	Bunker Adjustment Factor
bg	Barge - Container Carrier
C	Carbon

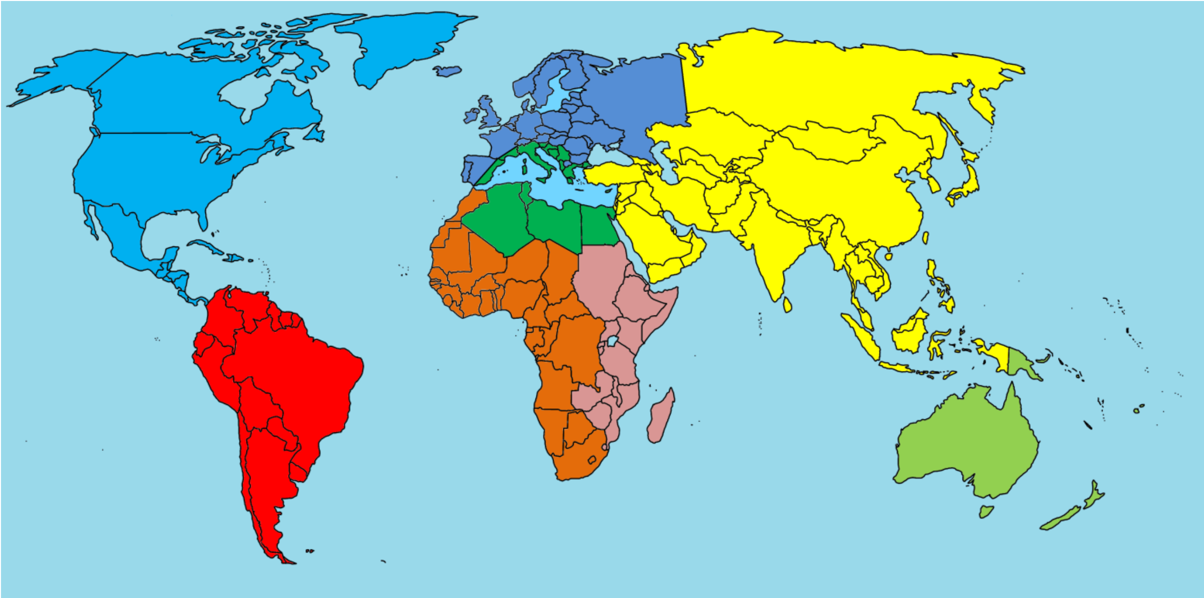
Carrier	Carriers transport the containers booked by their clients via their owned and/or chartered vessels active in their liner services to West Africa or they use a thirth party via for example a vessels sharing agreement or slot agreement to transport the containers booked by their clients via a liner service to West Africa.
cb	ConBulker
cc	Container Carrier
cc/h	Container Carrier / Cellular (semi - hatchless)
cc/o	Container Carrier Overpanamax - 17 rows
cc/v	Container Carrier / Cellular (Sub-Panamax VLCS - 17 rows)
CMA CGM	Companie Maritime d'Affrètement – Companie Générale Maritime
CNC Line	Cheng Lie navigation Company
CoMaNav	Companie Marocaine de Navigation
ConRo	Combination between a Roll-on/roll-of vessel and container vessel
cr	Container RoRo vessel (ConRo) - one cellular hold forward
CSAV	Compania Sud Americana de Vapores
CSCL	China Shipping Container Lines Co
DAL	Deutsche Afrika-Linien
DIE	Discharged Empty
DIF	Discharged Full
ECSA	East coast South America
FEWA	Far East – West Africa
First leg	Liner services serving West Africa directly.
GIE	Gate in Empty
GIF	Gate in Full
GOE	Gate out Empty
GOF	Gate out Full
gr	Multipurpose / Conventional (RoRo auxiliary access)

H	Hydrogen
IACF	Inverse Autocorrelation Function
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
IMTC	International Maritime Transport Corporation.
ISPS	International Ship and Port Facility Security
ITTC-Line	International Towing Tank Conference Line
K Line	Kawasaki Kisen Kaisha Ltd.
KPI	Key Performance Indicators
Lump sum	A single payment for the total amount due, as opposed to a series of periodic payments.
Long-term	Longer than one year
MACS	Maritime Carrier Shipping Center GmbH & Co.
MCC	Mercantile Cargo Consolidators
MCR	Maximum Continuous Rating
MCSE	Monte Carlo error
MDO	Marine Diesel Oil
MOL	Mitsui Osaka Shosen Kaisha Lines
mp	Multipurpose Box
mr	Multipurpose Box - RoRo access to main deck only - cargo hatches on upper deck - no lower hold
MSC	The Mediterranean Shipping Company
MSFE	Mean square forecast error
NYK Line	Nippon Yusen Kabushiki Kaisha Line
O	Oxygen
OACL	Ocean Africa Container Line
OLS	Ordinary Least squares
OPDR	Oldenburg – Portugiesische Dampschiffahrts Reederei

Operator	Operators transport the containers booked by their clients via their owned and/or chartered vessels active in their liner services to West Africa.
OTAL	OT Africa Line
PACF	Partial Autocorrelation Function
PDL	Pacific Direct Line
PEL	Pacific Eagle Line
PIL	Pacific International Lines
PTLEI	Portugal, Leixoes
PTLIS	Portugal, Lisbon
RMSE	Root Mean Squared Error
ro	RoRo Cargo vessel - hatchless
S	Sulphur
Sea margin	A powering margin defined as the margin which should be added to the estimation of the speed-power relationship for a newly built ship in ideal weather conditions to allow for the operation of the ship in realistic conditions.
Second leg	Liner services serving West Africa by the use of two liner services via a transshipments port.
Short-term	Shorter than one year
SBIC	Schwarz Bayesian Information Criterion
SOL	Swedish Orient Line
Stripping	Offloading the goods out of the container
Stuffing	Loading the container with goods
SWAX	South – West Africa Express
TAZ	Traffic analysis zones
THC	Terminal Handling Charge
UAL	Universal Africa Line
UASC	United Arab Shipping Company

US Lines	United States Lines
VACS	Van Uden Atlas service
vc	Vehicle Carrier
WAF1	West Africa feeder 1
WAF2	West Africa feeder 2
WEC Lines	West European Container Lines
X	Total containers

Appendix A : Regions defined



Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

A.1 Asia

Asia is defined by the next countries: Afghanistan, Armenia, Bahrain, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Christmas Islands, Cocos (Keeling) Islands, Dem. People’s Rep. Korea, East Timor, Georgia, Hong Kong, India, Indonesia, Iraq, Islamic Republic of Iran, Japan, Jordan, Kazakstan, Korea, Kuwait, Kyrgyzstan, Lao People's Democratic Rep., Macau, Malaysia, Maldives, Mongolia, Myanmar (Former Burma), Nepal, Oman, Pakistan, Philippines, Qatar, Russian Federation (East), Saudi Arabia, Singapore, Sri Lanka, Taiwan, Province Of China, Tajikistan, Thailand, Turkmenistan, United Arab Emirates, Uzbekistan, Viet Nam, and Yemen.

A.1.1 Far East

Asia is defined by the next countries: Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Christmas Islands, Cocos (Keeling) Islands, Dem. People's Rep. Korea, East Timor, Hong Kong, India, Indonesia, Japan, Korea, Lao People's Democratic Rep., Macau, Malaysia, Maldives, Mongolia, Myanmar (Former Burma), Nepal, Philippines, Russian Federation (East), Singapore, Sri Lanka, Taiwan, Province Of China, Thailand, and Viet Nam.

A.1.2 Middle East

Afghanistan, Armenia, Bahrain, Georgia, Iraq, Islamic Republic of Iran, Israel, Jordan, Kazakstan, Kuwait, Kyrgyzstan, Lebanon, Oman, Pakistan, State of Palestine, Qatar, Saudi Arabia, Syria, Tajikistan, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan, and Yemen.

A.2 East Africa

Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mayotte, Mozambique, Réunion, Rwanda, Seychelles, Somalia, South Sudan, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

A.3 Europe

Europe is defined by the next countries: Andorra, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Færø Islands, Finland, France (North), Germany, Hungary, Iceland, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Former Yugoslavian Rep of Macedonia., Moldova, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation (West), San Marino, Slovakia, Spain (North), Svalbard and Jan Mayen, Sweden, Switzerland, Ukraine, United Kingdom and Vatican City State.

A.4 The Mediterranean

The Mediterranean are defined by the next countries: Albania, Algeria, Bosnia-Hercegovina, Croatia, Cyprus, Egypt, France (South), Gibraltar, Greece, Israel, Italy, Lebanon, Libyan Arab Jamahiriya, Malta, Monaco, Slovenia, Spain (South), Syrian Arab Republic, Tunisia, Turkey, and Federal Republic of Yugoslavia.

A.5 North America

North America is defined by the next countries: Anguilla, Antigua And Barbuda, Aruba, Barbados, Belize, Canada, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Greenland, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, Puerto Rico, Saint Lucia, St Kitts-Nevis, St Vincent And Grenadines, St. Pierre And Miquelon, Trinidad And Tobago, Turks And Caicos Islands, United States, United States Virgin Islands, Us Minor Outlying Islands, and British Virgin Islands.

A.6 Oceania

Oceania is defined by next countries: Australia, Fiji, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, New Zealand, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

A.7 South America

South America is defined by the next countries: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Falkland Islands (Malvinas), French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, and Venezuela.

A.8 West Africa

West Africa is defined by the next countries: Angola, Benin, Botswana, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Congo, Cote d'Ivoire, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Lesotho, Liberia, Mali, Mauritania, Morocco, Namibia, Niger, Nigeria, São Tomé and Principé, Senegal, Sierra Leone, South Africa, St. Helena, Tchad, Togo, and Western Sahara.

Appendix B : Duration of rotation calculations

Table 67: Duration of rotation calculation: Maersk / Safmarine - West Africa services (extra sailors)

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Tangier						
Algeciras	32	16	0,08		1	1,08
Lagos - Apapa	3074	16	8,01	2	2	12,01
Lagos - Tincan	3	16	0,01	2	2	4,01
Cotonou	67	16	0,17	5	2	7,17
Tangier	2989	16	7,78		1	8,78
Total						**15,95**

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 68: Duration of rotation calculation: CMA CGM / CoMaNav / IMTC - France - Morocco 'RoRo Med Line'

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Marseille						
Sete	75	16	0,2		1	1,2
Casablanca	849	16	2,21		1	3,21
Tangier	171	16	0,44		1	1,44
Marseille	719	16	1,87		1	2,87
Total						**4,31**

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 69: Duration of rotation calculation: CoMaNav / IMTC - Cadiz - Casablanca RoRo services

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Cadiz						
Casablanca	188	16	0,49		1	1,49
Cadiz	188	16	0,49		1	1,49
Total						**2,98**

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 70: Duration of rotation calculation: Delmas - West Africa feeders 1

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Abidjan					1	
Onne	702	16	1,83		2,5	4,33
Libreville	307	16	0,8	7,5	2,5	10,8
Malabo	228	16	0,59	3	2,5	6,09
San Pedro	929	16	2,42	2	2,5	6,92
Abidjan	171	16	0,45	1	1	2,45
Total						**9,37**

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 71: Duration of rotation calculation: Delmas - West Africa feeders 2

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Abidjan						
Bata	853	16	2,22		1	3,22
Takoradi	712	16	1,85	1	1	3,85
Abidjan	152	16	0,4	2	1,5	3,9
Total						7,75

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 72: Duration of rotation calculation: Delmas - West Africa feeders 3

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Pointe Noire						
Matadi	159	16	0,41	3	2	5,41
Boma	30	16	0,08		1	1,08
Soyo	47	16	0,12		1	1,12
Banana	7	16	0,02		1	1,02
Pointe Noire	92	16	0,24	3,5	2,5	6,24
Total						7,26

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 73: Duration of rotation calculation: Delmas - West Africa feeders 4

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Pointe noire						
Cabina	55	16	0,14		1	1,14
Pointe Noire	55	16	0,14	3,5	2,5	6,14
Total						7,28

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 74: Duration of rotation calculation: Bolunda Lines - Canary - West Africa service (Mauretania and Senegal)

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Las Palmas						
Nouakchott	637	16	1,66	2,5	2	6,16
Nouadhibou	189	16	0,49		2	2,49
Dakar	399	16	1,04		2	3,04
Agadir	1113	16	2,9		2	4,9
Las Palmas	335	16	0,87		1	1,87
Total						6,77

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 75: Duration of rotation calculation: Lin Lines - Portugal - Africa services

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Lisbon						
Leixoes	176	16	0,46		1	1,46
Sao Tome	3468	16	9,03		2	11,03
Cabina	485	16	1,26		1	2,26
Luanda	220	16	0,57		2,5	3,07
Lobito	246	16	0,64		3	3,64
Namibe	210	16	0,55		1	1,55
Lisbon	4065	16	10,59		1	11,59
Total						13,14

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 76: Duration of rotation calculation: EuroAfrica - United West Africa Liner service (UWAS) - multipurpose liner service

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Tallinn						
Kaliningrad	396	16	1,03		1	2,03
Gdynia	74	16	0,19		1	1,19
Dakar	3386	16	8,82		2	10,82
Abidjan	1131	16	2,94	2	1,5	6,44
Tema	267	16	0,7	2	2,5	5,2
Takoradi	121	16	0,31	1	1	2,31
Lagos	328	16	0,85	2	2	4,85
Tallinn	5014		13,06		1	14,06
Total						18,91

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 77: Duration of rotation calculation: Universal Africa Line (UAL) - Europe-West Africa multipurpose service

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Bremen						
Rotterdam	281	16	0,73		1	1,73
Moerdijk	25	16	0,06		1	1,06
Aberdeen	409	16	1,07		1	2,07
Antwerp	447	16	1,16		1	2,16
Leixoes	920	16	2,4	1	2	5,4
Lisbon	176	16	0,46	2	1	3,46
Port Hartcourt	3340	16	8,7		2	10,7
Malabo	147	16	0,38	3	2	5,38
Luba	37	16	0,1		2	2,1
Pointe Noire	590	16	1,54	2	2	5,54
Port Gentil	353	16	0,92		2	2,92
Soyo	431	16	1,12	2	2	5,12
Luanda	196	16	0,51	2	2	4,51
Lobito	246	16	0,64	1,5	2	4,14
Cabinda	428	16	1,11	2	2	5,11
Bremen	5016	16	13,06		1	14,06
Total						**19,17**

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 78: Duration of rotation calculation: MSC - Nigeria & Ghana feeder

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Las Palmas						
Lagos	2404	16	6,26	2	2	10,26
Takoradi	328	16	0,85	1	1	2,85
San Pedro	300	16	0,78	2	2,5	5,28
Las Palmas	1793	16	4,67		1	5,67
Total						**10,95**

Source: Netpas Distance and NileDutch Operations department (25/05/2012)

Table 79: Duration of rotation calculation: CoMaNav / IMTC - Cadiz - Casablanca service

Port	Distance (Miles)	speed (Knots)	Days at Sea	Congestion (Days)	Days in Port	Total days
Cadiz						
Casablanca	188	16	0,49		1	1,49
Cadiz	188	16	0,49		1	1,49
Total						**2,98**

Source: Netpas Distance and NileDutch Operations department (25/05/201)

Appendix C : First leg ports, transshipment ports, and second leg ports

Per liner service, the port rotation schedules of the first leg ports, the transshipment ports, and the second leg ports are displayed in Table 82 to Table 115. They are sorted per subcontainer liner service and per trade and are ranked according to their annually TEU capacity.

C.1 Asia – East Africa – West Africa

C.1.1 Container liner services

Table 80: Port rotation schedule first leg ports: Asia – East Africa - West Africa: Container liner services 2011

Container liner services				First leg ports																													
				Asia															East Africa				West Africa										
				China	China	China	China	China	China	China	Hong Kong	India	Malaysia	Malaysia	Malaysia	Singapore	Sri Lanka	Taiwan	Madagascar	Mauritius	Mozambique	Réunion	Angola	Ghana	Ivory Coast	Namibia	Nigeria	Nigeria	South Africa	South Africa	South Africa	South Africa	Togo
	Liner services	Carrier	Operator	Chiwan	Fuzhou	Ningbo	Qingdao	Shanghai	Xiamen	Yantian	Hong Kong	Cochin	Pasir Gudang	Port Kelang	Tanjong Pelepas	Singapore	Colombo	Kaohsiung	Taomasina	Port Louis	Maputo	Le Port	Luanda	Tema	Abidjan	Walvis Bay	Lagos-Apapa	Lagos-Tincan	Cape Town	Durban	Ngqura	Port Elizabeth	Lomé
1	Safari Loop 1	Maersk Line / Safmarine / slots : Hamburg Süd	Maersk Line			2		1, 11		3	10				4, 9					8									7	5		6	
2	Cheetah	MSC	MSC	4					1, 12		3, 11					5, 10		2		6, 9										7	8		
3	WAX II	CMA CGM / Slots : Delmas	CMA CGM	5	4	3	1, 18	2				15		6, 17			16					7		10	14	9	11	12		8			13
4	Safari Loop 3	Maersk Line / Safmarine	Maersk Line												1, 6				4	2	5	3											
5	ALS	PIL	PIL										1, 7			2					3		6						5	4			

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each container liner service.

Table 81: Transshipment ports and second leg ports: Asia – East Africa - West Africa: Container liner services 2011

Container liner services

	Liner services	Carrier	Operator	T/S	T/S Asia: Malaysia	T/S Asia: Singapore	T/S EA: Mauritius
				Transhipment port unknown	Tanjong Pelepas	Singapore	Port Louis
1	**Safari Loop 1**	Maersk Line / Safmarine / slots : Hamburg Süd	Maersk Line	X	X		X
2	**Cheetah**	MSC	MSC	X		X	
3	**WAX II**	CMA CGM / Slots : Delmas	CMA CGM	X			
4	**Safari Loop 3**	Maersk Line / Safmarine	Maersk Line		X		
5	**ALS**	PIL	PIL			X	

	Liner services	Asia: China	China	China	China	China	China	China	China	China	China	Hong Kong	Japan	Japan	Japan	Japan
		Chiwan	Dalian	Nansha	Ningbo	Qingdao	Shanghai	Shekou	Xiamen	Xingang-Tianjin	Yantian	Hong Kong	Kobe	Osaka	Tokyo	Yokohama
1	**Safari Loop 1**												🔴	🔴	🔴	🔴
2	**Cheetah**												🔴	🔴	🔴	🔴
3	**WAX II**	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴				
4	**Safari Loop 3**															
5	**ALS**															

	Liner services	Asia: Korea	Korea	Malaysia	Malaysia	Oman	Saudi Arabia	South Asia	South China	South East Asia	United Arab Emirates	Viet Nam	EA: Madagascar	Réunion
		Busan	Kwangyang	Port Kelang	Tanjong Pelepas	Salalah	Jeddah	South Asia	South China	South East Asia	Khor Al Fakkan	Vung Tau	Taomasina	Le Port
1	**Safari Loop 1**	🔴				🟢		🟡		🟡			🟢	🟢
2	**Cheetah**	🔴						🟣		🟣				
3	**WAX II**	🔴	🔴	🔴	🔴		🔴				🔴	🔴		
4	**Safari Loop 3**							🟡		🟡				
5	**ALS**								🟣	🟣				

Source: Alphaliner (29/04/2011 and 02/05/2011)

The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Abbreviations:

EA: East Africa, WA: West Africa, T/S: Transshipment ports

Colour code dots: 🟡 **: Tanjong Pelepas** 🔴 **: Transshipment port unknown** 🟣 **: Singapore** 🟢 **: Port Louis**

C.2 Asia - South America - West Africa

C.2.1 Container liner services

Table 82: Port rotation schedule first leg ports: Asia - South America - West Africa: Container liner services 2011

	Container liner services			First leg ports																				
				Asia										South America							West Africa			
				China	China	China	China	Hong Kong	Japan	Japan	Korea	Malaysia	Singapore	Argentina	Brazil	Brazil	Brazil	Brazil	Brazil	Uruguay	South Africa	South Africa	South Africa	South Africa
	Liner services	Carrier	Operator	Dalian	Qingdao	Shanghai	Xingang-Tianjin	Hong Kong	Nagoya	Yokohama	Busan	Tanjong Pelepas	Singapore	Buenos Aires	Navegantes	Paranagua	Rio de Janeiro	Santos	São Francisco do Sul	Montevideo	Cape Town	Durban	Ngqura	Port Elizabeth
1	ASAS 1 / NGX 1	Maersk Line / Hamburg Süd / slots : Safmarine	Hamburg Süd / Maersk Line			4		5, 19	1, 20	2	3	6	7, 18	11	13	14	9, 12	10, 15				8, 17		16
2	CSW	MOL / Slots: Hamburg Süd	MOL	2	3	5	1, 21	6, 20			4		7, 19	11		13	16	10, 15	14	12	17	9	8, 18	

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each container liner service.

Table 83: Transshipment ports and second leg ports: Asia - South America - West Africa: Container liner services 2011

	Container liner services			T/S	Second leg ports							
				AS	Asia							
				Singapore	China	Hong Kong	Japan	Japan	Japan	Japan	Malaysia	Singapore
	Liner services	Carrier	Operator	Singapore	Shenzhen	Hong Kong	Kobe	Nagoya	Tokyo	Yokohama	Port Kelang	Singapore
1	ASAS 1 / NGX 1	Maersk Line / Hamburg Süd / slots : Safmarine	Hamburg Süd / Maersk Line									
2	CSW	MOL / Slots: Hamburg Süd	MOL	X	●	●	●	●	●	●	●	●

Source: Alphaliner (29/04/2011 and 02/05/2011) The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: ●: Singapore

Abbreviations:

AS: Asia, T/S: Transshipment ports

C.3 Asia – West Africa

C.3.1 Container liner services

Table 84: Port rotation schedule first leg ports: Asia - West Africa: Container liner services 2011

Container liner services; First leg ports – Asia

				China	China	China	China	China	China	China	China	China	China	China	Hong Kong	India	India	India	Islamic Republic Of Iran	Korea	Korea	Malaysia	Malaysia	Malaysia	Pakistan	Saudi Arabia	Singapore	Sri Lanka	Taiwan	Taiwan	United Arab Emirates	United Arab Emirates
	Liner services	Carrier	Operator	Chiwan	Fuzhou	Nansha	Ningbo	Qingdao	Shanghai	Shantou	Shekou	Shenzhen	Xiamen	Xingang-Tianjin	Hong Kong	Cochin	Mumbai	Mundra	Bandar Abbas	Inchon	Kwangyang	Pasir Gudang	Port Kelang	Tanjong Pelepas	Karachi	Jeddah	Singapore	Colombo	Keelung	Taichung	Jebel Ali	Khor Al Fakkan
1	FEW 2	Safmarine / Maersk Line	Maersk Line																				1, 9	2								
2	New Discovery	CSAV	CSAV	4			3		2					1, 10	5												6, 9					
3	UAEISAS	MSC	MSC														4	3							2			5			1, 7	
4	ASA	PIL / K Line / Slots: Hanjin Shipping	K Line / PIL				2		1, 13		5				4, 12								7, 10				6, 11		3			
5	Marco Polo II	CSAV	CSAV														3	4							2						1, 7	
6	MEW 1	Maersk Line	Maersk Line																							2					1, 8	
7	FEW 1	Safmarine / Maersk Line	Maersk Line			3	2		1, 10						4									5, 9								
8	FEW 3	Safmarine / Maersk Line	Maersk Line		11	3, 10	1, 12								2									4, 9								
9	MESA	Safmarine / Maersk Line	Maersk Line														3		2												1, 6	
10	WAX / WSX	CSCL / K Line / Hapag-Lloyd	CSCL / Hapag-Lloyd / K Line				2		1, 13		4		3										5, 12									
11	SW2	PIL	PIL		3	7				5			4		1, 6, 18							17					8, 16			2		
12	SWS	PIL	PIL				4		5					1, 15						2	3	13					6, 14					
13	ASAF	Delmas	CMA CGM / Delmas	4			1, 10		2						3								6, 9				5					
14	MIDAS	Delmas	CMA CGM / Delmas														2	1, 13													4	3
15	FAX	Gold Star Line / Slots: Zim	Gold Star Line				2		1, 13			3											4, 12					5, 11				
16	SWAX[b]	NYK Line / NileDutch	NileDutch / NYK Line				2		1, 13		3																4, 12					
17	FEWA[b]	NileDutch	NileDutch				4	2	3		5			1, 16													6, 15					
18	AMI	Laurel / PIL / Slots: Zim / Gold Star Line	Gold Star Line / PIL														3	2							1, 10						4	
19	AFEX	CMA CGM / Delmas	CMA CGM	3						1, 12					2	10							4, 11									

First leg ports – West Africa

		Angola	Angola	Angola	Benin	Cameroon	Congo	Ghana	Ghana	Ivory Coast	Morocco	Namibia	Nigeria	Nigeria	Nigeria	Senegal	South Africa	South Africa	South Africa	Togo
	Liner services	Lobito	Luanda	Namibe	Cotonou	Douala	Pointe Noire	Takoradi	Tema	Abidjan	Tangier	Walvis Bay	Lagos-Apapa	Lagos-Tincan	Onne	Dakar	Cape Town	Durban	Port Elizabeth	Lomé
1	FEW 2								5	4		3, 7	6					8		
2	New Discovery																8	7		
3	UAEISAS																	6		
4	ASA																9	8		
5	Marco Polo II																6	5		
6	MEW 1					6					3			5		4		7		
7	FEW 1				7													8		6
8	FEW 3					8	5							6	7					
9	MESA																	5	4	
10	WAX / WSX				9				7					10				6, 11		8
11	SW2						10			11			13		14			9, 15		12
12	SWS				9	11			8				10				7	12		
13	ASAF		8				7													
14	MIDAS		6				7		11	12		5	8	9						10
15	FAX							9	7	10				8				6		
16	SWAX[b]				10				8				9				6	5, 11		7
17	FEWA[b]	10	11	9			12										8, 13	7, 14		
18	AMI				8				7				6					5, 9		
19	AFEX				7, 9	8						5								6

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The numbers represent the order of ports of call in the port rotation schedule.

Table 85: Transshipment ports and second leg ports: Asia - West Africa: Container liner services 2011

Container liner services / T/S (transshipment ports)

#	Liner services	Carrier	Operator	T/S: Transhipment port unknown	T/S Asia: Singapore – Singapore	T/S Asia: United Arab Emirates – Jebel Ali	T/S WA: Congo – Pointe Noire
1	FEW 2	Safmarine / Maersk Line	Maersk Line				
2	New Discovery	CSAV	CSAV				
3	UAEISAS	MSC	MSC				
4	ASA	PIL / K Line / Slots: Hanjin Shipping	K Line / PIL		X		
5	Marco Polo II	CSAV	CSAV				
6	MEW 1	Maersk Line	Maersk Line				
7	FEW 1	Safmarine / Maersk Line	Maersk Line				
8	FEW 3	Safmarine / Maersk Line	Maersk Line				
9	MESA	Safmarine / Maersk Line	Maersk Line			X	
10	WAX / WSX	CSCL / K Line / Hapag-Lloyd	CSCL / Hapag-Lloyd / K Line				
11	SW2	PIL	PIL				
12	SWS	PIL	PIL	X			
13	ASAF	Delmas	CMA CGM / Delmas	X	X		
14	MIDAS	Delmas	CMA CGM / Delmas	X			
15	FAX	Gold Star Line / Slots: Zim	Gold Star Line				
16	SWAX[b]	NYK Line / NileDutch	NileDutch / NYK Line				
17	FEWA[b]	NileDutch	NileDutch				X
18	AMI	Laurel / PIL / Slots: Zim / Gold Star Line	Gold Star Line / PIL				
19	AFEX	CMA CGM / Delmas	CMA CGM				

Second leg ports – Asia

#	Liner services	Asia – China	India – Kandla	Indonesia – Jakarta	Japan – Japan	Japan – Kobe	Japan – Osaka	Japan – Tokyo	Japan – Yokohama	Korea – Busan	Malaysia – Port Kelang	Philippines – Manila	Singapore – Singapore	South East Asia – South East Asia	Sri Lanka – Colombo	Thailand – Bangkok	Viet Nam – Ho Chi Minh City
1	FEW 2																
2	New Discovery																
3	UAEISAS																
4	ASA																
5	Marco Polo II																
6	MEW 1																
7	FEW 1																
8	FEW 3																
9	MESA																
10	WAX / WSX																
11	SW2																
12	SWS	🔴			🔴									🔴			
13	ASAF			🔴		🔴	🔴	🔴	🔴	🔴	🟣	🔴	🟣		🟣 🔴	🔴	🔴
14	MIDAS		🔴														
15	FAX																
16	SWAX[b]																
17	FEWA[b]																
18	AMI																
19	AFEX																

Second leg ports – East Africa, EU, NA, Oceania, West Africa

#	Liner services	East Africa: Kenya – Mombasa	East Africa: United Republic of Tanzania – Dar Es Salaam	East Africa: United Republic of Tanzania – Tanga	EU: Europe – Europe	NA: Canada – Victoria	Oceania: Australia – Australia	Oceania: New Zealand – New Zealand	West Africa: Angola – Cabinda	West Africa: Angola – Soyo	West Africa: Benin – Cotonou	West Africa: Cameroon – Douala	West Africa: Democratic Republic of the Congo – Boma	West Africa: Democratic Republic of the Congo – Matadi	West Africa: Gabon – Libreville	West Africa: Gabon – Port Gentil	West Africa: Nigeria – Onne
1	FEW 2																
2	New Discovery																
3	UAEISAS																
4	ASA						🟣	🟣									
5	Marco Polo II																
6	MEW 1																
7	FEW 1																
8	FEW 3																
9	MESA				🟢												
10	WAX / WSX																
11	SW2																
12	SWS						🔴	🔴									
13	ASAF	🟣	🟣	🟣		🟣								🔴	🔴		🔴
14	MIDAS										🔴	🔴		🔴	🔴	🔴	
15	FAX																
16	SWAX[b]																
17	FEWA[b]								🔵	🔵		🔵	🔵	🔵	🔵		
18	AMI																
19	AFEX																

Source: Alphaliner (29/04/2011 and 02/05/2011)

🟠 : NileDutch's container liner services

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: 🟡 : Tanjong Pelepas 🔴 : Transshipment port unknown 🟣 : Singapore ● : Rio de Janeiro ● : Port Louis 🔵 : Pointe Noire 🟢 : Jebel Ali

Abbreviations: EA: East Africa, WA: West Africa

C.3.2 Multipurpose liner services

Table 86: Port rotation schedule first leg ports: Asia - West Africa: Multipurpose liner services 2011

Multipurpose liner services				First leg ports																			
				Asia						West Africa													
				China	China	China	China	China	Singapore	Angola	Angola	Angola	Congo	Democratic Republic of the Congo	Equatorial Guinea	Equatorial Guinea	Gabon	Gabon	Ghana	Liberia	Nigeria	Nigeria	South Africa
	Liner services	Carrier	Operator	Longkou	Qingdao	Shanghai	Xingang-Tianjin	Zhangjiagang	Singapore	Lobito	Luanda	Soyo	Pointe Noire	Matadi	Bata	Malabo	Libreville	Port Gentil	Tema	Monrovia	Lagos	Port Harcourt	Richards Bay
1	EASWAMS	PIL	PIL	3	4	5	2	1, 14			12				11		8		9	10	6	7	13
2	CWABS	Safmarine / Maersk Line	Safmarine			2	1, 11		3	4	7	6	9	8		5		10					

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each multipurpose liner service.

C.4 Europe – West Africa

C.4.1 Container liner services

Table 87: Port rotation schedule first leg ports: Europe- West Africa: Container liner services 2011

Container liner services				First leg ports: Europe																		
	Liner services	Carrier	Operator	Belgium Antwerp	France Dunkerque	France Le Havre	France Montoir de Bretagne	France Rouen	Germany Bremerhaven	Germany Hamburg	Netherlands Rotterdam	Portugal Leixoes	Portugal Lisbon	Portugal Setubal	Spain Algeciras	Spain Vigo	Sweden Helsingborg	United Kingdom Felixstowe	United Kingdom Liverpool	United Kingdom Portsmouth	United Kingdom Thamesport	United Kingdom Tilbury
1	ESAS	MSC / slots: Hapag-Lloyd / Stiness Linien	MSC	4		5				3	2							1, 13				
2	SAECS	Safmarine / Maersk Line / MOL / DAL / slots: SOL	DAL / Maersk Line / MOL / Safmarine						3		1, 10											2
3	WAF2	Safmarine / Maersk Line	Maersk Line / Safmarine												1, 6							
4	EURAF	Delmas	CMA CGM / Delmas	1, 11		2	3															
5	WAF1	Safmarine / Maersk Line	Maersk Line												1, 5							
6	WAF3	Safmarine / Maersk Line	Maersk Line												1, 6							
7	WAF6	Safmarine / Maersk Line	Maersk Line / Safmarine	2	1, 12	5					4				6, 11			3				
8	(WAF) (HL:MWX)	UASC / Hanjin Shipping / MOL / Slots: Hapag-Lloyd	Hanjin Shipping												1, 6							
9	WAF8	Safmarine / Maersk Line	Maersk Line / Safmarine												1, 5							
10	WANRF	MSC	MSC																			
11	NIGEX	Delmas	CMA CGM / Delmas	3						1, 9												2
12	NEWAS	MSC	MSC	1, 12		3												2				
13	ARN / WAX / NAF	MOL / Hapag-Lloyd / Zim	Hapag-Lloyd / MOL / Zim	1, 4, 8						2											3	
14	Battuta Express	Delmas	CMA CGM																			
15	WAF5	Safmarine / Maersk Line	Maersk Line									2	4		1, 5, 10	3						
16	Agadir Express	CMA CGM	CMA CGM		1, 7	3					2									6		
17	WEWA[b]	NileDutch	NileDutch	1, 10		2						3	4									
18	WAF7	Safmarine / Maersk Line	Maersk Line												1, 7							
19	Angola Loop	Safmarine / Maersk Line	Maersk Line / Safmarine												2							
20	CES[a]	CMA CGM / OPDR / CoMaNav / IMTC / VACS	CMA CGM / OPDR	1, 6	3			4			2											
21	EAS	Delmas / Slots: Marfret	CMA CGM									1, 9	2			3						
22	KNSM	Maersk Line	Maersk Line	4					1, 3, 8		7						2					
23	PAS[a]	Lin Lines	Lin Lines									2	1, 8									
24	Guiver Line	Portline	Portline			2					1, 11	3		4, 10								
25	WAF9	Safmarine / Maersk Line	Safmarine									2		3	1, 9							
26	WAS[a]	Safmarine / Maersk Line	Safmarine												2							
27	WAB	Bacoliner	Bacoliner	4				5		1, 15									3			2
28	Africa expresso	Transinsular / Slots: Portline / MSC	Transinsular									6	1, 7									

Container liner services		First leg ports: West Africa													
	Liner services	Angola Cabinda	Angola Lobito	Angola Luanda	Angola Namibe	Benin Cotonou	Cameroon Douala	Cape Verde Mindelo	Cape Verde Praia	Cape Verde São Vicente	Congo Pointe Noire	Gabon Libreville	Gambia Banjul	Ghana Takoradi	Ghana Tema
1	ESAS														
2	SAECS														
3	WAF2										4				
4	EURAF					8									
5	WAF1													4	3
6	WAF3														
7	WAF6					9	10								
8	(WAF) (HL:MWX)					5									3
9	WAF8												4		
10	WANRF														
11	NIGEX														5
12	NEWAS														6
13	ARN / WAX / NAF														7
14	Battuta Express												4		
15	WAF5			7											
16	Agadir Express														
17	WEWA[b]		8	7	9						6				5
18	WAF7														
19	Angola Loop		4	3								5			
20	CES[a]														
21	EAS		7	6	8						5				
22	KNSM														
23	PAS[a]	4	6	5	7										
24	Guiver Line								7	6			8		
25	WAF9							5	6						
26	WAS[a]					5									
27	WAB													11	
28	Africa expresso								4	3					

Container liner services		First leg ports: West Africa												
	Liner services	Guinea Conakry	Guinea-Bissau Bissau	Ivory Coast Abidjan	Ivory Coast San Pedro	Liberia Monrovia	Mauritania Nouadhibou	Mauritania Nouakchott	Morocco Agadir	Morocco Casablanca	Morocco Tangier	Namibia Walvis Bay	Nigeria Lagos	Nigeria Lagos-Apapa
1	ESAS													
2	SAECS													
3	WAF2			3							2			
4	EURAF	6		9							4			
5	WAF1										2			
6	WAF3										2			3
7	WAF6										7			8
8	(WAF) (HL:MWX)										2		4	
9	WAF8							3			2			
10	WANRF	4					3	2						
11	NIGEX			8							4			6
12	NEWAS			9	10									7
13	ARN / WAX / NAF													
14	Battuta Express					6		2		7	1, 8			
15	WAF5				9						6	8		
16	Agadir Express								5	4				
17	WEWA[b]													
18	WAF7	3, 6				5					2			
19	Angola Loop										1, 6			
20	CES[a]									5				
21	EAS										4			
22	KNSM								6	5				
23	PAS[a]													
24	Guiver Line		9											
25	WAF9		7				8				4			
26	WAS[a]										1, 6			3
27	WAB	8		10	9		6	7						12
28	Africa expresso		5											

Container liner services		First leg ports: West Africa												
	Liner services	Nigeria Lagos-Tincan	Nigeria Onne	Nigeria Port Harcourt	Nigeria Warri	São Tomé and Principé São Tomé and Principé	Senegal Dakar	Sierra Leone Freetown	South Africa Cape Town	South Africa Durban	South Africa Ngqura	South Africa Port Elizabeth	Spain Las Palmas	Togo Lomé
1	ESAS								7, 11	9	8, 10		6, 12	
2	SAECS								5, 8	7		6	4, 9	
3	WAF2													5
4	EURAF						5, 10							7
5	WAF1													
6	WAF3		4				5							
7	WAF6													
8	(WAF) (HL:MWX)													
9	WAF8													
10	WANRF												1, 5	
11	NIGEX	7												
12	NEWAS	8					5						4, 11	
13	ARN / WAX / NAF	6					5							
14	Battuta Express						3	5						
15	WAF5													
16	Agadir Express													
17	WEWA[b]													
18	WAF7							4						
19	Angola Loop													
20	CES[a]													
21	EAS													
22	KNSM													
23	PAS[a]					3								
24	Guiver Line												5	
25	WAF9													
26	WAS[a]	4												
27	WAB			14	13									
28	Africa expresso												2	

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The numbers represent the order of ports of call in the port rotation schedule, and the orange colour represents NileDutch.

Table 88: Transshipment ports and second leg ports: Europe - West Africa: Container liner services 2011 (1)

No	Liner services	Carrier	Operator	Transhipment port unknown	Europe / Germany / Hamburg	Europe / Portugal / Lisbon	Europe / Spain / Algeciras	West Africa / Congo / Pointe Noire	West Africa / Morocco / Tangier	West Africa / Senegal / Dakar	West Africa / South Africa / Durban	West Africa / Spain / Las Palmas
1	ESAS	MSC / slots: Hapag-Lloyd / Stiness Linien	MSC		X						X	X
2	SAECS	Safmarine / Maersk Line / MOL / DAL / slots: SOL	DAL / Maersk Line / MOL / Safmarine								X	
3	WAF2	Safmarine / Maersk Line	Maersk Line / Safmarine				X		X			
4	EURAF	Delmas	CMA CGM / Delmas	X					X	X		
5	WAF1	Safmarine / Maersk Line	Maersk Line				X		X			
6	WAF3	Safmarine / Maersk Line	Maersk Line				X		X			
7	WAF6	Safmarine / Maersk Line	Maersk Line / Safmarine				X		X			
8	(WAF) (HL:MWX)	UASC / Hanjin Shipping / MOL / Slots: Hapag-Lloyd	Hanjin Shipping									
9	WAF8	Safmarine / Maersk Line	Maersk Line / Safmarine				X		X			
10	WANRF	MSC	MSC									
11	NIGEX	Delmas	CMA CGM / Delmas						X			
12	NEWAS	MSC	MSC	X								X
13	ARN / WAX / NAF	MOL / Hapag-Lloyd / Zim	Hapag-Lloyd / MOL / Zim									
14	Battuta Express	Delmas	CMA CGM						X			
15	WAF5	Safmarine / Maersk Line	Maersk Line				X		X			
16	Agadir Express	CMA CGM	CMA CGM									
17	WEWA[b]	NileDutch	NileDutch					X				
18	WAF7	Safmarine / Maersk Line	Maersk Line				X		X			
19	Angola Loop	Safmarine / Maersk Line	Maersk Line / Safmarine				X					
20	CES[a]	CMA CGM / OPDR / CoMaNav / IMTC / VACS	CMA CGM / OPDR									
21	EAS	Delmas / Slots: Marfret	CMA CGM						X			
22	KNSM	Maersk Line	Maersk Line									
23	PAS[a]	Lin Lines	Lin Lines									
24	Guiver Line	Portline	Portline									X
25	WAF9	Safmarine / Maersk Line	Safmarine				X		X			
26	WAS[a]	Safmarine / Maersk Line	Safmarine				X		X			
27	WAB	Bacoliner	Bacoliner									
28	Africa expresso	Transinsular / Slots: Portline / MSC	Transinsular			X						

Second leg ports – Asia and East Africa:

No	Liner services	Asia / Asia	China / Dalian	China / Shanghai	China / Xiamen	China / Xingang-Tianjin	China / Yantian	Hong Kong / Hong Kong	India / Mumbai	India / Mundra	Malaysia / Port Kelang	Middle East / Middle East	Pakistan / Karachi	Saudi Arabia / Jeddah	United Arab Emirates / Jebel Ali	United Arab Emirates / Khor Al Fakkan	East Africa: Kenya / Mombasa	Mozambique / Beira	United Republic of Tanzania / Dar Es Salaam
1	ESAS																● Durban	● Durban	● Durban
2	SAECS																● Durban		● Durban
3	WAF2	● Algeciras										● Algeciras							
4	EURAF																		
5	WAF1	● Algeciras										● Algeciras							
6	WAF3	● Algeciras										● Algeciras							
7	WAF6	● Algeciras										● Algeciras							
8	(WAF) (HL:MWX)																		
9	WAF8	● Algeciras										● Algeciras							
10	WANRF																		
11	NIGEX																		
12	NEWAS																		
13	ARN / WAX / NAF																		
14	Battuta Express		● Tangier	● Tangier	● Tangier	● Tangier	● Tangier	● Tangier	● Tangier	● Tangier	● Tangier		● Tangier	● Tangier	● Tangier	● Tangier			
15	WAF5	● Algeciras										● Algeciras							
16	Agadir Express																		
17	WEWA[b]																		
18	WAF7	● Algeciras										● Algeciras							
19	Angola Loop	● Algeciras										● Algeciras							
20	CES[a]																		
21	EAS								● Tangier	● Tangier			● Tangier	● Tangier	● Tangier	● Tangier			
22	KNSM																		
23	PAS[a]																		
24	Guiver Line																		
25	WAF9	● Algeciras										● Algeciras							
26	WAS[a]	● Tangier ● Algeciras										● Tangier ● Algeciras							
27	WAB																		
28	Africa expresso																		

Second leg ports – Europe:

No	Liner services	Belgium / Antwerp	Belgium / Zeebrugge	France / Dunkerque	France / Le Havre	Germany / Bremen	Germany / Bremerhaven	Germany / Hamburg	Netherlands / Rotterdam	Portugal / Leixoes	Portugal / Lisbon	Portugal / Sines	Spain / Algeciras	Spain / La Coruña	Spain / Vigo	United States / Boston	United States / Charleston	United Kingdom / Felixstowe	United Kingdom / Southampton	United Kingdom / Tilbury
1	ESAS	● Las Palmas			● Las Palmas	● Hamburg	● Hamburg					● Las Palmas				● Las Palmas	● Las Palmas	● Las Palmas		
2	SAECS																			
3	WAF2	● Algeciras					● Algeciras		● Algeciras											● Algeciras
4	EURAF												● Tangier							
5	WAF1	● Algeciras					● Algeciras		● Algeciras											● Algeciras
6	WAF3	● Algeciras					● Algeciras		● Algeciras											● Algeciras
7	WAF6	● Algeciras					● Algeciras		● Algeciras											● Algeciras
8	(WAF) (HL:MWX)																			
9	WAF8	● Algeciras					● Algeciras		● Algeciras											● Algeciras
10	WANRF																			
11	NIGEX	● Tangier			● Tangier			● Tangier	● Tangier				● Tangier							
12	NEWAS	● Las Palmas			● Las Palmas		● Transshipment port unknown	● Transshipment port unknown ● Las Palmas	● Transshipment port unknown ● Las Palmas									● Transshipment port unknown ● Las Palmas		
13	ARN / WAX / NAF																			
14	Battuta Express	● Tangier	● Tangier		● Tangier			● Tangier	● Tangier	● Tangier	● Tangier		● Tangier						● Tangier	
15	WAF5	● Algeciras					● Algeciras		● Algeciras											● Algeciras
16	Agadir Express																			
17	WEWA[b]																			
18	WAF7	● Algeciras					● Algeciras		● Algeciras											● Algeciras
19	Angola Loop	● Algeciras					● Algeciras		● Algeciras											● Algeciras
20	CES[a]																			
21	EAS	● Tangier		● Tangier	● Tangier			● Tangier	● Tangier										● Tangier	
22	KNSM																			
23	PAS[a]																			
24	Guiver Line																			
25	WAF9	● Algeciras					● Algeciras		● Algeciras											● Algeciras
26	WAS[a]	● Algeciras					● Algeciras		● Algeciras											● Algeciras
27	WAB																			
28	Africa expresso								● Lisbon	● Lisbon				● Lisbon	● Lisbon			● Lisbon		

Second leg ports – Mediterranean:

No	Liner services	Egypt / Port Said	France / Fos sur Mer	Italy / Genoa	Italy / Gioia Tauro	Italy / La Spezia	Italy / Livorno	Italy / Napoli	Malta / Marsaxlokk	Mediterranean / Mediterranean	Spain / Barcelona	Spain / Cadiz	Spain / Valencia
1	ESAS		● Las Palmas	● Las Palmas	● Las Palmas	● Las Palmas	● Las Palmas	● Las Palmas			● Las Palmas		● Las Palmas
2	SAECS												
3	WAF2									● Algeciras			
4	EURAF		● Tangier	● Tangier			● Tangier				● Tangier		● Tangier
5	WAF1									● Algeciras			
6	WAF3									● Algeciras			
7	WAF6									● Algeciras			
8	(WAF) (HL:MWX)												
9	WAF8									● Algeciras			
10	WANRF												
11	NIGEX		● Tangier	● Tangier			● Tangier				● Tangier		● Tangier
12	NEWAS		● Las Palmas	● Las Palmas	● Las Palmas	● Las Palmas	● Las Palmas				● Las Palmas		● Las Palmas
13	ARN / WAX / NAF												
14	Battuta Express	● Tangier	● Tangier	● Tangier			● Tangier		● Tangier		● Tangier	● Tangier	● Tangier
15	WAF5									● Algeciras			
16	Agadir Express												
17	WEWA[b]												
18	WAF7									● Algeciras			
19	Angola Loop									● Algeciras			
20	CES[a]												
21	EAS	● Tangier							● Tangier				
22	KNSM												
23	PAS[a]												
24	Guiver Line												
25	WAF9									● Algeciras			
26	WAS[a]									● Tangier ● Algeciras			
27	WAB												
28	Africa expresso												

Source: Alphaliner (29/04/2011 and 02/05/2011)

● : NileDutch's container liner services

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: ● : Hamburg ● : Transshipment port unknown ● : Las Palmas ● : Tangier ● : Pointe Noire ● : Algeciras ● : Durban ● : Lisbon ● : Dakar

Table 89: Transshipment ports and second leg ports: Europe - West Africa: Container liner services 2011 (2)

Container liner services / Transshipment ports (Europe: Hamburg, Lisbon, Algeciras; West Africa: Pointe Noire, Tangier, Dakar, Durban, Las Palmas)

No.	Liner services	Carrier	Operator	Transhipment port unknown (Transhipment port unknown)	Hamburg (Germany)	Lisbon (Portugal)	Algeciras (Spain)	Pointe Noire (Congo)	Tangier (Morocco)	Dakar (Senegal)	Durban (South Africa)	Las Palmas (Spain)
1	ESAS	MSC / slots: Hapag-Lloyd / Stiness Linien	MSC		X						X	X
2	SAECS	Safmarine / Maersk Line / MOL / DAL / slots: SOL	DAL / Maersk Line / MOL / Safmarine								X	
3	WAF2	Safmarine / Maersk Line	Maersk Line / Safmarine				X		X			
4	EURAF	Delmas	CMA CGM / Delmas	X					X	X		
5	WAF1	Safmarine / Maersk Line	Maersk Line				X		X			
6	WAF3	Safmarine / Maersk Line	Maersk Line				X		X			
7	WAF6	Safmarine / Maersk Line	Maersk Line / Safmarine				X		X			
8	(WAF) (HL:MWX)	UASC / Hanjin Shipping / MOL / Slots: Hapag-Lloyd	Hanjin Shipping									
9	WAF8	Safmarine / Maersk Line	Maersk Line / Safmarine				X		X			
10	WANRF	MSC	MSC									
11	NIGEX	Delmas	CMA CGM / Delmas						X			
12	NEWAS	MSC	MSC	X								X
13	ARN / WAX / NAF	MOL / Hapag-Lloyd / Zim	Hapag-Lloyd / MOL / Zim									
14	Battuta Express	Delmas	CMA CGM						X			
15	WAF5	Safmarine / Maersk Line	Maersk Line				X		X			
16	Agadir Express	CMA CGM	CMA CGM									
17	WEWA[b]	NileDutch	NileDutch					X				
18	WAF7	Safmarine / Maersk Line	Maersk Line				X		X			
19	Angola Loop	Safmarine / Maersk Line	Maersk Line / Safmarine				X					
20	CES[a]	CMA CGM / OPDR / CoMaNav / IMTC / VACS	CMA CGM / OPDR									
21	EAS	Delmas / Slots: Marfret	CMA CGM						X			
22	KNSM	Maersk Line	Maersk Line									
23	PAS[a]	Lin Lines	Lin Lines									
24	Guiver Line	Portline	Portline									X
25	WAF9	Safmarine / Maersk Line	Safmarine				X		X			
26	WAS[a]	Safmarine / Maersk Line	Safmarine				X		X			
27	WAB	Bacoliner	Bacoliner									
28	Africa expresso	Transinsular / Slots: Portline / MSC	Transinsular		X							

Second leg ports: North Amerika and South America

Liner services	Cristobal (Panama)	Baltimore (United States)	Houston (United States)	New Orleans (United States)	New York (United States)	Norfolk (United States)	Port Everglades (United States)	Savannah (United States)	Buenos Aires (Argentina)	Rio Grande (Argentina)	Imbituba (Brazil)	Itajai (Brazil)	Navegantes (Brazil)	Paranagua (Brazil)	Rio de Janeiro (Brazil)	Salvador (Brazil)	Santos (Brazil)	São Francisco do Sul (Brazil)	São Gonçalo (Brazil)	Suape (Brazil)	Other Argentinean ports (Argentina)	Montevideo (Uruguay)
1 ESAS	●	●	●	●	●	●	●	●	●	●		●	●		●		●			●		●
2 SAECS																						
3 WAF2									●	●	●			●			●		●			●
4 EURAF																						
5 WAF1									●	●	●			●			●		●			●
6 WAF3									●	●	●			●			●		●			●
7 WAF6									●	●	●			●			●		●			●
8 (WAF) (HL:MWX)																						
9 WAF8									●	●	●			●			●		●			●
10 WANRF																						
11 NIGEX												●		●	●	●	●			●		
12 NEWAS									●	●			●	●	●	●	●	●	●	●		
13 ARN / WAX / NAF																						
14 Battuta Express												●		●	●	●	●			●		
15 WAF5									●	●	●			●			●		●			●
16 Agadir Express																						
17 WEWA[b]																						
18 WAF7									●	●	●			●			●		●			●
19 Angola Loop									●	●	●			●			●		●			●
20 CES[a]																						
21 EAS																						
22 KNSM																						
23 PAS[a]																						
24 Guiver Line																						
25 WAF9									●	●	●			●			●		●			●
26 WAS[a]									●	●	●			●			●		●			●
27 WAB																						
28 Africa expresso																						

Second leg ports: West Africa

Liner services	Cabinda (Angola)	Lobito (Angola)	Luanda (Angola)	Namibe (Angola)	Soyo (Angola)	Cotonou (Benin)	Douala (Cameroon)	Pointe Noire (Congo)	Banana (Democratic Republic of the Congo)	Boma (Democratic Republic of the Congo)	Matadi (Democratic Republic of the Congo)	Bata (Equatorial Guinea)	Malabo (Equatorial Guinea)	Libreville (Gabon)	Port Gentil (Gabon)	Banjul (Gambia)	Takoradi (Ghana)	Tema (Ghana)	Conakry (Guinea)	Abidjan (Ivory Coast)	San Pedro (Ivory Coast)	Nouadhibou (Mauritania)	Nouakchott (Mauritania)	Tangier (Morocco)	Walvis Bay (Namibia)	Lagos (Nigeria)	Lagos-Apapa (Nigeria)	Lagos-Tincan (Nigeria)	Dakar (Senegal)	Cape Town (South Africa)	Durban (South Africa)	Ngqura (South Africa)	Lomé (Togo)
1 ESAS							●											●		●	●			●			●	●	●		●	●	
2 SAECS																																	
3 WAF2							●																	●			●						●
4 EURAF		●		●	●	● ●		● ● ●	●	●	● ●	●	●	●	●		●			● ●	●			●	●	●			●				
5 WAF1							●																	●			●						●
6 WAF3							●																	●			●						●
7 WAF6							●																	●			●						●
8 (WAF) (HL:MWX)																																	
9 WAF8							●																	●			●						●
10 WANRF																																	
11 NIGEX						●		●						●						●									●				
12 NEWAS							●									●		●	●		●	●	●				●	●	●	●	●	●	
13 ARN / WAX / NAF																																	
14 Battuta Express		●	●	●		●		●						●						●									●				
15 WAF5							●																				●						●
16 Agadir Express																																	
17 WEWA[b]	●				●		●			●	●			●																			
18 WAF7							●																				●						●
19 Angola Loop							●																	●			●						●
20 CES[a]																																	
21 EAS																																	
22 KNSM																																	
23 PAS[a]																																	
24 Guiver Line																			●														
25 WAF9							●																				●						●
26 WAS[a]							●																				●						●
27 WAB																																	
28 Africa expresso																																	

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: ●: Hamburg ●: Transshipment port unknown ●: Las Palmas ●: Tangier ●: Pointe Noire ●: Algeciras ●: Durban ●: Lisbon ●: Dakar

C.4.2 ConRo liner service

Table 90: Port rotation schedule first leg ports: Europe - West Africa: ConRo liner services 2011

	ConRo liner services			First leg ports																												
				Europe											West Africa																	
				Belgium	France	France	France	Germany	Netherlands	Netherlands	Portugal	Portugal	Spain	United Kingdom	Angola	Benin	Cameroon	Congo	Democratic Republic of the Congo	Gabon	Gabon	Gambia	Ghana	Ghana	Guinea	Ivory Coast	Ivory Coast	Liberia	Morocco	Nigeria	Senegal	Togo
	Liner services	Carrier	Operator	Antwerp	La Pallice	Le Havre	Rouen	Hamburg	Amsterdam	Flushing	Leixoes	Lisbon	Bilbao	Tilbury	Luanda	Cotonou	Douala	Pointe Noire	Boma	Libreville	Port Gentil	Banjul	Takoradi	Tema	Conakry	Abidjan	San Pedro	Monrovia	Casablanca	Lagos	Dakar	Lomé
1	NEAS	Delmas	Delmas	1, 9	7		8										5	2		4	3					6						
2	Southern Express loop	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	3		4		2	1, 16		6	7	5		13		14	12							10	15			8		9	11
3	Central Express loop	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	4				2	1, 15	14			5	3		8							11	10		7, 12	13			9	6	
4	Eurocargo Express	Grimaldi (Napoli)	Grimaldi (Napoli)	1, 8			2												7			4						6			3, 5	

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each ConRo liner service.

Table 91: Transshipment ports and second leg ports: Europe - West Africa: ConRo liner service 2011

ConRo liner services

				T/S		Second leg ports				
					WA	Europe		West Africa		
				Transhipment port unknown	Congo	France	United Kingdom	Angola	Democratic Republic of the Congo	Liberia
	Liner services	Carrier	Operator	Transhipment port unknown	Pointe Noire	Le Havre	Tilbury	Soyo	Matadi	Monrovia
1	NEAS	Delmas	Delmas		X			🔵	🔵	
2	Southern Express loop	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	X			🔴			
3	Central Express loop	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	X		🔴				🔴
4	Eurocargo Express	Grimaldi (Napoli)	Grimaldi (Napoli)							

Source: Alphaliner (29/04/2011 and 02/05/2011)

The X represents the Transshipment ports corresponding to the ConRo liner service, the dots represent the ports that are called in the second leg for each ConRo liner service.

Colour code dots: 🔴: Transshipment port unknown 🔵: Pointe Noire

Abbreviations: WA: West Africa

C.4.3 Multipurpose liner services

Table 92: Port rotation schedule first leg ports: Europe - West Africa: Multipurpose liner services 2011

Multipurpose liner services — First leg ports: Europe

	Liner services	Carrier	Operator	Belgium	Estonia	France	France	France	France	France	France	France	France	Germany	Germany	Netherlands	Netherlands	Netherlands	Netherlands	Norway	Poland	Portugal	Portugal	Portugal	Portugal	Russian Federation	Spain	United Kingdom
				Antwerp	Tallinn	Bayonne	Caen	Honfleur	La Pallice	Le Havre	Montoir de Bretagne	Nantes	Rouen	Bremen	Hamburg	Amsterdam	Flushing	Moerdijk	Rotterdam	Larvik	Gdynia	Leixoes	Lisbon	Setubal	Viana do Castelo	Kaliningrad	Vigo	Aberdeen
1	EWAMS[a]	UAL	UAL	5										1, 17				3	2			6	7					4
2	UWAS[a]	EuroAfrica	EuroAfrica		1, 9																3					2		
3	OPEX	Safmarine / Maersk Line	Safmarine	1, 29				27	25			26			4	28	5			3		7		8	24		6	2
4	ACE	Safmarine / Maersk Line	Safmarine	1, 28		22	25	26	23	3	4	24	2			27						6	5		21			

Multipurpose liner services — First leg ports: West Africa

	Liner services	Carrier	Operator	Angola	Angola	Angola	Angola	Angola	Angola	Cameroon	Congo	Democratic Republic of the Congo	Democratic Republic of the Congo	Democratic Republic of the Congo	Equatorial Guinea	Equatorial Guinea	Equatorial Guinea	Gabon	Ghana	Ghana	Ivory Coast	Nigeria	Nigeria	Nigeria	São Tomé and Principé	Senegal	Spain	Spain
				Cabinda	Lobito	Luanda	Malongo	Namibe	Soyo	Douala	Pointe Noire	Banana	Boma	Matadi	Bata	Luba	Malabo	Port Gentil	Takoradi	Tema	Abidjan	Lagos	Onne	Port Harcourt	São Tomé and Principé	Dakar	Las Palmas	Tenerife
1	EWAMS[a]	UAL	UAL	16	15	14			13		11					10	9	12						8				
2	UWAS[a]	EuroAfrica	EuroAfrica																7	6	5	8				4		
3	OPEX	Safmarine / Maersk Line	Safmarine	21	19	17		18	20	14	16				11		12	15			23		13		22		9	10
4	ACE	Safmarine / Maersk Line	Safmarine	13	11	12	15		14		17	16	19	18				10			20				9		7	8

Source: Alphaliner (29/04/2011 and 02/05/2011)

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

The numbers represent the order of ports of call in the port rotation schedule of each multipurpose liner service.

Table 93: Transshipment ports and second leg ports: Europe - West Africa: Multipurpose liner services 2011

	Multipurpose liner services			T/S	2th LP
				WA	WA
				Spain	Spain
	Liner services	Carrier	Operator	Las Palmas	Other destinations at Las Palmas
1	EWAMS[a]	UAL	UAL		
2	UWAS[a]	EuroAfrica	EuroAfrica		
3	OPEX	Safmarine / Maersk Line	Safmarine	X	●
4	ACE	Safmarine / Maersk Line	Safmarine		

Source: Alphaliner (29/04/2011 and 02/05/2011)

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

The X represents the Transshipment ports corresponding to the multipurpose liner service, the dots represent the ports that are called in the second leg for each multipurpose liner service.

Colour code dots: ●: Las Palmas

Abbreviations: WA: West Africa, T/S: Transshipment ports, and 2[th] LP: Second leg ports

C.5 Europe – West Africa – South America

C.5.1 ConRo liner service

Table 94: Port rotation schedule first leg ports: Europe – West Africa – South America: ConRo liner service 2011

ConRo service				First leg ports																	
				Europe						South America								West Africa		
				Belgium	France	Germany	Germany	Spain	United Kingdom	Argentina	Argentina	Brazil	Brazil	Brazil	Brazil	Brazil	Uruguay	Guinea	Senegal	Sierra Leone
	Liner service	Carrier	Operator	Antwerp	Le Havre	Emden	Hamburg	Bilbao	Tilbury	Buenos Aires	Zarate	Fortaleza	Paranagua	Rio de Janeiro	Santos	Vitoria	Montevideo	Conakry	Dakar	Freetown
1	NE-WA-ECSA	Grimaldi (Napoli)	Grimaldi (Napoli)	4	5	1, 21	2	6	3	16	15	10	17	12, 19	13, 18	11	14	8	7, 20	9

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each ConRo liner service.

Table 95: Transshipment ports and second leg ports: Europe – West Africa – South America: ConRo liner service 2011

ConRo service				T/S	Second leg ports																			
				WA	Europe								West Africa											
				Senegal	Belgium	France	Germany	Netherlands	Portugal	Portugal	Spain	United Kingdom	Angola	Benin	Cameroon	Congo	Ghana	Ghana	Guinea	Ivory Coast	Ivory Coast	Morocco	Nigeria	Togo
	Liner service	Carrier	Operator	Dakar	Antwerp	Le Havre	Hamburg	Amsterdam	Leixoes	Lisbon	Bilbao	Tilbury	Luanda	Cotonou	Douala	Pointe Noire	Takoradi	Tema	Conakry	Abidjan	San Pedro	Casablanca	Lagos	Lomé
1	NE-WA-ECSA	Grimaldi (Napoli)	Grimaldi (Napoli)	X	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Source: Alphaliner (29/04/2011 and 02/05/2011)

The X represents the Transshipment ports corresponding to the ConRo liner service, the dots represent the ports that are called in the second leg for each ConRo liner service.

Colour code dots: ●: Dakar

Abbreviations: WA: West Africa and T/S: Transshipment ports

C.6 Inter West Africa

C.6.1 Container liner services

Table 96: Port rotation schedule first leg ports: Inter West Africa: Container liner services 2011

Container liner services				First leg ports																														
				West Africa																														
				Angola	Angola	Angola	Angola	Angola	Benin	Congo	Democratic Republic of the Congo	Democratic Republic of the Congo	Democratic Republic of the Congo	Equatorial Guinea	Equatorial Guinea	Gabon	Gabon	Ghana	Ghana	Ivory Coast	Ivory Coast	Morocco	Morocco	Morocco	Namibia	Namibia	Nigeria	Nigeria	South Africa	South Africa	South Africa	South Africa	Spain	Togo
	Liner services	Carrier	Operator	Cabinda	Lobito	Luanda	Namibe	Soyo	Cotonou	Pointe Noire	Banana	Boma	Matadi	Bata	Malabo	Libreville	Port Gentil	Takoradi	Tema	Abidjan	San Pedro	Agadir	Casablanca	Tangier	Luderitz	Walvis Bay	Lagos	Onne	Cape Town	Durban	Ngqura	Port Elizabeth	Las Palmas	Lomé
1	WAF1[a]	Delmas	CMA CGM												4	3				1, 6	5							2						
2	DWAFS	CSAV	CSAV						3										4	5							2			1, 6				
3	West Coast	OACL / Maersk Line / Safmarine / Slots: Mozline	OACL		8	7	6																		5	4			3	1, 9		2		
4	WAF2SM	Safmarine / Maersk Line	Maersk Line											2			3			1, 4														
5	WAF2[a]	Delmas	CMA CGM												4	3				1, 6	5							2						
6	WAF1SM	Safmarine / Maersk Line	Maersk Line							2			1, 3																					
7	TCFS	Maersk Line	Maersk Line																				2	1, 3										
8	WAF3DO[a]	Delmas	CMA CGM					4		1, 6	5	3	2																					
9	WAMFL	Delmas	CMA CGM					3		2, 6		4	5			7				1, 8														
10	AOS	MOL	MOL		5	6																				4			3	2	1, 7			
11	N&GF[a]	MSC	MSC															3			4						2						1, 5	
12	IMS	CMA CGM / CoMaNav	CoMaNav																			3	2	1, 4										
13	WAF4[a]	Delmas	CMA CGM	2						1, 3																								
14	WALF	MSC	MSC						1, 3																									2
15	A & N	MSC	MSC		4	3																				5			2		1, 6			
16	Sango	MSC	CMA CGM			4				3																5			2	1, 6				

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each container liner service.

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

Table 97: Transshipment ports and second leg ports: Inter West Africa: Container liner services 2011

Container liner services — T/S SA

	Liner services	Carrier	Operator	Cape Town (South Africa)	Durban (South Africa)	Ngqura (South Africa)
1	WAF1[a]	Delmas	CMA CGM			
2	DWAFS	CSAV	CSAV		X	
3	West Coast	OACL / Maersk Line / Safmarine / Slots: Mozline	OACL		X	
4	WAF2SM	Safmarine / Maersk Line	Maersk Line			
5	WAF2[a]	Delmas	CMA CGM			
6	WAF1SM	Safmarine / Maersk Line	Maersk Line			
7	TCFS	Maersk Line	Maersk Line			
8	WAF3DO[a]	Delmas	CMA CGM			
9	WAMFL	Delmas	CMA CGM			
10	AOS	MOL	MOL			X
11	N&GF[a]	MSC	MSC			
12	IMS	CMA CGM / CoMaNav	CoMaNav			
13	WAF4[a]	Delmas	CMA CGM			
14	WALF	MSC	MSC			
15	A & N	MSC	MSC	X		X
16	Sango	MSC	CMA CGM		X	

Second leg ports — Asia

	Liner services	Chiwan (China)	Dalian (China)	Fuzhou (China)	Ningbo (China)	Qingdao (China)	Shanghai (China)	Xiamen (China)	Xingang-Tianjin (China)	Hong Kong (Hong Kong)	Mumbai (India)	Mundra (India)	Busan (Korea)	Port Kelang (Malaysia)	Karachi (Pakistan)	Singapore (Singapore)	Kaohsiung (Taiwan)	Jebel Ali (United Arab Emirates)
1	WAF1[a]																	
2	DWAFS	🟢			🟢		🟢		🟢	🟢	🟢	🟢			🟢	🟢		🟢
3	West Coast																	
4	WAF2SM																	
5	WAF2[a]																	
6	WAF1SM																	
7	TCFS																	
8	WAF3DO[a]																	
9	WAMFL																	
10	AOS		🟠			🟠	🟠		🟠	🟠			🟠			🟠		
11	N&GF[a]																	
12	IMS																	
13	WAF4[a]																	
14	WALF																	
15	A & N	🟠		🟠				🟠		🟠						🟠	🟠	
16	Sango	🟢			🟢		🟢			🟢			🟢	🟢				

Second leg ports — East Africa

	Liner services	Port Louis (Mauritius)	Beira (Mozambique)	Maputo (Mozambique)	Nacala (Mozambique)	Pemba (Mozambique)	Quelimane (Mozambique)
1	WAF1[a]						
2	DWAFS						
3	West Coast		🟢	🟢	🟢	🟢	🟢
4	WAF2SM						
5	WAF2[a]						
6	WAF1SM						
7	TCFS						
8	WAF3DO[a]						
9	WAMFL						
10	AOS						
11	N&GF[a]						
12	IMS						
13	WAF4[a]						
14	WALF						
15	A & N	🟠					
16	Sango						

Second leg ports — North America, South America, West Africa

	Liner services	Freeport (Bermuda)	Baltimore (United States)	Charleston (United States)	New York (United States)	Norfolk (United States)	Buenos Aires (Argentina)	Rio Grande (Argentina)	Itajai (Brazil)	Paranagua (Brazil)	Rio de Janeiro (Brazil)	Santos (Brazil)	São Francisco do Sul (Brazil)	Montevideo (Uruguay)	Cape Town (South Africa)	Durban (South Africa)	Port Elizabeth (South Africa)
1	WAF1[a]																
2	DWAFS														🟢		
3	West Coast																
4	WAF2SM																
5	WAF2[a]																
6	WAF1SM																
7	TCFS																
8	WAF3DO[a]																
9	WAMFL																
10	AOS						🟠			🟠	🟠	🟠	🟠	🟠	🟠	🟠	
11	N&GF[a]																
12	IMS																
13	WAF4[a]																
14	WALF																
15	A & N	○	○	○	○	○										🟠 ○	○
16	Sango						🟢	🟢	🟢	🟢	🟢	🟢	🟢				

Source: Alphaliner (29/04/2011 and 02/05/2011)

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: ○ : Cape Town 🟠 : Ngqura 🟢 : Durban

Abbreviations: SA: South America and T/S: Transshipment ports

C.6.2 ConRo liner service

Table 98: Port rotation schedule first leg ports: Inter West Africa: ConRo liner service 2011

	ConRo liner service			First leg ports				
				West Africa				
				Mauritania	Mauritania	Morocco	Senegal	Spain
	Liner service	Carrier	Operator	Nouadhibou	Nouakchott	Agadir	Dakar	Las Palmas
1	CWAS[a]	Bolunda Lines / Slots: Delmas	Boluda Lines	3	2	5	4	1, 6

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each ConRo liner service.

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

Table 99: Transshipment ports and second leg ports: Inter West Africa: ConRo liner service 2011

	ConRo liner service			T/S	Second leg ports							
				WA	Europe			Mediterranean				
				Spain	Portugal	Spain	Spain	Spain	Spain	Spain	Spain	Spain
	Liner service	Carrier	Operator	Las Palmas	Lisbon	Algeciras	Bilbao	Alicante	Barcelona	Pontevedra Marin	Valencia	Santa Cruz de Tenerife
1	CWAS[a]	Bolunda Lines / Slots: Delmas	Boluda Lines	X	●	●	●	●	●	●	●	●

Source: Alphaliner (29/04/2011 and 02/05/2011)

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

The X represents the Transshipment ports corresponding to the ConRo liner service, the dots represent the ports that are called in the second leg for each ConRo liner service.

Colour code dots: ●: Las Palmas

Abbreviations: WA: West Africa and T/S: Transshipment ports

C.6.3 Multipurpose liner services

Table 100: Port rotation schedule first leg ports: Inter West Africa: Multipurpose liner services 2011

Multipurpose liner services				First leg ports – West Africa																																
				Angola	Angola	Angola	Angola	Angola	Cameroon	Congo	Democratic Republic of the Congo	Democratic Republic of the Congo	Democratic Republic of the Congo	Equatorial Guinea	Equatorial Guinea	Equatorial Guinea	Gabon	Gabon	Gabon	Ghana	Ivory Coast	Ivory Coast	Liberia	Mauritania	Mauritania	Morocco	Namibia	Nigeria	Nigeria	Nigeria	Senegal	Sierra Leone	South Africa	South Africa	South Africa	Spain
	Liner services	Carrier	Operator	Cabinda	Lobito	Luanda	Namibe	Soyo	Douala	Pointe Noire	Banana	Boma	Matadi	Bata	Luba	Malabo	Libreville	Mayoumba	Port Gentil	Tema	Abidjan	San Pedro	Monrovia	Nouadhibou	Nouakchott	Agadir	Walvis Bay	Lagos	Port Harcourt	Warri	Dakar	Freetown	Cape Town	Durban	Richards Bay	Las Palmas
1	WAF2SM	Safmarine / Maersk Line	Maersk Line											2					3		1, 4															
2	DF	MSC	MSC																												2					1, 3
3	WAF4	Delmas	CMA CGM / CoMaNav	2						1, 3																										
4	SLLF	MSC	MSC																			1, 4	2									3				
5	WAF2[b]	NileDutch	NileDutch	2				5		1, 6		3	4																							
6	SAWACS	Safmarine / Maersk Line	Safmarine	8	5		4	9	14	10			11	6	13	12	15	17	16	7							3						2, 18	1, 19		
7	WAF1[b]	NileDutch	NileDutch						3	1, 4							2																			
8	WAF3DO[a]	Delmas	CMA CGM					4		1, 6	5	3	2																							
9	SAWAMS	UAL	UAL	12	11	10		13	7							8			9								14	4	6	5			3	2	1, 15	
10	CWAS[a]	Bolunda Lines / Slots: Delmas	Boluda Lines																					3	2	5					4					1, 6
11	CAS	Angola South Line	Angola South Line	4		2		3																									1, 5			

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The numbers represent the order of ports of call in the port rotation schedule of each container liner service.

Table 101: Transshipment ports and second leg ports: Inter West Africa: Multipurpose liner services 2011

				T/S			Second leg ports									
					WA		AS	EUR			MED				WA	
	Multipurpose liner services			Transshipment port unknown	South Africa	Spain	India	Portugal	Spain	Spain	Spain	Spain	Spain	Spain	Spain	West Africa
	Liner services	Carrier	Operator	Transshipment port unknown	Durban	Las Palmas	Mumbai	Lisbon	Algeciras	Bilbao	Alicante	Barcelona	Pontevedra Marin	Valencia	Santa Cruz de Tenerife	West Africa
1	WAF2SM	Safmarine / Maersk Line	Maersk Line													
2	DF	MSC	MSC													
3	WAF4	Delmas	CMA CGM / CoMaNav													
4	SLLF	MSC	MSC													
5	WAF[b]	NileDutch	NileDutch													
6	SAWACS	Safmarine / Maersk Line	Safmarine	X												●
7	WAF[b]	NileDutch	NileDutch													
8	WAF3DO[a]	Delmas	CMA CGM													
9	SAWAMS	UAL	UAL		X		●									
10	CWAS[a]	Bolunda Lines / Slots: Delmas	Boluda Lines			X		●	●	●	●	●	●	●	●	
11	CAS	Angola South Line	Angola South Line													

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: ●: Transshipment port unknown ●: Las Palmas ●: Durban

Abbreviations: AS: Asia, EUR: Europe, MED: The Mediterranean, WA: West Africa and T/S: Transshipment ports

C.7 The Mediterranean – West Africa

C.7.1 Container liner services

Table 102: Port rotation schedule first leg ports: The Mediterranean - West Africa: Container liner services 2011

Container liner services				First leg ports																									
				Mediterranean											West Africa														
				Spain	France	France	France	Italy	Italy	Italy	Malta	Spain	Spain	Italy	Benin	Cameroon	Congo	Gabon	Ghana	Ivory Coast	Ivory Coast	Morocco	Morocco	Morocco	Nigeria	Nigeria	Senegal	Spain	Togo
	Liner services	Carrier	Operator	Algeciras	Fos sur Mer	Marseille	Port Vendres	Genoa	La Spezia	Livorno	Marsaxlokk	Barcelona	Valencia	Napoli	Cotonou	Douala	Pointe Noire	Libreville	Takoradi	Abidjan	San Pedro	Agadir	Casablanca	Tangier	Lagos-Apapa	Lagos-Tincan	Dakar	Las Palmas	Lomé
1	MCWAS	MSC	MSC		1, 13				2				3		7	10			11	8	9				5			4, 12	6
2	WMMS	CMA CGM / CoMaNav / Slots: Arkas Line	CMA CGM			5		4		3	1, 8			2									7	6					
3	MMS	CMA CGM	CMA CGM			5		4	3		1, 8			2									6	7					
4	DIAMS	Delmas	CMA CGM / Delmas		3			4		5		2	1, 15	6		13	11	12		9, 14				7		10	8		
5	PVMSM	CMA CGM / CoMaNav / Slots: Arkas Line	CMA CGM	5		2	1, 9					3	4									8	7	6					

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each container liner service.

Table 103: Transshipment ports and second leg ports: The Mediterranean - West Africa: Container liner services 2011

				T/S		Second leg ports																																				
					WA	Europe						Mediterranean							South America										West Africa													
	Container liner services			Transshipment port unknown	Spain	Belgium	France	Germany	Germany	Netherlands	United Kingdom	France	Italy	Italy	Italy	Italy	Spain	Spain	Argentina	Argentina	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Cameroon	Gambia	Ghana	Guinea	Ivory Coast	Mauritania	Mauritania	Nigeria	Nigeria	Nigeria	Senegal	South Africa	South Africa	South Africa
	Liner services	Carrier	Operator	Transshipment port unknown	Las Palmas	Antwerp	Le Havre	Bremerhaven	Hamburg	Rotterdam	Felixstowe	Fos sur Mer	Genoa	Gioia Tauro	La Spezia	Livorno	Barcelona	Valencia	Buenos Aires	Rio Grande	Navegantes	Paranagua	Rio de Janeiro	Salvador	Santos	São Francisco do Sul	São Gonçalo	Suape	Douala	Banjul	Tema	Conakry	San Pedro	Nouadhibou	Nouakchott	Lagos	Lagos-Apapa	Lagos-Tincan	Dakar	Cape Town	Durban	Ngqura
1	MCWAS	MSC	MSC	X	X	🟣	🟣	🔴	🔴 🟣	🔴 🟣	🔴 🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣	🟣 🟣	🟣	🟣	🟣	🟣	🟣	🟣
2	WMMS	CMA CGM / CoMaNav / Slots: Arkas Line	CMA CGM																																							
3	MMS	CMA CGM	CMA CGM																																							
4	DIAMS	Delmas	CMA CGM / Delmas																																							
5	PVMSM	CMA CGM / CoMaNav / Slots: Arkas Line	CMA CGM																																							

Source: Alphaliner (29/04/2011 and 02/05/2011)

The X represents the Transshipment ports corresponding to the container liner services, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: 🔴 : Transshipment port unknown 🟣 : Las Palmas

Abbreviations: WA: West Africa and T/S: Transshipment ports

C.7.2 ConRo liner services

Table 104: Port rotation schedule first leg ports: The Mediterranean - West Africa: ConRo liner services 2011

	ConRo liner services			First leg ports											
				Mediterranean						West Africa					
				France	France	Italy	Italy	Spain	Spain	Benin	Morocco	Morocco	Nigeria	Senegal	Togo
	Liner services	Carrier	Operator	Marseille	Sète	Genoa	Salerno	Cadiz	Valencia	Cotonou	Casablanca	Tangier	Lagos	Dakar	Lomé
1	RORO Med Line[a]	CMA CGM / CoMaNav / IMTC	CoMaNav / IMTC	1, 5	2						3	4			
2	C - C[a]	CoMaNav / IMTC	IMTC					1, 3			2				
3	WMWAM	Grimaldi (Napoli)	Grimaldi (Napoli)	3		2	1, 9		4	7			8	5	6

Source: Alphaliner (29/04/2011 and 02/05/2011)

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department.

The numbers represent the order of ports of call in the port rotation schedule of each ConRo liner service.

C.8 North America – South America - West Africa

C.8.1 ConRo liner service

Table 105: Port rotation schedule first leg ports: North America – South America - West Africa: ConRo liner services 2011

	ConRo liner service			First leg ports															
				North America					South America							West Africa			
				Dominican Republic	Mexico	United States	United States	United States	Argentina	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil	Ghana	Ivory Coast	Nigeria	Nigeria
	Liner service	Carrier	Operator	Rio Haina	Tampico	Houston	Jacksonville	Savannah	General Roca	Ananindeua	Itajai	Maceio	Rio de Janeiro	Salvador	Santos	Tema	Abidjan	Lagos-Tincan	Onne
1	USSAMSN	Nordana Line	Nordana Line	15	16	3	2	1, 17	11	14	9	12	8	13	10	6	7	4	5

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each ConRo liner service.

Table 106: Transshipment ports and second leg ports: North America – South America - West Africa: ConRo liner service 2011

ConRo liner service				T/S	Second leg ports								
					West Africa								
				Transhipment port unknown	Angola	Angola	Benin	Equatorial Guinea	Equatorial Guinea	Gabon	Nigeria	Senegal	Togo
	Liner service	Carrier	Operator	Transhipment port unknown	Lobito	Luanda	Cotonou	Luba	Malabo	Port Gentil	Lagos	Dakar	Lomé
1	USSAMSN	Nordana Line	Nordana Line	X	●	●	●	●	●	●	●	●	●

Source: Alphaliner (29/04/2011 and 02/05/2011)

The X represents the Transshipment ports corresponding to the ConRo liner service, the dots represent the ports that are called in the second leg for each ConRo liner service.

Colour code dots: ●: Transshipment port unknown

Abbreviations: T/S: Transshipment ports

C.9 North America – West Africa

C.9.1 Container liner services

Table 107: Port rotation schedule first leg ports: North America - West Africa: Container liner services 2011

	Container liner services			First leg ports											
				North America								West Africa			
				Bermuda	United States	United States	United States	United States	United States	United States	United States	South Africa	South Africa	South Africa	South Africa
	Liner services	Carrier	Operator	Freeport	Baltimore	Charleston	Houston	Jacksonville	New Orleans	New York	Norfolk	Cape Town	Durban	Port Elizabeth	Richards Bay
1	AMEX	MSC / Safmarine / Maersk Line	Maersk Line / MSC / Safmarine	5	2	4				1, 10	3	6, 9	8	7	
2	GAL	MACS / Danneburg	MACS				1, 8	3	2			4	5, 7		6

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each container liner service.

Table 108: Transshipment ports and second leg ports: North America - West Africa: Container liner services 2011

	Container liner services			T/S			Second leg ports											
					NA	WA	East Africa						NA			SA	WA	
				Transshipment port unknown	Bermuda	South Africa	Kenya	Madagascar	Madagascar	Mozambique	Mozambique	United Republic of Tanzania	Mexico	United States	United States	Brazil	Namibia	South Africa
	Liner service	Carrier	Operator	Transshipment port unknown	Freeport	Durban	Mombasa	Majunga	Taomasina	Beira	Maputo	Dar Es Salaam	Veracruz	Houston	New Orleans	Altamira	Walvis Bay	Ngqura
1	AMEX	MSC / Safmarine / Maersk Line	Maersk Line / MSC / Safmarine		X	X	●			●		●	●	●	●	●		●
2	GAL	MACS / Danneburg	MACS	X		X		●	●	●	●	●				●	●	

Source: Alphaliner (29/04/2011 and 02/05/2011) The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: ● : Transshipment port unknown ● : Freeport ● : Durban

Abbreviations: NA: North America; SA: South America, WA: West Africa, T/S: Transshipment ports

C.9.2 ConRo liner service

Table 109: Port rotation schedule first leg ports: North America - West Africa: ConRo liner service 2011

ConRo liner service				First leg ports									
				North America					West Africa				
				United States	United States	United States	United States	United States	Benin	Ghana	Nigeria	Senegal	Togo
	Liner service	Carrier	Operator	Baltimore	Boston	Jacksonville	New York	Savannah	Cotonou	Tema	Lagos	Dakar	Lomé
1	USWARS	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	3	5	1, 11	4	2	7	10	8	6	9

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each ConRo liner service.

Table 110: Transshipment ports and second leg ports: North America - West Africa: ConRo liner service 2011

ConRo liner service				T/S	Second leg ports											
				WA	West Africa											
				Senegal	Angola	Angola	Cameroon	Congo	Democratic Republic of the Congo	Democratic Republic of the Congo	Gambia	Ghana	Guinea	Ivory Coast	Liberia	Sierra Leone
	Liner service	Carrier	Operator	Dakar	Lobito	Luanda	Douala	Pointe Noire	Boma	Matadi	Banjul	Takoradi	Conakry	Abidjan	Monrovia	Freetown
1	USWARS	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	X	●	●	●	●	●	●	●	●	●	●	●	●

Source: Alphaliner (29/04/2011 and 02/05/2011)

The X represents the Transshipment ports corresponding to the ConRo liner service, the dots represent the ports that are called in the second leg for each ConRo liner service.

Colour code dots: ●: Dakar

Abbreviations: WA: West Africa, T/S: Transshipment ports

C.9.3 Multipurpose liner service

Table 111: Port rotation schedule first leg ports: North America - West Africa: Multipurpose liner service 2011

Multipurpose liner services				First leg ports																												
				North America										West Africa																		
				Canada	Mexico	Mexico	United States	United States	United States	United States	United States	United States	United States	Angola	Angola	Angola	Angola	Cameroon	Congo	Equatorial Guinea	Equatorial Guinea	Gabon	Ghana	Ivory Coast	Ivory Coast	Namibia	Nigeria	Nigeria	Nigeria	South Africa	South Africa	South Africa
	Liner services	Carrier	Operator	Montreal	Tampico	Veracruz	Baltimore	Brooklyn	Houston	Jacksonville	New Orleans	Philadelphia	Savannah	Cabinda	Lobito	Luanda	Soyo	Douala	Pointe Noire	Luba	Malabo	Port Gentil	Takoradi	Abidjan	San Pedro	Walvis Bay	Lagos-Tincan	Onne	Port Harcourt	Cape Town	Durban	Richards Bay
1	Corex	Maersk Line / Safmarine	Maersk Line					12	4		3	1, 13	2					8					9	5, 10	11		6	7				
2	UAL	UAL	UAL		13	14			1, 15					6	5	4	7		8	10	3, 11	9		12					2			
3	GAL	MACS / Danneburg	MACS						1, 8	3	2																			4	5, 7	6
4	Angorex	Safmarine / Maersk Line	Safmarine						1, 13			11	12		7	6	3		8	4	2			9	10			5				
5	USSAMS	CSCL / Slots: Hapag-Lloyd	CSAL	1, 12			2		5		4		3													6, 11				7	8, 10	9

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each multipurpose liner service.

Table 112: Transshipment ports and second leg ports: North America - West Africa: Multipurpose liner service 2011

Multipurpose liner services

				T/S		Second leg ports						
					WA	East Africa					NA	WA
				Transhipment port unknown	South Africa	Madagascar	Madagascar	Mozambique	Mozambique	United Republic of Tanzania	Brazil	Namibia
	Liner services	Carrier	Operator	Transhipment port unknown	Durban	Majunga	Taomasina	Beira	Maputo	Dar Es Salaam	Altamira	Walvis Bay
1	Corex	Maersk Line / Safmarine	Maersk Line									
2	UAL	UAL	UAL									
3	GAL	MACS / Danneburg	MACS	X	X	●	●	●	●	●	●	●
4	Angorex	Safmarine / Maersk Line	Safmarine									
5	USSAMS	CSCL / Slots: Hapag-Lloyd	CSAL									

Source: Alphaliner (29/04/2011 and 02/05/2011)

The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: ●: Transshipment port unknown ●: Durban

Abbreviations: NA: North America; WA: West Africa, and T/S: Transshipment ports

C.10 South America – West Africa

C.10.1 Container liner service

Table 113: Port rotation schedule first leg ports: South America - West Africa: Container liner service 2011

	Container service			First leg ports						
				South America					WA	
				Argentina	Brazil	Brazil	Brazil	Brazil	Angola	Congo
	Service	Carrier	Operator	Buenos Aires	Itajai	Rio de Janeiro	Santos	São Francisco do Sul	Luanda	Pointe Noire
1	ECSA[b]	Delmas / NileDutch	CMA CGM / NileDutch	1, 7		4	3	2	6	5

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The numbers represent the order of ports of call in the port rotation schedule of each container liner service.

Abbreviations: WA: West Africa

Table 114: Transshipment ports and second leg ports: South America - West Africa: Container liner service 2011

	Container service			T/S		Second leg ports											
				SA	WA	SA		West Africa									
				Brazil	Congo	Argentina	Argentina	Angola	Angola	Angola	Cameroon	Democratic Republic of the Congo	Democratic Republic of the Congo	Gabon	Ghana	Ivory Coast	Nigeria
	Service	Carrier	Operator	Rio de Janeiro	Pointe Noire	Buenos Aires	Other Argentinean ports	Cabinda	Lobito	Soyo	Douala	Boma	Matadi	Libreville	Tema	Abidjan	Lagos
1	ECSA[b]	Delmas / NileDutch	CMA CGM / NileDutch	X	X	●	●	●	●	●	●	●	●	●	●	●	●

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

b: Port rotation schedule, duration of rotation, frequency, and vessel's names are obtained from NileDutch's 29/04/2011 sailing schedules.

The X represents the Transshipment ports corresponding to the container liner service, the dots represent the ports that are called in the second leg for each container liner service.

Colour code dots: ●: Rio de Janeiro ●: Pointe Noire

Abbreviations: SA: South America, WA: West Africa, T/S: Transshipment ports

C.10.2 Multipurpose liner service

Table 115: Port rotation schedule first leg ports: South America - West Africa: Multipurpose liner service 2011

	Multipurpose service				First leg ports				
					SA			WA	
					Brazil	Brazil	Brazil	Angola	Congo
	Service	Carrier	Operator	Trade	Itajai	Rio de Janeiro	Santos	Luanda	Pointe Noire
1	SATWACS	Clipper Shipping Line	Clipper Shipping Line	South America - West Africa	2	4	3	1, 5, 7	6

Source: Alphaliner (29/04/2011 and 02/05/2011)

The numbers represent the order of ports of call in the port rotation schedule of each multipurpose liner service.

Abbreviation: SA: South America and WA: West Africa

Appendix D : Formulas used to calculate the average container vessels in the West African container shipping market

For the determination of the average container vessel in the West African container shipping market the length between perpendiculars (L_{pp}), weight ship and machinery (W_{sm}), displacement weight (Δ) and block coefficient (C_b) were unknown. By the use of the data from Alphaliner (29/04/2011 and 02/05/2011) and formulas from various sources the desired values are obtained:

Janssens and Otto (2008):

$$L_{pp} = 0,9659 \cdot L_{ao} - 4,5624 \tag{49}$$

- L_{pp} : Length between perpendiculars $[m]$
- L_{ao} :Length over all $[m]$

Janssens and Otto (2008):

$$W_{sm} = 37,532 \cdot nTEU^{0.754} \tag{50}$$

- W_{sm} :Weight ship and machinery $[t]$
- $nTEU$: Nominal TEU capacity vessel $[TEU]$

van Dokkum (2007:32):

$$\Delta = dwt + W_{sm} \tag{51}$$

- Δ :Displacement weight $[t]$
- dwt :Deadweight tonnage $[t]$
- W_{sm} :Weight ship and machinery $[t]$

Keuning (2006):

$$C_b = \frac{\frac{\Delta}{1,025}}{L_{pp} \cdot B \cdot T} \tag{52}$$

- C_b : Block coefficient $[/]$
- Δ : Displacement weight $[t]$
- L_{pp} : Length between perpendiculars $[m]$
- B : Beam $[m]$
- T : Draft $[m]$

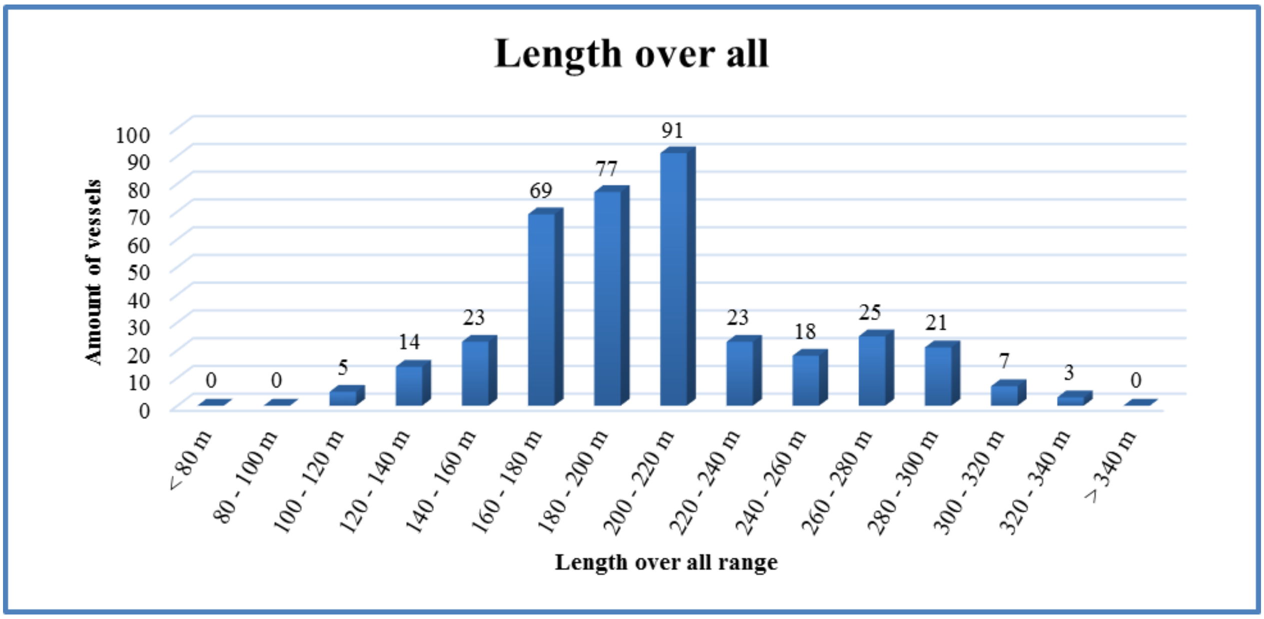
The calculation of the average 14 ton TEU capacity is based on 361 container vessels because these data are lacking for 15 container vessels in the list of 373.

The calculation of the average maximum brake power ($P_{B,Max}$) is based on 371 container vessel as information lacks for two container vessels.

Appendix E : Ranges of the container vessels' specifications

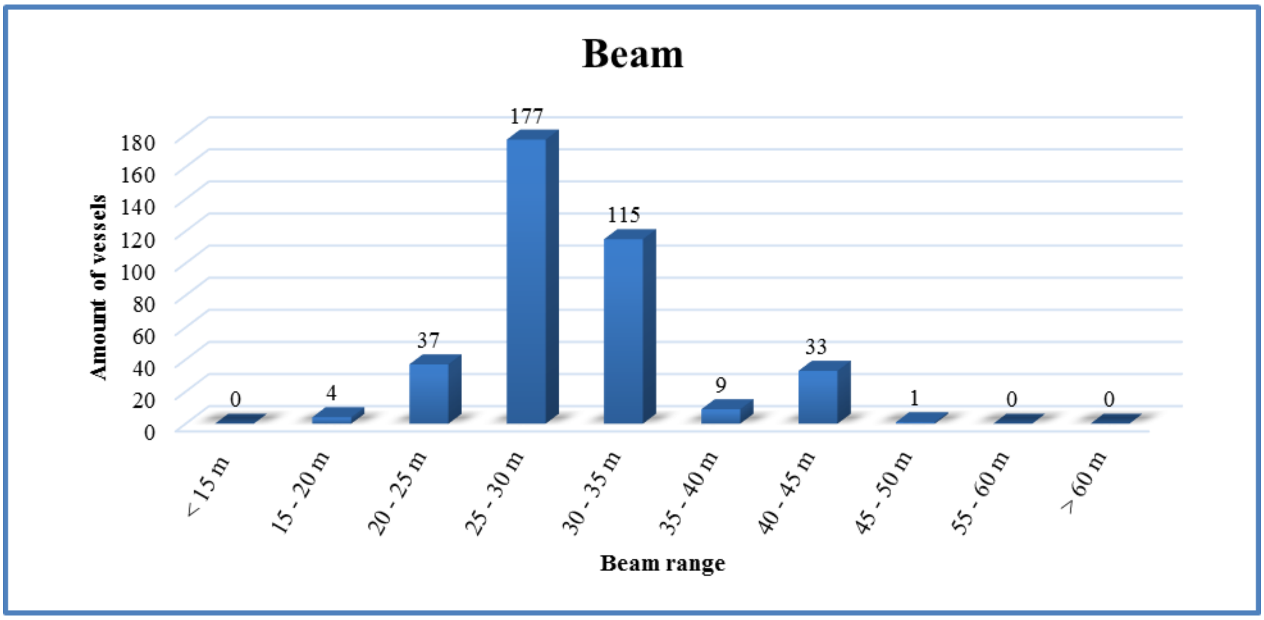
The ranges of the container vessels specifications are indicated in graphs. These graphs are based on the 376 container vessels from the database made with data from Alphaliner (28/04/2011 and 02/05/2011). This is done for the length over all (L_{oa}), beam (B), draft (T), nominal TEU capacity class, 14 ton TEU capacity class, reefer plugs, deadweight tonnage (dwt), vessel's speed (v_s), the power maximum continuous rating of the engine ($P_{B,Max}$), and the gears. As with the calculation of the average container vessel the range of 14 ton TEU capacity is based on 361 container vessels because these data are lacking for 15 container vessels in the list of 373 and the range of maximum brake power ($P_{B,Max}$) is based on 371 container vessel as information lacks for 17 container vessels. The tables can be seen in Figure 125 to Figure 134.

Figure 125: Length over all range



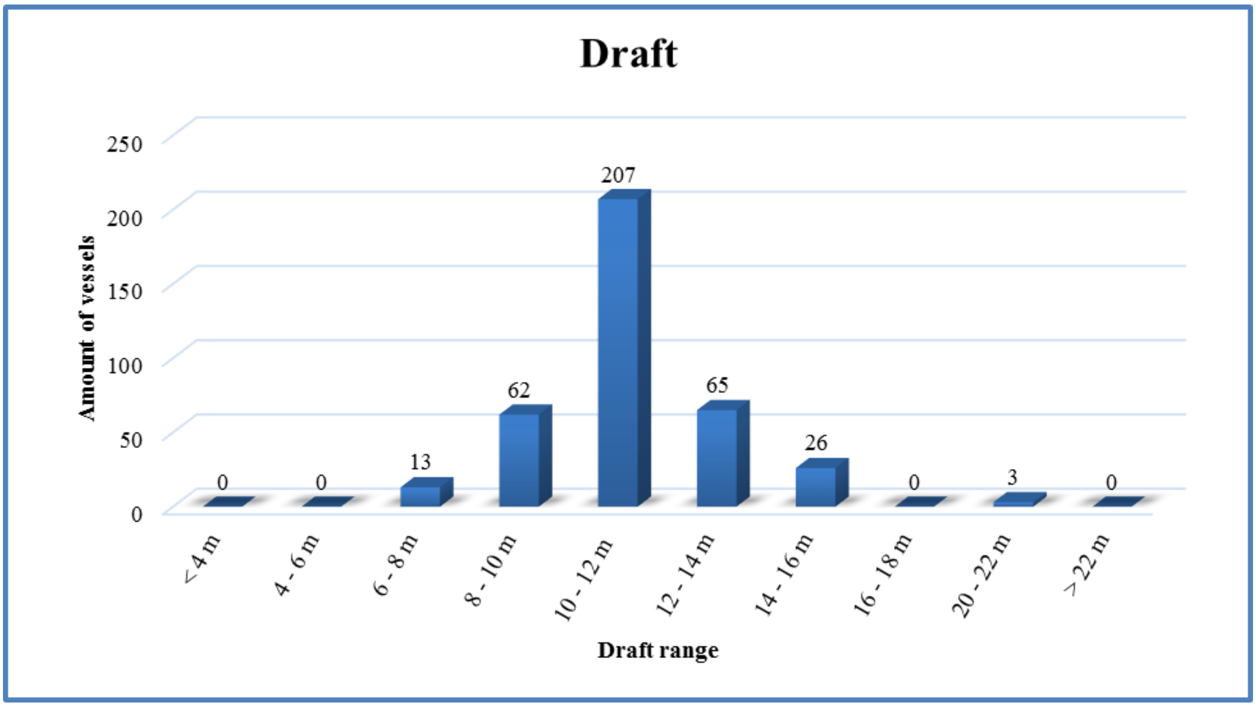
Source: Alphaliner (28/04/2011 and 02/05/2011)

Figure 126: Beam range



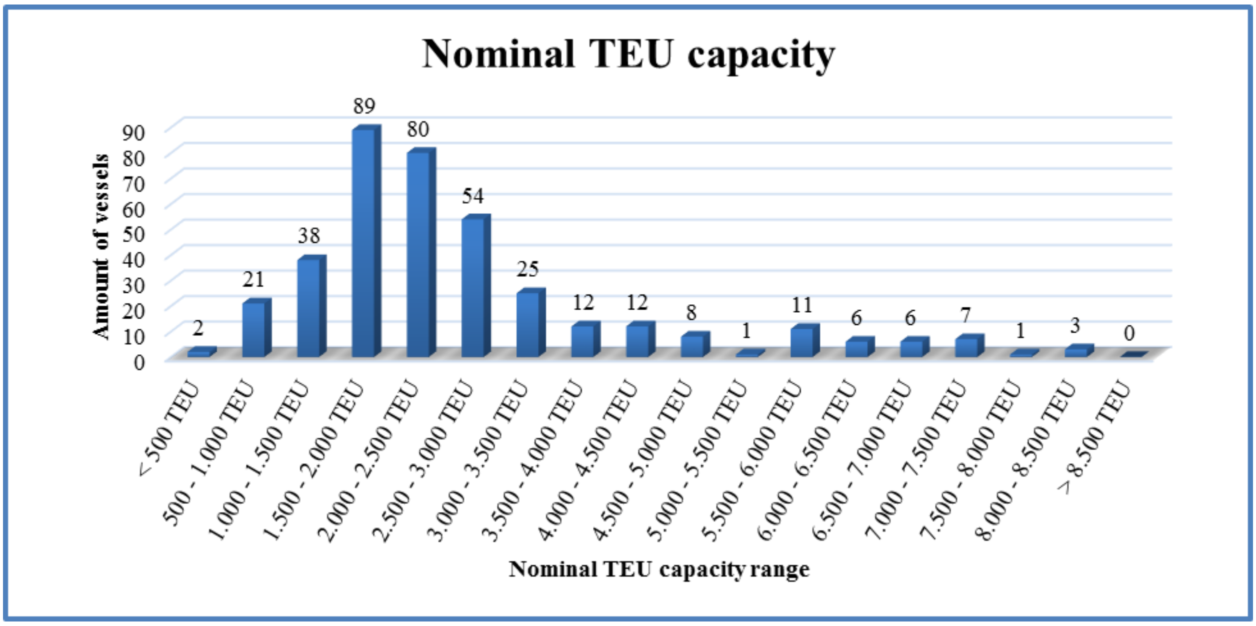
Source: Alphaliner (28/04/2011 and 02/05/2011)

Figure 127: Draft range



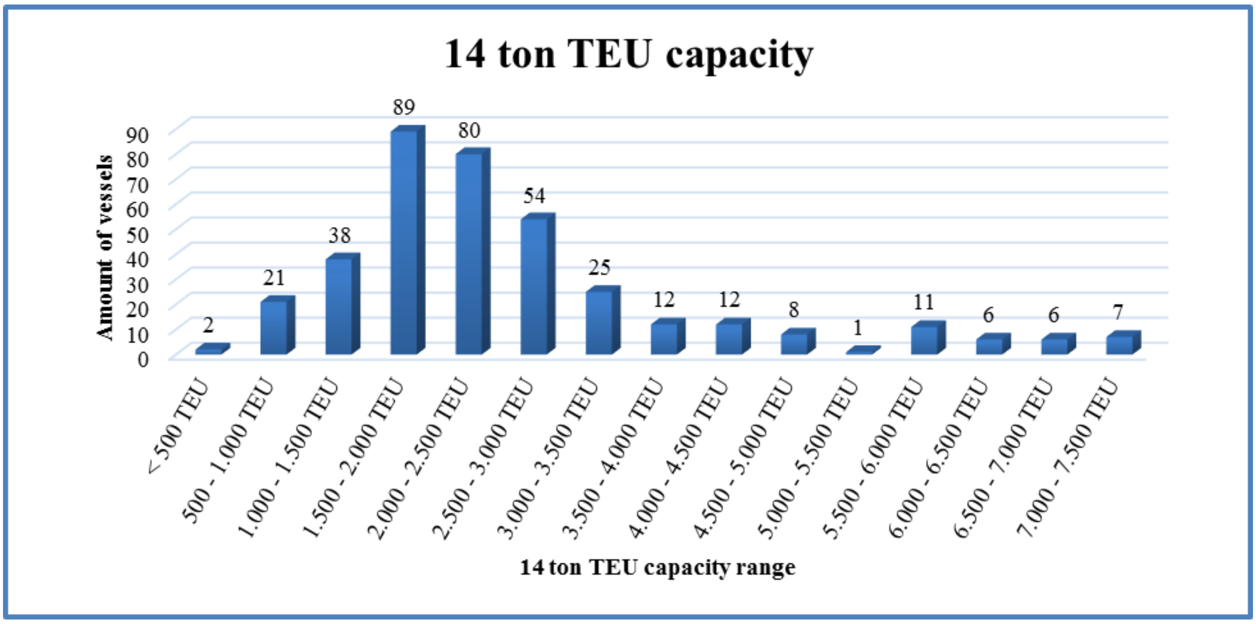
Source: Alphaliner (28/04/2011 and 02/05/2011)

Figure 128: Nominal TEU capacity range



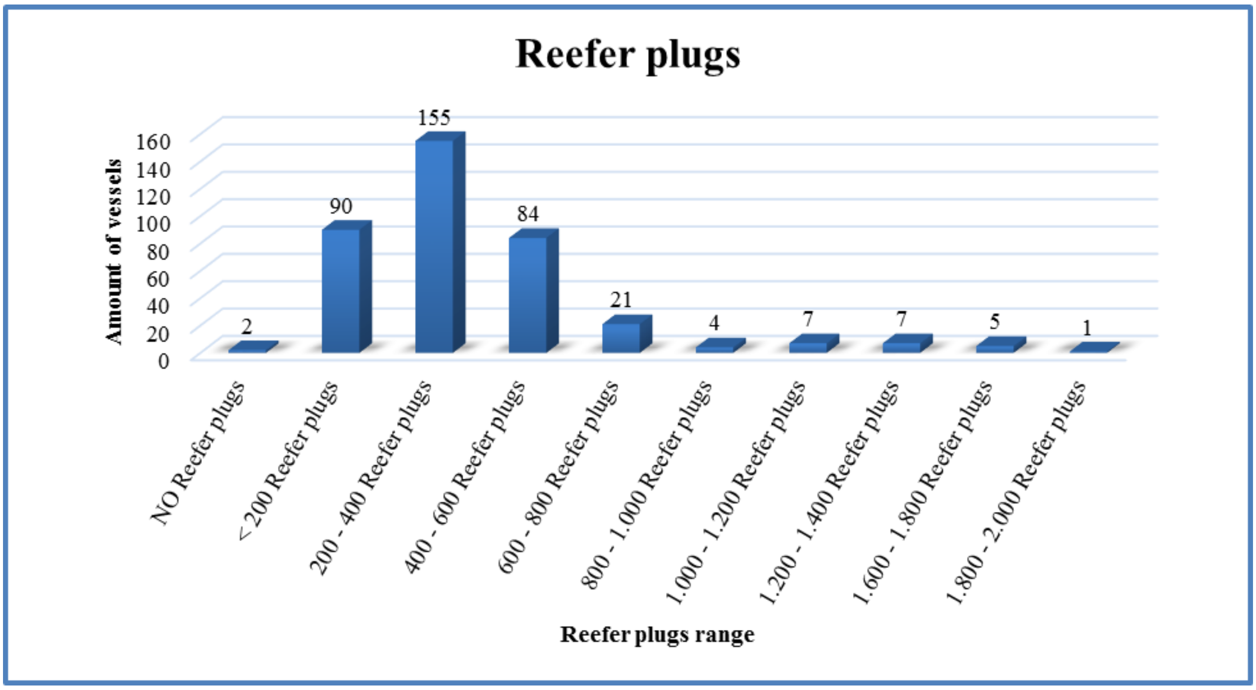
Source: Alphaliner (28/04/2011 and 02/05/2011)

Figure 129: 14 ton TEU capacity range



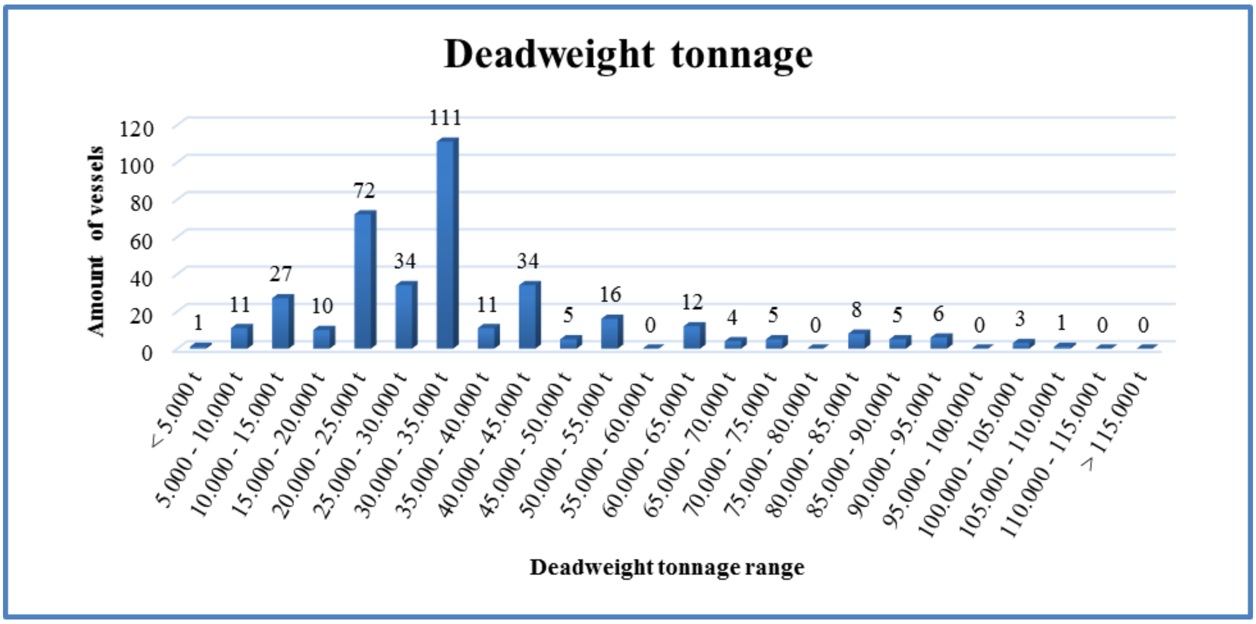
Source: Alphaliner (28/04/2011 and 02/05/2011)

Figure 130: Reefer plugs range



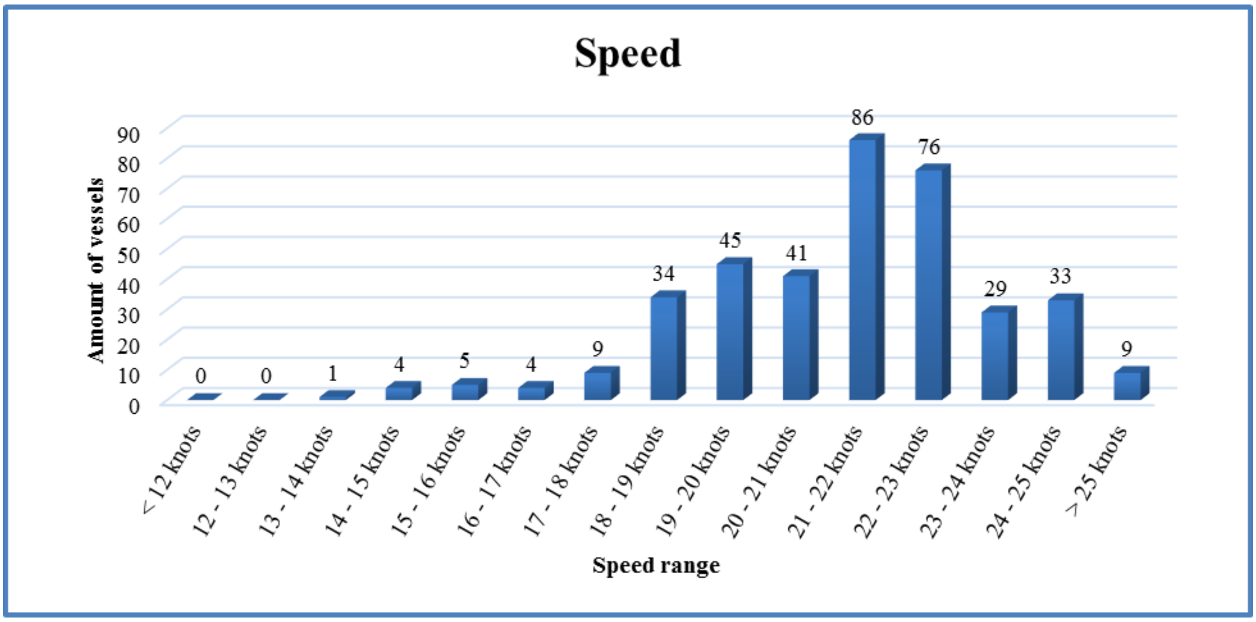
Source: Alphaliner (28/04/2011 and 02/05/2011)

Figure 131: Deadweight tonnage range



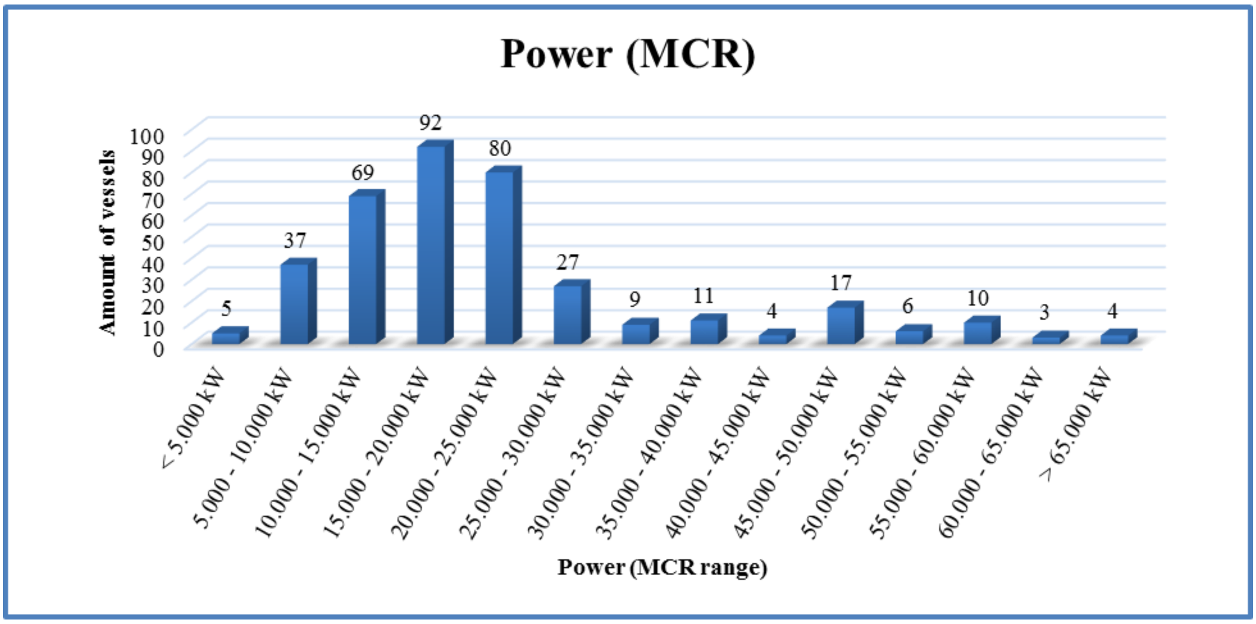
Source: Alphaliner (28/04/2011 and 02/05/2011)

Figure 132: Speed range



Source: Alphaliner (28/04/2011 and 02/05/2011)

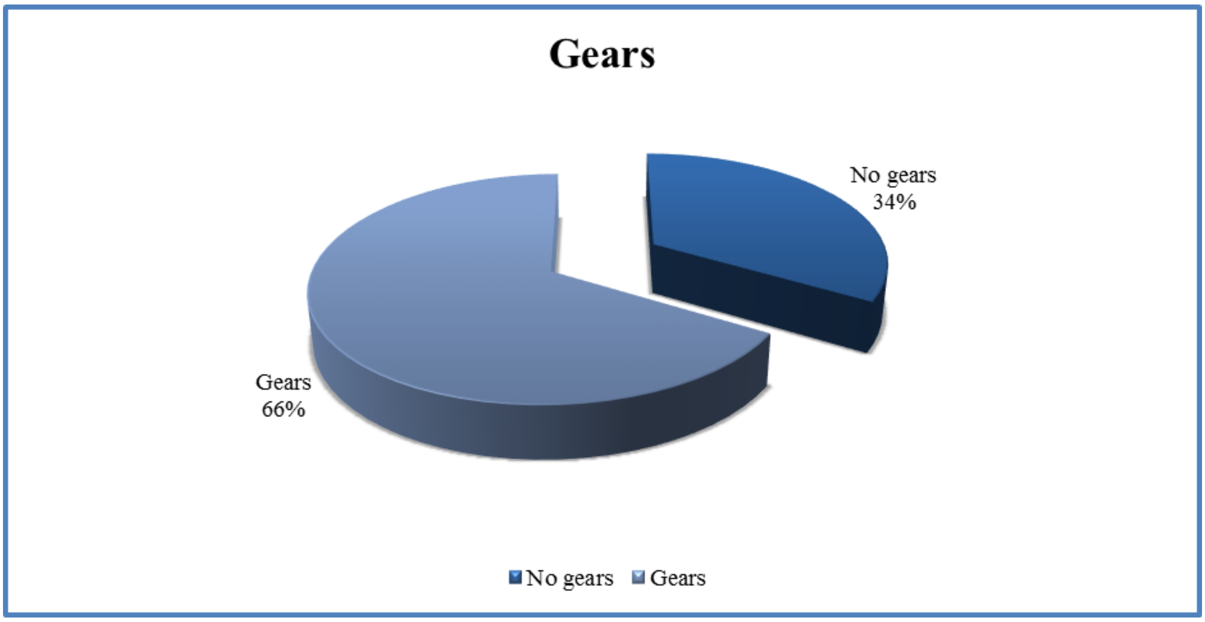
Figure 133: Power (MCR) range



Source: Alphaliner (28/04/2011 and 02/05/2011)

MCR: Maximum Continuous Rating

Figure 134: Percentage of vessels that have cargo gears



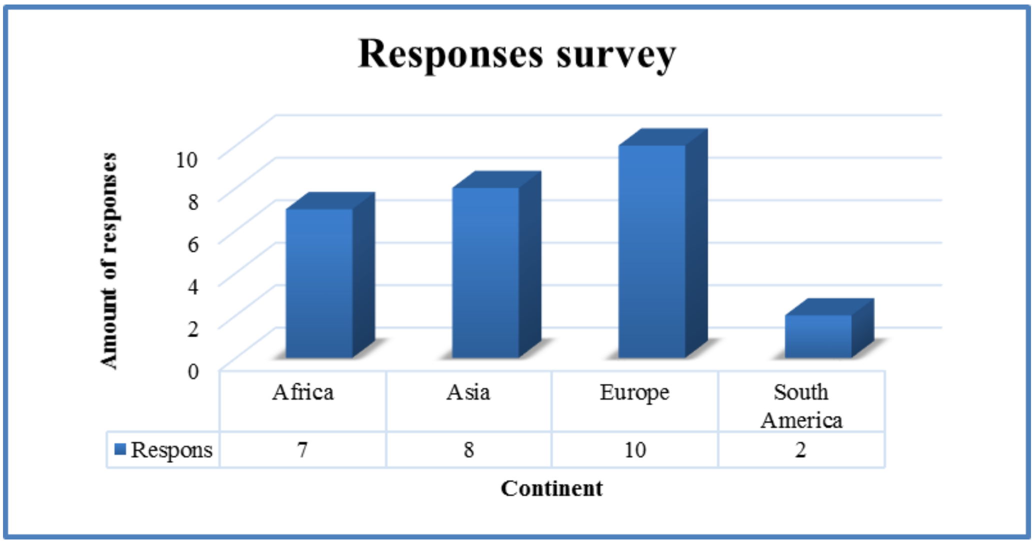
Source: Alphaliner (28/04/2011 and 02/05/2011)

Appendix F : Agency questionnaire report

To obtain more information about the West African container shipping market a questionnaire is send to NileDutch's agencies. NileDutch's agencies are very suited to provide this information as they are in direct contact with the market. The main objective of this questionnaire is to obtain more information about the changes in demand of the container volumes in NileDutch's container liner services. Other objectives are to ask the agencies about interesting future ports and the container volumes going through these ports. The agency questionnaire also asks about the importance of the exchange rates for the customer. Congestion, protectionism and the competitors are also treated in the questionnaire.

The questionnaire is carried out by an internet questionnaire made in Google documents. Due to internet censorship in China, Chinese agencies received the questionnaire via a word document. The questionnaire has been send to 46 agencies of which 27 filled out the questionnaire. Figure 135 shows the amount of responses per continent. Seven responses come from Africa, eight come from Asia, ten come from Europe and two come from South America. The timespan of the questionnaire was three and a half months. The first questionnaire was sent on the 30 of May 2011. Four reminders have been send of which the last one was on the 16th of September 2011.

Figure 135: Responses per continent on the agency questionnaire



F.1 NileDutch Container liner services

To get an estimation about the demand for TEUs in NileDutch's West African container shipping market in 2015 the Agencies are asked to specify what they think the container volumes will be between their ports of loading and the final ports of discharge for 2015. Indicated whether it involves a decrease or an increase and how much the mainly importers, mainly exporters and freight forwarders / NVOCC[34] ship in terms of percentage.

F.1.1 Europe – West Africa Container liner service

NileDutch Rotterdam, The Netherlands, Rotterdam

Final lifting's (all ports of loading) in 2010: 4.400TEU for Southbound and 3.100TEU for northbound.

Breakdown as follows:

Southbound:

Amsterdam/Antwerp - Pointe Noire: 547 TEU

Amsterdam/Antwerp - Luanda: 1.515 TEU

Amsterdam/Antwerp - Lobito: 200TEU

Amsterdam/Antwerp - Namibe: 26 TEU

Amsterdam/Antwerp - Cabinda: 201 TEU

Amsterdam/Antwerp - Matadi: 486 TEU

Amsterdam/Antwerp - Libreville: 324 TEU

Amsterdam/Antwerp - Douala: 112 TEU

Amsterdam/Antwerp - Boma: 9 TEU

Amsterdam/Antwerp - Soyo: 17 TEU

Amsterdam/Antwerp - Lagos: 14 TEU (container liner service stopped)

Amsterdam/Antwerp - Tema: 949 TEU (container liner service stopped)

With present situation, in which Douala and Libreville went from direct container liner service into transhipment via Pointe Noire, plus the withdraw of the container liner service to Tema (and Lagos), NileDutch agencies do not foresee big growth.

At the time more ports of loading will be added, and in especially Tema, NileDutch agencies could go for big increase on volumes (Growth Tema could be 50-100% or even plus).

[34] NVOCC/ Non Vessel Operating Common Carrier

Northbound (Tema and Douala) growth is pending on container liner service and availability of equipment. With direct call Douala and sufficient container availability in both ports, a growth of 30% could be realistic.

Aquamaritime logistics, Shah Alam, Malaysia

50TEU for 2015: 100% Trader.

Furness shipping Zurich, Switzerland, Zurich

We are a peanut with less than 20TEU.

Currie Nord, Dunkirk, France

2015 is very far away in our present shipping industry. Say that we hope an increase in 20%

Supermaritime Ghana Ltd., Tema, Ghana

Exports:

Tema - Amsterdam, Antwerp, Le Havre, Leixoes, Rotterdam, and Rouen = 3.834 TEU in 2015. Increase 12.5% : mainly freight forwarders.

NileDutch Antwerp, Belgium, Antwerp

Antwerp to West Africa:

36:000TEU, increase in approximately 20%: (60% traders and 40% forwarders)

60% to Angola, 30% to Democratic Republic of the Congo, 10% to remaining other destinations"

Marmedsa, Portugal, Leixoes

Leixoes – Luanda: 4.500TEU, increase: 20% direct exporter and 80% freight forwarder.

Leixoes – Lobito: 1.375 TEU, increase: 20% direct exporter, 80% freight forwarder.

Leixoes – Cabinda: 600TEU, increase: 80% direct exporter, 20% freight forwarder.

Leixoes - other West African ports: 800TEU, increase: 50% direct exporter, 50% freight forwarder.

Currie SAS, France, Le Havre

Difficult to say as the situation is very difficult nowadays (world crisis). If the situation remains the same as nowadays we can expect an increase for 2015 of ±10% in general for Southbound

Thos.Carr & Son, Genoa, Italy

For 2015:

Genoa – Luanda: 5.000TEU, increase in 10%: 10% mainly importer, 10% mainly exporter and 80% mainly Freight Forwarder.

Livorno – Luanda: 3.000TEU, increase in 7%: 10% mainly importer, 10% mainly exporter and 80% mainly Freight Forwarder.

Salerno – Luanda: 2.000TEU, increase in 5%: 10% mainly importer, 10% mainly exporter and 80% mainly Freight Forwarder.

Genoa – Lobito: TEU 3.500, increase in 8%: 10% mainly importer, 10% mainly exporter and 80% mainly Freight Forwarder.

Livorno – Lobito: TEU 2.000, increase in 5%: 10% mainly importer, 10% mainly exporter and 80% mainly Freight Forwarder.

Salerno – Lobito: 1.500TEU, increase in 3%: 10% mainly importer, 10% mainly exporter and 80% mainly Freight Forwarder.

Genoa – Matadi: 4.000TEU, increase in 8%: 8% mainly importer, 8% mainly exporter and 84% mainly Freight Forwarder.

Livorno – Matadi: 2.500TEU, increase in 5%: 8% mainly importer, 8% mainly exporter and 84% mainly Freight Forwarder.

Salerno - Matadi 2.000TEU, increase in 3%: 8% mainly importer, 8% mainly exporter and 84% mainly Freight Forwarder"

Comexas Afrique, Kinshasa, Matadi, Boma, Lubumbashi, and Goma, Democratic Republic of the Congo

Antwerp, Rotterdam, and Le Havre to Matadi-Boma: 10% untill 2015 => total 6.050TEU

Matadi-Boma to Antwerp, Rotterdam, and Le Havre: 15% untill 2015 => total 160TEU

Sudmar, Cameroon, Douala

Netherlands:

Here the main product that is exported is cacao, for the forecast in view of the trend of cacao crop, we believe there will be an increase in more or less 10 to 20% of volume. Here the main receivers are ADM and Cargill

As far as timber is concerned, in view of the policy that is being implemented for the protection of forest, we surely will forecast a decrease in export of timber. Here there are two major players, REEF and wijma.

Antwerp, Belgium:

We export timber, cotton, coffee, bananas, pineapple, and rubber. Apart from timber in all these products on should forecast an increase here for at least 5%.

Le Havre, France:

Here we export cacao and its product, coffee, timber, and rubber

Apart of timber we should forecast an increase, here the imports of rubber are for Michelin and the cocoa product is for Barry Callebaut.

Portugal

Leixoes/Lisbon:

Here we do export mainly coffee, a slight increase should be forecast

Libreville, Gabon:

Here they export product from Nestlé, beer from the brewery, foodstuff. One should forecast as well slight increase.

Matadi, Democratic Republic of Congo

We export finished cocoa product from Choco companies, packing material from plastic companies, some salt. If those factories will not soon be established there, then we should forecast increase

Pointe Noire, Congo:

Here you have empty bottles from Socaver, foodstuff from local farmer such as beans, beer from the local brewery, building material, soap, perfume from Gandour, and finished aluminium from the aluminium company,

All will depend if they do not open such factories in Congo in the year to come then we should forecast a slight increase.

Luanda, Angola:

They export alcohol from fermen companies, also now and then building material, foodstuff,

One can provision a slight increase

Durban, South Africa:

We export woodcraft. This is a market that we just started. We cannot predict how it will develop.

China

With all his ports: Shenzhen, Shanghai, Ningbo, Xinggang, and Tianjin

They export timber, cotton, scrap,

Here one should forecast a fast increase between 10and 15%.

F.1.2 Asia – West Africa Container liner service

NileDutch agencies, Netherlands, Rotterdam

Total volumes 2010 were 1.308 TEU, mainly Luanda, 1.006 TEU (out of several ports of loading).

Although there is no strong X-trade market out of the Netherlands, we forecast growth of 20%.

Jardine shipping services, Indonesia, Jakarta

Jakarta-Luanda - 350TEU for 2015: increase, 20% importer, 20% exporter, and 60% freight forwarder/NVOCC

Jakarta-Pointe Noire - 200TEU for 2015: increase, 20% importer, 20% exporter, and 60% freight forwarder/NVOCC

Jakarta-Matadi - 200TEU for 2015: increase, 20% importer, 20% exporter, and 60% freight forwarder/NVOCC

Jakarta - Durban - 400TEU for 2015: increase, 10% importer, 15% exporter, and 75% freight forwarder/NVOCC

Aquamaritime Logistics, Malaysia, Shah Alam

2.300TEU from Malaysia (based on 10% yearly increased from 2010): 20% Exporter, 50% Trader, 20% Importer, and 10% Freight Forwarder.

Supermaritime Benin SA, Benin, Cotonou

NileDutch start its activities in Benin three month ago. So it is too early to get relevant statistics and make forecasting for 2015.

Kukbo Express Co., Ltd., South Korea, Seoul

Kukbo Express in Korea:

Korea-Luanda: 600TEU for 2015: mainly exporter 50% and 50% freight forwarder/NVOCC.

Korea-Lobito: 48 TEU for 2015: mainly exporter 50% and 50% freight forwarder/NVOCC.

Korea-Namibe: 24 TEU for 2015: 100% forwarder/NVOCC.

Korea-Matadi: 60TEU for 2015: 100% forwarder/NVOCC.

Korea-Pointe Noire: 36 TEU for 2015: 100% forwarder/NVOCC.

Korea-Boma: 12 TEU for 2015: 100% forwarder/NVOCC.

Korea-Libreville: 120TEU for 2015: 100% forwarder/NVOCC.

Korea-Douala: 24 TEU for 2015: 100% forwarder/NVOCC.

Supermaritime Ghana Ltd., Ghana, Tema

Exports:

Tema, Port Kelang, Singapore, Shanghai, Jakarta, Huangpu, Bangkok, and Hong Kong: 4.869 TEU, 2015 increase in 12.5%.

Tema port - Durban 37 TEU 2015 increase in12.5%.

NileDutch Antwerp, Belgium, Antwerp

Antwerp- Angola: 5.000TEU

Antwerp – Democratic Republic of the Congo: 3.000TEU

Antwerp – remaining destination: 1.000TEU

Approximately 60% traders – 40% freight forwarders

Marmedsa, Portugal, Leixoes

Portuguese agency in Asia:

Asia – Luanda: 750TEU for 2015, increase: 20% direct exporters, 80% freight forwarders

Asia – Lobito: 50TEU for 2015, increase 20% direct exporters, 80% freight forwarders.

NileDutch Guangzhou, China, Guangzhou

Chinese Agency in Guangzhou:

Shekou – Luanda: 4.000TEU for 2015; Increase: 20% mainly from exporter, 10% mainly from importer and 70% from Freight forwarder / NVOCC.

Shekou – Lobito: 1.500TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

Shekou – Namibe: 500TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

Shekou – Cabinda: 600TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

Shekou – Soyo: 50TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

Shekou – Pointe Noire: 500TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

Shekou – Matadi 1.600TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

Shekou – Boma – 60TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

Shekou – Libreville: 200TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

Shekou – Douala: 100TEU for 2015; increase: 20% mainly importer, 10% mainly exporter and 70% Freight forwarder / NVOCC.

* Above figure is for Shenzhen (Shekou) as port of loading.

Currie SAS, France, Le Havre

We can expect an increase in 20% in cross trade. Maybe more mainly to Pointe Noire, Luanda, and Matadi.

Comexas Afrique: Democratic Republic of the Congo, Kinshasa, Matadi, Boma, Lubumbashi, and Goma

Asia to Matadi-Boma: 10% till 2015: total TEU: 7.000TEU

Matadi-Boma to Asia: 15% till 2015: total TEU: 650TEU

NileDutch Shanghai, China, Shanghai

Frankly speaking, it is very difficult to forecast the volume/percentage of increase for some specific trade. But as far as I am concerned, Trade to West African countries are on the trend to increase for sure, due to governmental strategy to develop China-Africa business, especially Angola will become China's largest oil exporter. 300.000 Chinese people are living now in Angola for doing business / infrastructure construction / farming, etc.

Meanwhile, more and more inbound cargo to China is affected from West African countries.

Our main customers are certainly forwarders and exporters / traders. Percentages for forwarders are 80%, exporters / traders 20%.

Sudmar, Cameroon, Douala

Here the containers volume will increase between to 10% to 15%; taking into account that China has signed a big contract with our government, the construction of deep sea port of Kribi, the construction of Longpangar (electricity power from water), constructions of roads, and construction of football stadium.

Next to it India is setting a factory of producing the agricultural trailers in the South, Korean have been also awarded the license to explore diamond in the East part of Cameroon.

Besides those projects our importers of building material, namely the Fokou, Sorepco, Afrique construction, Quiferou, etc. They are receiving nowadays 80% of their import from Asia, here items cost cheap, which suit the Cameroonian market.

F.1.3 Asia – South & West Africa Container liner service (SWAX)

NileDutch Rotterdam, The Netherlands, Rotterdam

For total volume SWAX 2010 was 138 TEU (to and from various ports, mainly Lagos (88 TEU).

Jardine shipping services, Indonesia, Jakarta

"Jakarta-Lomé - 250TEU: increase: 20% importer, 20% exporter, and 60% freight forwarder/NVOCC

Jakarta-Tema - 250TEU: increase: 20% importer, 20% exporter, and 60% freight forwarder/NVOCC

Jakarta-Lagos- 350TEU: increase: 20% importer, 20% exporter, and 60% freight forwarder/NVOCC

Jakarta-Cotonou - 200TEU: increase: 20% importer, 20% exporter, and 60% freight forwarder/NVOCC

Aquamaritime Logistics, Malaysia, Shah Alam

3.900TEU from Malaysia (based on 10% yearly increased from 2010): 20% Exporter, 40% Trader, 20% Importer, and 20% Freight Forwarder.

Furness Shipping Zurich, Zurich, Switzerland

Cotton, Cocoa, maybe 100TEUS

SDV Togo, Togo, Lomé

Presume our import volume from Asia to Lomé will increase with 10% - 15%.

Kukbo Express Co., Ltd. South Korea Seoul

Kukbo Express in Korea

Korea-Apapa, 120TEU: 100% forwarder/NVOCC.

Korea-Tema, 360TEU: 100% forwarder/NVOCC.

Korea-Lomé, 36 TEU: 100% forwarder/NVOCC.

Korea-Cotonou, 24 TEU: 100% forwarder/NVOCC.

NileDutch Antwerp, Belgium, Antwerp

NileDutch Antwerp: approximately 1.000TEU

NileDutch Guangzhou, China, Guangzhou

Chinese Agency in Guangzhou:

Shekou - Lomé – 1.200TEU for 2015; Increase; 15% mainly from exporter, 10% mainly from importer and 75% from freight forwarder / NVOCC

Shekou - Tema – 700TEU for 2015; Increase; 15% mainly from exporter, 10% mainly from importer and 75% from freight forwarder / NVOCC

Shekou - Lagos – 2.500TEU for 2015; Increase; 15% mainly from exporter, 10% mainly from importer and 75% from freight forwarder / NVOCC

Shekou - Cotonou – 250TEU for 2015; Increase; 15% mainly from exporter, 10% mainly from importer and 75% from freight forwarder / NVOCC

* Above figure is for Shenzhen (Shekou) as Port of loading and depend on our SWAX allotment as well.

Currie SAS, France, Le Havre

We can expect a decrease for this container liner service especially due to the fact that we are really limited in space and weight. Our main port of loading was Thailand and the weight of the containers are high (22/27 T inclusive tare per container) and we had to stop.

NileDutch Shanghai, China, Shanghai

Same as trade to Far East – West Africa destinations, it is not easy to forecast volumes for 2015.

But 20-40% increase can be expected in line with close tie between China and African countries.

In this trade, forwarders enjoy more shares, around 90%, comparing with traders/exporters 10%

Sudmar, Cameroon, Douala

Here the containers volume will increase between to 10% to 15%; taking into account that China has signed a big contract with our government, the construction of deep sea port of Kribi, the construction of Longpangar (electricity power from water), constructions of roads, and construction of football stadium.

Next to it India is setting a factory of producing the agricultural trailers in the South, Korean have been also awarded the license to explore diamond in the East part of Cameroon.

Besides those projects our importers of building material, namely the Fokou, Sorepco, Afrique construction, Quiferou, etc. They are receiving nowadays 80% of their import from Asia, here items cost cheap, which suit the Cameroonian market.

F.1.4 South America East Coast – West Africa Container liner service

NileDutch Rotterdam, Netherlands, Rotterdam

Total volume 2010 was 207 TEU, mainly Luanda (190TEU).

Forecast of 20% growth.

Abbey Sea, Argentina, Buenos Aires

It is difficult to say, but understand that as our main market which is Angola is growing and will continue growing over the next year. I will say that the volume to Luanda could be increase in about 20 %. the volume will still be controlled mainly by importer (60 %) and traders (%)

NileDutch Antwerp, Belgium, Antwerp

NileDutch Antwerp:

Approximately 3.000TEU to Angola

Approximately 1.000TEU to Democratic Republic of the Congo

Mainly traders 60 % and 40 % freight forwarders.

Increase in approximately 15%

Marmedsa, Portugal, Leixoes

Portuguese Agency in Brazil: 50TEU: increase: 10% direct exporters, 90% freight forwarders.

Currie SAS, France, Le Havre

This is actually a very small part of our shipment we can expect an increase in 10% of the nowadays shipment.

Comexas Afrique, Democratic Republic of the Congo, Kinshasa, Matadi, Boma, Lubumbashi, and Goma

South America (Brazil, Argentina) to Matadi-Boma: 10% till 2015: 1.000TEU

Sudmar, Cameroon, Douala

Actually not so much is moving between South America and Douala, we have wine received from Argentina from importer Soccint, as people need to get use on the wine of South America, we forecast a slow increase.

Rochamar Agência Maritima SA, Brazil, Santos

In 2015 we can expect an increase in 20%, Brazilian agencies Rio de Janeiro, Santos and São Francisco Do Sul to West Africa destinations. 20% mainly exporter

F.1.5 West Africa Feeder Container liner service

NileDutch Luanda, Angola, Luanda

We might see an increase in our coastal bookings from Luanda to other Angolan ports, because of the industrialization process that is slowly taking place in especially Luanda. It is impossible to predict any numbers.

NileDutch Rotterdam, Netherlands, Rotterdam

Not directly, however cargo to Matadi, Libreville, Douala, Soyo, Boma, and Cabinda is served via Pointe Noire feeder container liner service (included in previous reporting).

Abbey Sea, Argentina, Buenos Aires

The growth for the transhipment ports understand will be much lower. No more than10 %. In this case the volume will still be controlled mainly by importer (60 %) and traders (20 %)

Comexas Afrique, Democratic Republic of the Congo, Kinshasa, Matadi, Boma, Lubumbashi, and Goma

South Africa to Matadi-Boma: 10% till 2015: 2.500TEU

West Africa to Matadi-Boma: 10% till 2015: 60TEU

Matadi-Boma to West Africa : 10% till 2015: 12 TEU

Sudmar, Cameroon, Douala

The exchange we are having in our costal container liner service actually depend on the exchange of property between the countries, also multinational companies established in Africa, in some area they implant factories for finished products and in some they are getting raw material, this is sometimes due to a lack of power supply, and sometimes depends on political code of investment.

In our case, here in Cameroon, Central Africa here, there are factories that produce and export their product to neighbouring countries:

Sosucam: producing sugar ship to Congo, Pointe Noire.

Chococam: they are producing candies and chocolate ship through the sub region, Congo, Pointe Noire, Democratic Republic of the Congo, Matadi and Libreville.

Socaver: this factory belongs to the Castel group and will supply in the region the needs of Castel brewery group regarding empties bottles, so they ship to Pointe Noire, in the past they were shipping to Angola, now it stopped, they ship to Lomé, Ghana, and Ivory Coast.

Cep : they ship pain to pointe noire, how do they see the sales in 2015, need to ask

Foodstuff:

A lot of food stuff is being ship between Cameroon and Gabon, Cameroon and Congo Brazzaville, Cameroon / Guinea (Malabo), here you have yams, beans, plantains…cassava, this traffic the big part is controlled with small landing craft.

Brasseries or Guinness

They also ship their product towards these directions

Based on above one can believe on an increase in view of people working to produce more, and also of the demography factor of both sides

Rochamar Agência Maritima SA, Brazil, Santos

In 2015 we can expect an increase in 20% from Brazilian agencies to West African ports, mainly exporter

F.2 Important new ports

F.2.1 Locations

The agencies were asked to name new ports they think are important in 2015.The results of the agency's answers are conveniently arranged in Figure 136 and listed below. The green pin represent countries, the blue pins represent specific ports.

Figure 136: Interesting ports according to the agents

Europe:

Russia

Poland

Bulgaria

Hamburg, Germany

Felixstowe, United Kingdom

Rouen, France

Spain

Italy

Turkey

Mediterranean ports

Asia:

Dubai, United Arab Emirate

Kandla, India

Nhava-Sheva, India

Mumbai, India

Mangalore, India

Kochi, India

Chennai, India

Tuticorin, India

Banjarmasin, Indonesia

Panjang, Indonesia

South Korea

South America:

Brazil

North America:

Canada

United States of America

Charleston, South Carolina, United States

Savannah, Georgia, United States

Africa:

West Africa East Coast

Tunis, Tunisia

Casablanca, Morocco

Dakar, Senegal

Conakry, Guinea

Freetown, Sierra Leone

San Pedro, Ivory Coast

Takoradi, Ghana

Tema, Ghana

Onne, Nigeria

Abidjan, Ivory Coast

Bata, Equatorial Guinea

Malabo, Equatorial Guinea

Beira, Mozambique

Maputo, Mozambique

Mombasa, Kenya

Dar al Salaam, Tanzania

Djibouti, Djibouti

F.2.2 Container volumes

The agencies are asked to specify the amount of container volumes they expect to come from the ports they think are interesting for 2015. The ports of discharge will be indicated as well. The answers per agency are listed below:

NileDutch Angola, Angola, Luanda

Mumbai (approx. 1000TEU/month)

Dubai (approx. 500TEU/month)

Charleston / Savannah (approx. 300 a 400TEU reefers/month)

Mediterranean ports (no idea of exact volumes)

NileDutch Rotterdam, Netherlands, Rotterdam

Tema: out of Netherlands/Belgium and Germany

Freetown to Amsterdam

Jardine Shipping, Indonesia, Jakarta

Panjang - Lomé - 80TEU/year

Panjang - Durban - 100TEU/year

Banjarmasin – Durban / Cape Town - 80TEU/year

Aquamaritime Logistics, Malaysia, Shah Alam

From Malaysia to Tanzania, Djibouti, and Mozambique annually about 8.000TEU.

Furness Shipping, Zurich, Switzerland

1.000TEU for Europe + Philadelphia

Supermaritime Benin SA Benin, Cotonou

We can expect in average of 70,000 MT cashew nuts loaded ex Cotonou to India and Vietnam (Ho chi minh city) & 11,200 cubic meter of timber to Kandla and various china ports.

SDV Togo, Togo, Lomé

Export volume can be 10 X 20' per call

Kukbo Express Co., Ltd., South Korea, Seoul

Based on the present market, the total volume to export from Korea is 100TEU per month. Regretfully, import volume is not good and maybe there is some imbalance status for container inventory.

Mehrtens & Schwickerath GmbH, Germany, Bremen

Load ports would be Hamburg, Bremerhaven, and Antwerp to Tema and Lagos with volumes of about 5.000TEU up to 7.500TEU.

Supermaritime Ghana Ltd., Ghana, Tema

Hamburg: 250TEU.

Felixstowe: 150TEU.

Rouen : 120TEU.

Hecksher, Denmark, Copenhagen

I expect to book containers, volume unknown, depends on rate level.

NileDutch Antwerp, Belgium, Antwerp

Ivory Coast: 4.000TEU

Nigeria: 4.000TEU

Ghana: approx. 1.500TEU

EC Africa: approx. 4.000TEU

Marmedsa, Portugal, Leixoes

We expect a regular volume of 50TEU per voyage.

NileDutch Guangzhou, China, Guangzhou

Around 400TEU per year for Conakry from Shekou

Around 600TEU per year for Onne from Shekou

Around 500TEU per year for Dakar from Shekou

NileDutch Tianjin, China, Tianjin

I think there will be 500TEU per year between Tianjin and Abidjan.

Currie SAS, France, Le Havre

Bata Malabo: as per various info around 500TEU per year seems workable

Regarding volume out of Poland, Bulgaria and Russia, this is only the beginning so client do not have the actual volume and do not know if this will be for a long time only for 1 or 2 year

Cross Marine service Ltd., Nigeria, Lagos

Total 6.500TEU (3.000TEU for Mersin, 2.000TEU for Nagoya and 1.500TEU for Chittagon)

Thos.Carr & Son, Italy, Genoa

Mainly to (Southbound) for some 10.000/15.000TEU per year + project cargo

Comexas Afrique, Democratic Republic of the Congo, Kinshasa, Matadi, Boma, Lubumbashi, Goma

No idea of the amount of container volumes in 2015 for each port of loading and port of discharge, but we can give you a total estimation for the volume of all the lines (NileDutch, Maersk, Delmas, CMDC, and Grimaldi) for and from Matadi / Boma:

POL to Matadi-Boma: + 10%: 72.000TEU

Matadi-Boma to POL: + 10%: 12.300TEU

NileDutch Shanghai, China, Shanghai

Every week, from Shanghai, more than 100TEU

Sudmar, Cameroon, Douala

As far as we are concerned, there are a lot of ports where we do not call, but in fact do not think that those ports have a lot of potential in containers like where we are calling now.

So I do not have any port in mind as such.

Rochamar Agência Maritime S/A, Brazil Santos

We need to have a competitive rate in order to carry volumes to Tema.

NileDutch Qingdao, China, Qingdao

As per market questionnaire result, maybe 100-150TEU per month ex Qingdao to Abidjan (only for pure trade cargo), the volumes of project cargo is difficult to statistic because project cargo is unstable.

F.2.3 Additions

NileDutch Angola, Angola, Luanda

The change of strategy of our competitors is very important. Maersk Angola has become far more customer friendly over the last year, also CMA CGM will work on this the years to come.

Jardine Shipping, Indonesia, Jakarta

We need to develop the same strength as the competitors.

Aquamaritime Logistics, Malaysia, Shah Alam

Expansion via new vessels: purchased or leased.

Adding new port calls.

Investing in computer system and software

Supermaritime Benin SA Benin, Cotonou

Maersk group owns Maersk oil gas. They are exploring off shores and produce fuel for sale. Their container business enjoys this comparative advantage in connection with sea freight rates applied in the market. Let’s remind that the bunker represent up to 45% of the cost related to vessel running. Besides, these competitors in general use transhipments hubs in order to serve West Africa ports in direct from these transhipment ports. That way, they could maximise volume loaded from different locations and reach acceptable frequency sailing.

SDV Togo, Togo, Lomé

Local market is very small and we have to be aggressive and more competitive in terms of transit time and ocean freight

Abbey Sea, Argentina, Buenos Aires

The most constant and important competition are Maersk/Safmarine, as they are part of a big group and if they want a market they have power enough to go for it even if it means losing money.

Kukbo Express Co., Ltd., South Korea, Seoul

Relationships with customers and advertisement

Mehrtens & Schwickerath GmbH, Germany, Bremen

MSC, Maersk and CGM/CMA are working with an aggressive rate policy,

They are able to offer very low rates which are based on gate in all in rate structures.

Supermaritime Ghana Ltd., Ghana, Tema

NileDutch will have to be bold and compete in the West African market .opportunity lost now means opportunity lost to built and grow in the only growing market.

Hecksher, Denmark, Copenhagen

The main problem for agents in Scandinavia is that we have no equipment on stock and NileDutch will not lease in equipment and if equipment has to be picked up in Antwerp rate will be too expensive.

NileDutch Antwerp, Belgium, Antwerp

A good agency network is very important.

NileDutch Guangzhou, China, Guangzhou

While Africa trade is almost the most profitable if comparing with Europe, US and so on, more and more carriers would join the competition. As we can see, CSAV, Hanjin, UASC already opened WAF container liner service and then competition become further intensified. Thus, we may need to keep our container liner service more stable, to increase frequency if possible, and to enhance our image and influence on FEWA container liner service. On the other hand, we may adjust our market/rate strategy if needed as well.

NileDutch Tianjin, China, Tianjin

Could we provide special container on our vessels?

Cross Marine service Ltd., Nigeria, Lagos

Competition generally is key to development. It makes you eager to explore other areas of development

Thos.Carr & Son, Italy, Genoa

Actually to maximize direct container liner service to Angola there are no direct calls performed by actual players base liner container liner services

Comexas Afrique, Democratic Republic of the Congo, Kinshasa, Matadi, Boma, Lubumbashi, Goma

The main problem for the lines in DRC is the space availability in the ports (Matadi and Boma).

NileDutch Shanghai, China, Shanghai

Here in China, for our container liner services, we face huge competitions from different carriers. But as a leading player for WAF destinations, NileDutch has its advantage to survive among these monsters. What we are referring to is: container liner service quality-quick response / customer container liner service / short transit times, which is unique in this market. We have to stick to this container liner service advantage in order to distinguish ourselves.

Sudmar, Cameroon, Douala

As far as competition is concerned, they continue to call our port on regular basis, at least once a week, whereby, it is only three months ago that we are coming to Douala with our feeder twice a month, also we cannot lift important tonnage due to the small size of feeder.

You have asked about the door to door container liner service, in my opinion NileDutch should as well be involved in the shore maritime activities with his partners around the world, as when you look at competition, what they lose at sea; they gain at shore with those various container liner services.

Rochamar Agência Maritime S/A, Brazil Santos

Depends on the business involved, we can close containers with rates larger than the ones from the competition due to our good relationship with clients and NileDutch container liner services.

F.3 Customer

In this part of the questionnaire the agencies were asked to answers the questions form the customers' point of view. The customer types are split up in mainly exporter, mainly importer and freight forwarder/NVOCC. The agencies were asked to give scores from one to ten. The meaning of each score can be interpreted as:

1-2: Extremely unimportant

2-3: Very unimportant

3-4: Unimportant

4-5: Somewhat unimportant

5-6: Neutral

6-7: Somewhat important

7-8: Important

8-9: Very important

9-10: Extremely important

The questions answered are:

How important are price rates for the customer?

How important are the frequency of departure for the customer?

How important are the transit times for the customer?

How important is the reliability of schedules for the customer?

How important are the capacity / space availability on the date they want to ship for the customer?

How important is a direct call with the port of destination for the customer?

The results in Table 116 show an overall average of 8,2/10. So the six subjects questioned are indicated to be very important for the customers. Looking more into detail at the overall scores per question, the average score per question fits into the important and very important range. Looking at the average scores per customer these numbers fit in the very imported range. When looking at the average scores per question per customer, the figures varies between important and very important. The overall score and the average score per question are obtained assuming that the types of customers in the market have an equal share of 1/3. This is in fact not realistic because it varies per trade. Because exact numbers are not known an equal proportion assumption is used in the calculations.

Table 116: Average scores per question per customer type

Average scores per question per customer type out of ten.	Mainly exporter	Mainly Importer	Freight forwarder / NVOCC	Average
Question 1	8,6	8,3	8,8	8,6
Question 2	7,9	8,2	8,3	8,1
Question 3	7,9	8,0	8,3	8,0
Question 4	8,4	8,1	8,6	8,4
Question 5	8,4	8,5	8,5	8,5
Question 6	7,8	7,8	7,6	7,7
Average	8,2	8,2	8,3	
overall average		8,2		

Table 117 shows the rankings according to importance for each customer type and the overall ranking of the customers. The overall ranking shows that the price rates followed by the capacity/space availability and the reliability of the schedule form the top three according to importance. The frequency of departure and the transit times share a fourth position and whether the vessel has a direct call with the port of destination is placed on the fifth place. Looking separately at the customer types is shows that the mainly exporter and the freight forwarder / NVOCC have the same ranking order. However the scores in Table 116 show differently. The capacity / space availability on the date the mainly importer wants to ship is at the first place instead of the third place with the two other customer types. The price rates and the reliability of the schedules are one position down for the mainly importer compared with the two others, but the transit times is two positions up and the frequency one. This shows a clear difference for the mainly importer compared with the mainly exporter and the freight forwarder NVOCC.

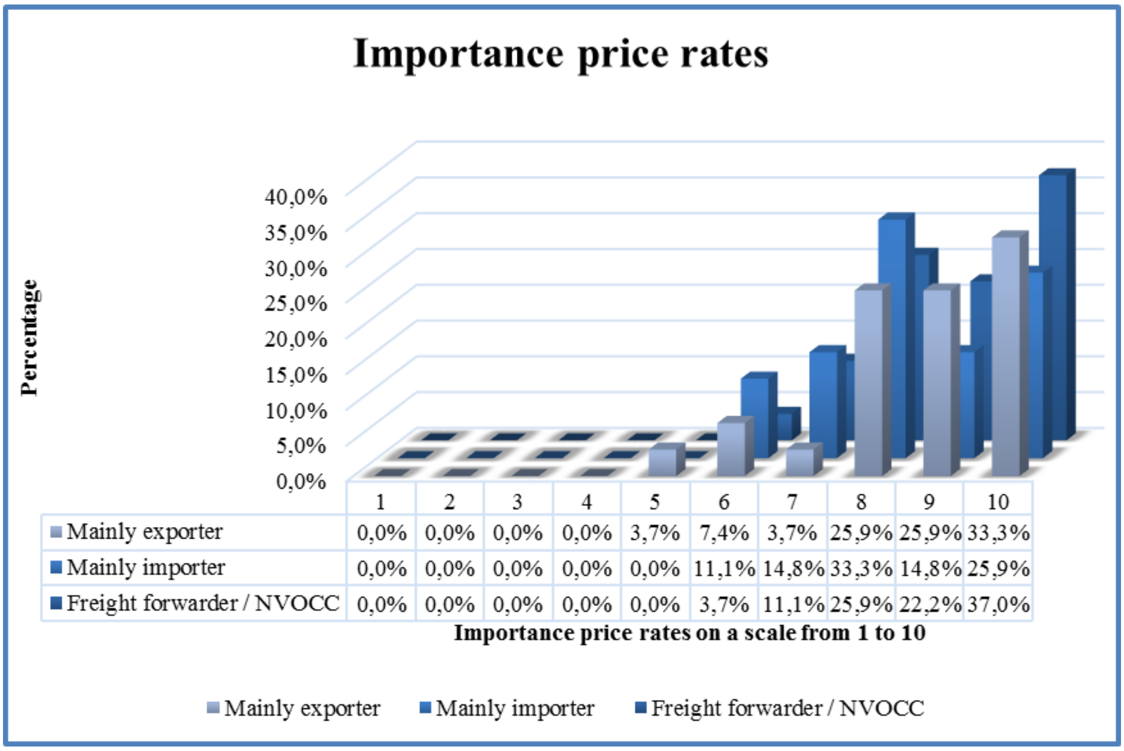
Table 117: Ranking according to importance

Ranking according to importance	Mainly exporter	Mainly importer	Freight forwarder / NVOCC	Overall ranking
1	Price rate	Capacity / Space	Price rate	Price rate
2	Reliability schedule	Price rate	Reliability schedule	Capacity / Space
3	Capacity / Space	Frequency - Reliability schedule	Capacity / Space	Reliability schedule
4	Frequency - Transit times		Frequency - Transit times	Frequency - Transit times
5		Transit times		
6	Direct call	Direct call	Direct call	Direct call

F.3.1 Price rates

Looking at the three graphs in Figure 137 it is clear that the mainly importer does not value price rate as much as the mainly exporter and freight forwarder / NVOCC do. The highest percentages in Figure 137 show 33,3% and 37,0% with a common rating of 10 for respectively the mainly importer and the freight forwarder / NVOCC and 33,3% at rating 8 for the mainly exporter. The three highest scores per customer type are good for 74%-85,0% for all the responses. Looking at the average score per customer the freight forwarder / NVOCC (8,8/10) values the prices rates more than the mainly exporter (8,6/10) and the mainly importer (8,3/10).

Figure 137: Importance price rates

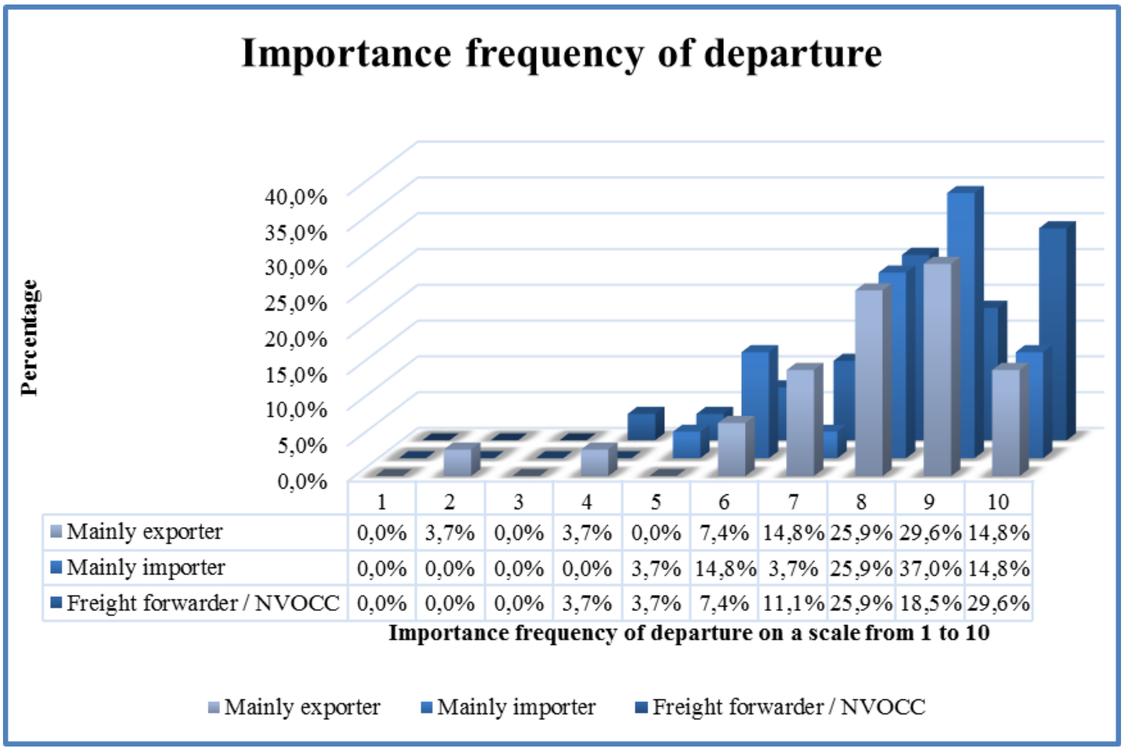


	1	2	3	4	5	6	7	8	9	10
Mainly exporter	0,0%	0,0%	0,0%	0,0%	3,7%	7,4%	3,7%	25,9%	25,9%	33,3%
Mainly importer	0,0%	0,0%	0,0%	0,0%	0,0%	11,1%	14,8%	33,3%	14,8%	25,9%
Freight forwarder / NVOCC	0,0%	0,0%	0,0%	0,0%	0,0%	3,7%	11,1%	25,9%	22,2%	37,0%

F.3.2 Frequency of departure

Figure 138 show that the freight forwarder / NVOCC values the frequency of departure more than the mainly importer and the mainly exporter. The highest percentages per customer type in Figure 138 show 29,6% with rating 10 for the freight forwarder / NVOCC and 29,6% and 37% at rating 9 for respectively the mainly exporter and mainly importer. The three highest scores are good for 70,3%-77,7% per customer for all the responses. Looking at the average score per customer the freight forwarder / NVOCC (8,3/10) values the frequency of departure more than the mainly importer (8,2/10) and the mainly exporter (7,9/10).

Figure 138: Importance frequency of departure

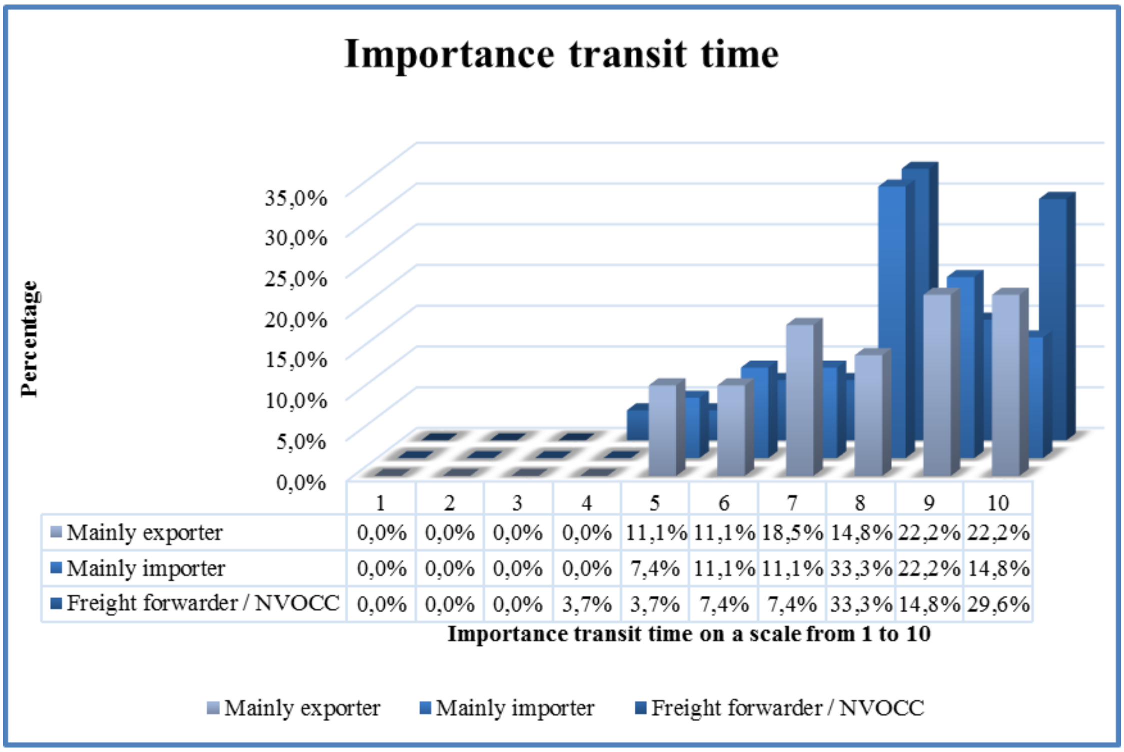


	1	2	3	4	5	6	7	8	9	10
Mainly exporter	0,0%	3,7%	0,0%	3,7%	0,0%	7,4%	14,8%	25,9%	29,6%	14,8%
Mainly importer	0,0%	0,0%	0,0%	0,0%	3,7%	14,8%	3,7%	25,9%	37,0%	14,8%
Freight forwarder / NVOCC	0,0%	0,0%	0,0%	3,7%	3,7%	7,4%	11,1%	25,9%	18,5%	29,6%

F.3.3 Transit times

Looking at the three graphs in the Figure 139 it is clear that the mainly importer does not value the transit time as much as the mainly exporter and freight forwarder / NVOCC do. The highest percentages per customer type in Figure 139 show 22,2% for the mainly exporter at rating 10 and 33,3% at rating 8 for both the mainly importer and the freight forwarder / NVOCC. The three highest scores are good for 62,9%-77,7% per customer for all the responses. Looking at the average score per customer the freight forwarder / NVOCC (8,3/10) values the prices rates more than the mainly importer (8,0/10) and the mainly exporter (7,9/10).

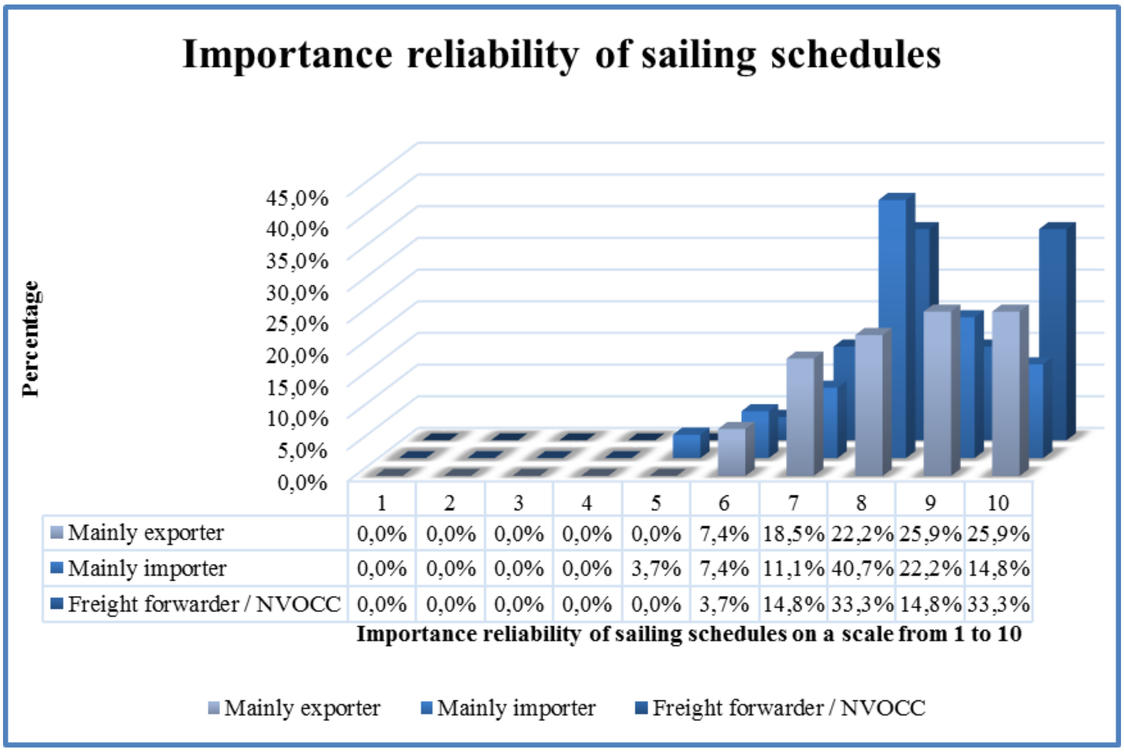
Figure 139: Importance transit time



F.3.4 Reliability of sailing schedules

Figure 140 show that the freight forwarder / NVOCC values the frequency of departure more than the mainly exporter and the mainly importer. The highest percentages per customer type in Figure 140 shows 33,3% and 25,9% with rating 10 for respectively the freight forwarder / NVOCC and the mainly exporter. 40,7% at rating 8 for the mainly importer. The three highest scores are good for 74%-81,4% per customer for all the responses. Looking at the average score per customer the freight forwarder / NVOCC (8,6/10) values the frequency of departure more than the mainly exporter (8,4/10) and the mainly exporter (8,1/10).

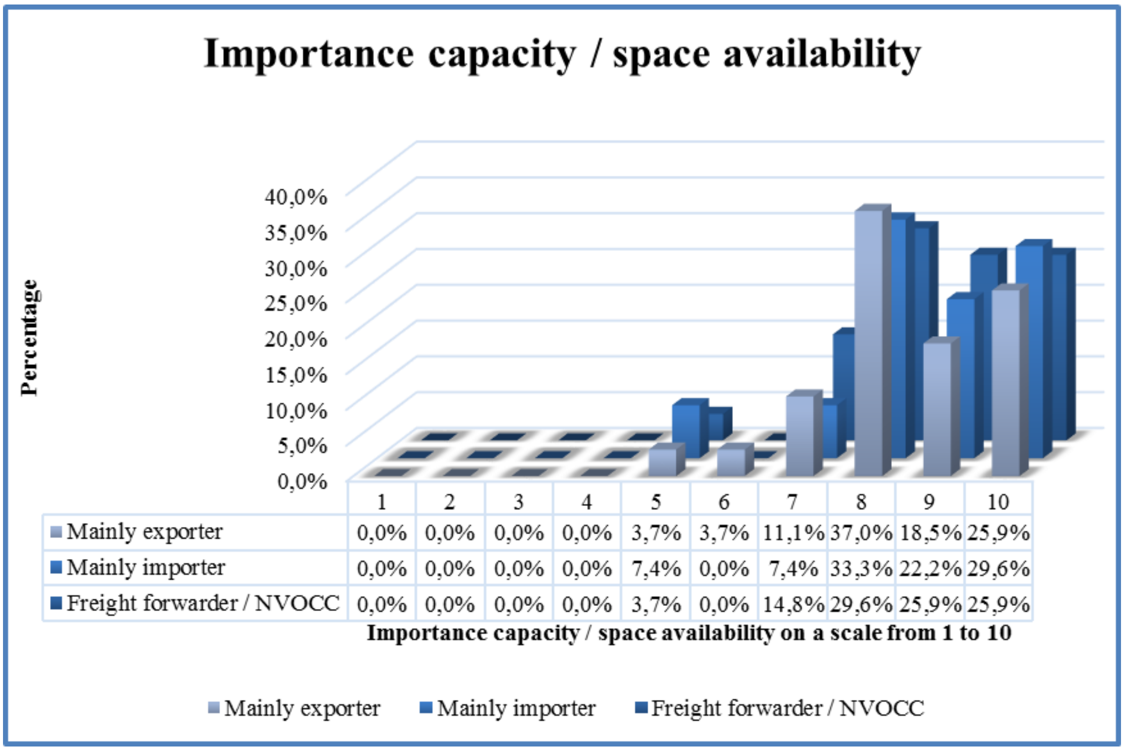
Figure 140: Importance reliability of sailing schedules



F.3.5 Capacity / Space availability on the date you want to ship

Looking at the three graphs in the Figure 141 it is clear that the mainly exporter does not value the transit time as much as the mainly importer and freight forwarder / NVOCC do. The highest percentages per customer type in Figure 141 show 37%, 33,3%, and 29.6% for respectively the mainly exporter, the mainly importer, and the freight forwarder / NVOCC at rating 8. The three highest scores are good for 81,4%-85,1% per customer for all the responses. Looking at the average score per customer the mainly importer (8,5/10) and freight forwarder / NVOCC (8,5/10) value the prices rates more than the mainly exporter (8,4/10).

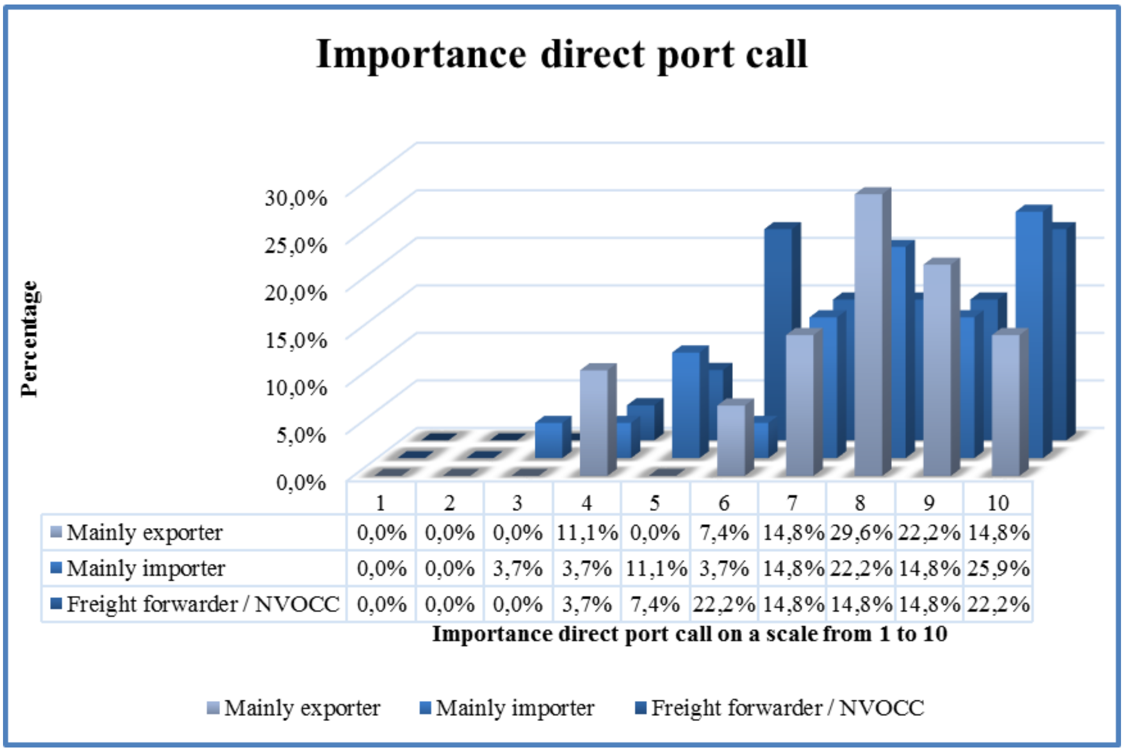
Figure 141: Importance capacity / space availability



F.3.6 The vessel has a direct call with the port of destination

Figure 142 show that the mainly exporter and the mainly importer value direct calls with the port of destination more than the freight forwarder / NVOCC. The highest percentages per customer type in Figure 142 show 25,9% and 22,2% with rating 10 for respectively the mainly importer and the freight forwarder / NVOCC. 29,6% at rating 8 for the mainly exporter. The three highest scores are good for 59,2%-66,6% per customer for all the responses. Looking at the average score per customer the mainly exporter (7,8/10) and the mainly importer (7,8/10) value the frequency of departure more than the freight forwarder / NVOCC (7,6/10).

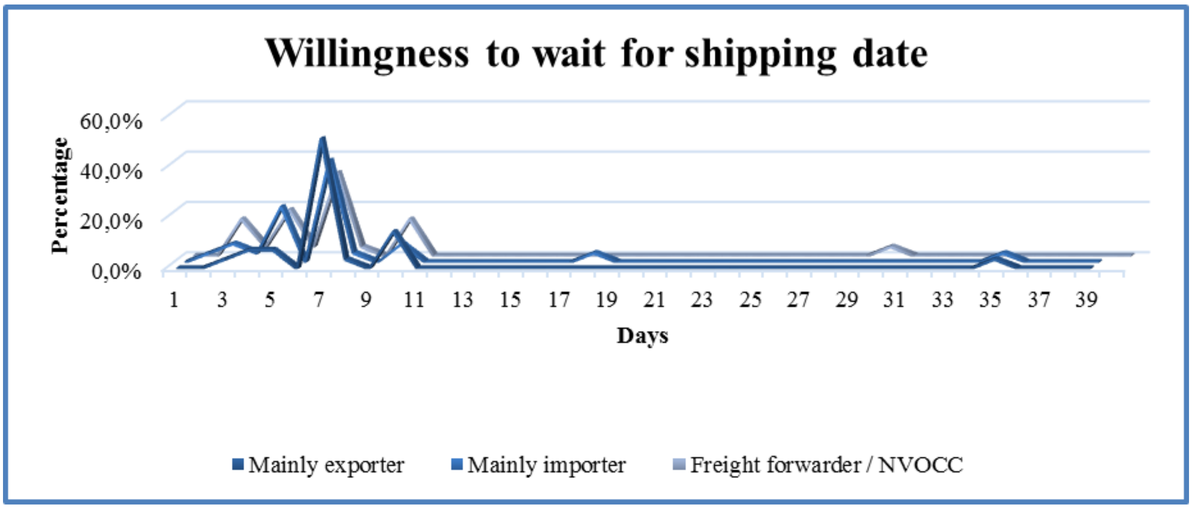
Figure 142: Importance direct port call



F.3.7 Willingness to wait

The agencies are asked to estimate how long the mainly exporter, mainly importer and the freight forwarder are willing to wait for a shipment when the desired shipping date is not available. The results are displayed in Figure 143. Three, five, seven and ten days are indicated to be the maximum days they are willing to wait. The maximum value in the graph is located at seven days. The average values show that the freight forwarder / NVOCC is willing to wait for 6,7 days, the mainly exporter 7 days, and the mainly importer 7,5 days.

Figure 143: Willingness to wait for shipping date



F.4 Wishes customer relevant for container liner services in 2015

F.4.1 Is there e need for the door to door concept?

The question if there is a need for NileDutch to offer its customers the door to door concept in 2015 is asked to the agencies. The results of the agency's answers are conveniently arranged in Figure 144 and listed below. What is leaping out of the results is that the demand for the door to door concept comes solely from Europe. Landlocked countries in West Africa are also requesting party for door to door transport. This will save them time, costs, and give them more reliability. Landlocked countries are: Mali, Burkina Faso and Niger (Niamy and Maradi). In West Africa several agencies indicated Kinshasa as a city with a big demand for door to door transport. Two reasons for wanting this concept can be concluded: Places further away from the ports like inland cities and landlocked countries benefit from this and the customer itself wishes to get a better container liner service by the use of the door to door concept.

Figure 144: Area door to door concept

Europe:

Denmark

Germany

Netherlands

Belgium

France

Portugal

Africa:

Mali

Niger

Burkina Faso

Cameroon

Gabon

Congo

DRC

Angola

South Africa

F.4.2 Additional wishes customer for 2015

An open question for other wishes showed the next results:

Fixed sailing schedule (Portugal, China)

Higher frequency (China)

More stable container liner service (China)

Online tools:

Track and trace

web booking

E-bill of lading

E-release

Equipment availability

21 free days for demurrage / detention for all hinterland destination cargoes

Better quality of containers

More reefer equipment

Container deports in the German hinterland and in Austria

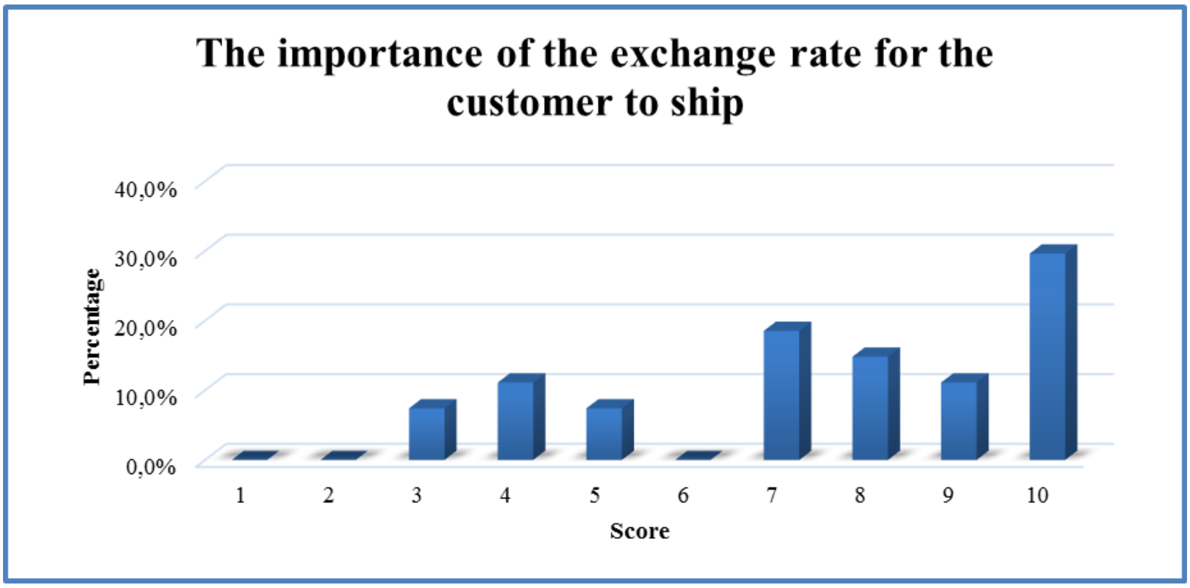
-A truck container liner service from Matadi/Boma to Kinshasa in The Democratic Republic of the Congo

F.5 Exchange rates

F.5.1 Importance

The importance of the exchange rate according to the agencies for the customers has an uneven spread. Figure 145 shows this uneven spread; However the averaged value for the score given is 7,5/10. Meaning that the exchange rates play an important role for the customers.

Figure 145: Importance of the exchange rate for the customer to ship



F.5.2 Behaviour customer

When the exchange rates vary, the behaviour of the customers changes as well. The agencies were asked to describe the behaviour of the customer when exchange rates change.

In general the trades from Asia to Africa and from South America to Africa have freight rates in US Dollar, the trade from Europe to Africa in Euro. The trades from Africa to Europe, Asia, or South America are done in Euro or US Dollar according to the agreements made with the agent. An exception is the container transport from Angola to the rest of the world. This is always done in US Dollar because their international trade is done in US dollars.

Exceptions in choice of currency can only be made if the customer transports big volumes and / or has its own business in US dollars or Euro. An example of this is Heineken. They do business using the US Dollar and are an important customer because they transport big volumes, so when they ship from Europe to Africa they exceptionally get freight rates in US Dollar instead of Euro. Although the currency does not necessary need to be fixed, the reasons for requesting another currencies is not that one currency is more beneficial to the company than another one.

What does have an influence on the customers behaviour are changes in exchange rates. According to the extent of the change the customer will no longer sign long-term contracts, the export will decreases, the shipments will be postponed until further notice or the country of export will be relocated. Relocation is only the case if the commodities are available at different places.

Concrete examples:

When the Euro vs. US Dollar course increases too much, the imports changes from Europe to the East Coast of South America.

When the US Dollar devalues in comparison with the Chinese Yuan or the Hong Kong Dollar non longer term contract are signed, the export from China decreases, the shipments are postponed until further notice or the country of export is relocated.

If the US Dollar or the Euro is getting weaker than other local currencies the export bookings are postponed until further notice and the import bookings increase. Examples of this are Switzerland with the Swiss francs and the Indonesian Rupiah.

F.6 Congestion

Two types of congestion can be distinguished: Congestion caused by weather condition and congestions caused by the lack of infrastructure. Because weather conditions cannot be influenced, the congestion caused by the lack of infrastructure is only relevant in the agency questionnaire.

Congestion within the NileDutch trades occurs in Africa and in South America. Europe and Asia do not know congestion.

Lomé, Togo:

The congestion in the port of Lomé should be better in 2015 due to the construction of a third quay and the extension of the container terminal by Bolloré Africa Logistics.

Luanda, Angola:

The economy of Angola largely depends on their oil revenues. If this keeps on growing the import will decrease and congestion may come back. The government is taking steps to privatize most or all Angolan ports so this will influence the congestion positively. The completion of the new jetty in Cabinda should drastically reduce the congestion in 2012. An outstanding government project of a new port for Luanda will reduce the congestion in the future to a minimum, if executed.

F.7 Protectionism

Luanda: Feeder container liner services can only be done by domestic carriers.

South: From South Korea to China or the other way around only Korean and Chinese feeder container liner service are allowed.

Brazil: Feeder container liner services need to use the Brazilian flag.

China: Feeder container liner services can only be done by domestic carriers.

F.8 Competition

F.8.1 Carriers present in the West African container market

The agents were asked to indicate the competitors present in their region. Because only the carriers present in the West African container market are important, only the results of the West African agencies are applicable. The list of competitors out of which they were able to choose are de carriers indicated by Dynamar (2010). The indicated competitors by the African agencies can be found in Figure 146.

Figure 146: Competitors present in the West African market according to the African Agencies

Agency	NileDutch, Luanda, Angola	Supermaritime Benin S.A., Cotonou, Benin	SDV Togo, Lome Togo	Supermaritime Ghana LTD., Tema, Ghana	Cross marine service limited, Lagos, Nigeria	Comexas Afrique, Kinshasa, DRC	Sudmar, Douala, Cameroon	Total:
APM - Maersk group		X	X	X	X	X	X	6
MSC	X	X		X	X			4
CMA CGM Group	X	X	X	X	X	X	X	7
Hapag - Lloyd		X	X	X				3
CSAV Group		X		X				2
CSCL		X	X	X				3
MOL	X	X		X				3
NYK Line		X	X	X				3
K Line		X	X	X				3
Zim		X		X				2
PIL	X	X	X	X				4
Grimaldi (Napoli)	X	X		X	X	X	X	6
UAL	X							1
Nordana								0
Euroafrica								0
Lin Lines	X							1
Portline								0
Transinsular								0
Clipper Lines	X							1
Bacoliner								0
AEL		X						1
Secil Maritana	X	X						2
Angola South Line								0

The results show that Nordana, Euroafrica, Portline, Transinsular, Bacoliner, and Angola South Line are not present in the West-African Market. However the agencies of Ivory Coast, Gabon, Congo, and South Africa did not fill out the questionnaire. So the absence of these six carriers in this questionnaire does not mean the absence of the in the West African container market.

F.8.2 Competitors price changes

Abbey Sea, Argentina, Buenos Aires

The rates of everyone are about 25% lower than NileDutch's Understand they will be mostly in the same way for 2015 as they are not offering direct container liner services are we do.

Marmedsa, Portugal, Leixoes

APM-Maersk has prices around 150 US Dollar, for 2015 I expect a similar price.

NileDutch Guangzhou, China, Guangzhou

Now the clients are more sensitive to freight thus other competitors offer more flexible rates and we expect that the freight difference is still a key element for client's consideration.

NileDutch Tianjin, China, Tianjin

Maersk provides lower prices in the market and have a lot of space available.

NileDutch Hong Kong, China, Hong Kong

Freight will more up at around 8% per year to recover the operational costs.

Currie SAS, France, Le Havre

MSC: very aggressive since they started serving Africa. For example: They always offer 100 Euro / TEU less than the market.

Grimaldi (Napoli): Strange commercial way of thinking, I mean that they can be aggressive by under quoting (100 euro to 300 Euro/TEU less than the market (nowadays this is the case out of Mediterranean ports of loading) during 1 month to a destination, then after change the destination or port of loading they are interested in and under quote the new forecast.

SAFMARINE and CMA CGM Group: They do protect their own business by very low rate, on our side we are mainly in competition with them to Pointe Noire but our container liner service (direct call, good frequency, relation with client) saves us. I also think that in the future if we can keep our way of thinking, especially for documentation, issue Bill of Lading in various POL and not somewhere in the world as CMA CGM and MAERSK Group do, this will be a point we as commercial can sell to have more bookings (this will be a personal container liner service, personal contact...)

Crossmarine services Ltd., Nigeria, Lagos

Generally freight rate continue to be a determinant factor in choosing the shipping company. We are looking at amore stiffer competition by the year 2015 as more lines are likely to come on board.

Comexas Afrique, Democratic Republic of the Congo, Kinshasa, Matadi, Boma, Lubumbashi, and Goma

Maersk-Safmarine is very aggressive with their freight rates.

NileDutch Shanghai, China, Shanghai: Big carriers are aggressive in China to generate cargo. But on the long run rates could go up, due to upturn of cargo volumes and the downturn of the exchange rate. (USD - CNY)

Sudmar, Cameroon, Douala

I can see Maersk and Bolloré increase the fees of their container terminal operation.

Grimaldi (Napoli) wants to increase their tariff.

Rochamar Agência Maritime SA, Brazil, Santos

Usually competition offers 200 USD / TEU less than NileDutch.

NileDutch Qingdao, China, Qingdao

CMA CGM and MSC always offer lower rates to attract customers in the market.

F.8.3 Investments in new offices

NileDutch Angola, Angola Luanda

CMA CGM might invest in new offices.

MSC Angola will receive their newly constructed office later this year.

Aquamaritime Logistics, Malaysia, Shah Alam

CMA CGM/Delmas: Hub in Port Kelang, Centralized finance in Kuala Lumpur for Asia ports

Maersk: Hub in Port Tanjung Pelepas

NYK: Asia Pacific Head Office in Singapore

NileDutch Guangzhou, China, Guangzhou

We expect that newcomers or existing African “players” will launch more container liner service to new *destinations.*

Currie SAS, France, Le Havre

Nowadays they are not speaking about any new offices expect MSC who is speaking about Pointe Noire.

Sudmar, Cameroon, Douala

With the creation of the deep seaport which will be put into operation by 2015, it is likely that Maersk and Bolloré will invest in an office next to the container terminal.

F.8.4 Recruitment new personnel

NileDutch Luanda, Angola, Luanda

CMA CGM is constantly recruiting, lot of changes on the top lead to his.

Supermaritime Ghana Ltd. Ghana, Tema

New lines always recruit former (senior) staff from the competition first. Same has been and will be the norm.

NileDutch Guangzhou, China, Guangzhou

We feel other carriers are more conservative than before and may not expand during coming years for their staff base, then it would be more stable or some carriers may reduce offices and combine together.

NileDutch Tianjin, China, Tianjin

CMA CGM Tianjin is recruiting some persons from Maersk.

Comexas Afrique, Democratic Republic of the Congo, Kinshasa, Matadi, Boma, Lubumbashi, Goma:

Maersk- Safmarine, Delmas, CMDC, and Grimaldi (Napoli) are not recruiting right now. It depends on the market. If there is an increase in 10% they have to recruit some new personnel.

F.9 Agencies point of view

Supermaritime Benin SA, Benin, Cotonou

The vessels frequency should be increased. It is good to have a weekly container liner service in order to catch up with shippers/consignees shipment readiness.

SDV Togo, Togo, Lomé

European ports are also interesting for us to export coffee and cocoa loading.

Kukbo Express Co., Ltd., South Korea, Seoul

The Chinese government is interested in developing the North-East area of China (Hunchun, Yanji, and Tumen). But they do not have and sea-port. The nearest port is Najin, North Korea and Jarubino, Russia. If they can use this 3rd country ports, our Busan port can be a god option as transhipment port.

Mehrtens & Schwickerath, Germany, Bremen

In my opinion no further shipping areas should be added to the present schedules.

Supermaritime Ghana Ltd., Ghana, Tema

Need to have a consistent European container liner service to West Africa.

Aim to operate a weekly Asia / South East Asia container liner service to West Africa on account of the envisaged increase in China trade to West Africa from this year 2011.

NileDutch Antwerp, Belgium, Antwerp

Potential at the East Coast of Africa.

Huge potential in the Democratic Republic of the Congo (Lubumbashi and Katanga area)

Marmedsa, Portugal, Leixoes

Offer South Africa via Luanda.

NileDutch Guangzhou, China, Guangzhou

If we do want to open container liner service to new ports, we would suggest ports of loading to prepare recruiting several weeks before the container liner service kicks off. Not only for market questionnaire beforehand. For previous SWAX adding Cotonou, I think ports of loading did not prepare to more market recruiting.

Currie SAS, France, Le Havre

I think that a good container liner service out of India will be very important for the near future.

Cross Marine service Ltd.

In the ports of Mersin, Nagoya, and Chittagon in Bangladesh there is a lot of demand for sesame seeds.

NileDutch Shanghai, China, Shanghai

Port of loading wise, I prefer to develop Xiamen and Fuzhou in China.

Sudmar, Cameroon, Douala

In the Mediterranean ports we have a big part of coffee and small quantities of cocoa, in addition a lot of timber moves from Cameroon to Mediterranean ports.

NileDutch Qingdao, China, Qingdao

Could we consider offering special containers, open top for glass, etc.?

Appendix G : Demand

G.1 Demand NileDutch 2011 per port

Table 118: NileDutch 2011 TEU trip matrix per port of NileDutch's container liner services

		Asia						Europe				SA	West Africa																	
	Origen / Destination	Ningbo	Qingdao	Shanghai	Shekou	Singapore	Xingang-Tianjin	Antwerp	Le Havre	Leixoes	Lisbon	Buenos Aires	Boma	Cabinda	Cape Town	Cotonou	Douala	Durban	Lagos	Libreville	Lobito	Lomé	Luanda	Matadi	Namibe	Pointe Noire	Soyo	Tema	Total	
Asia	Ningbo												15	220	24	142	55	818	702	11	896	357	2.662	1.971	43	41		854	8.811	60.001
	Qingdao					14							11	59	286		319	1.375	589	13	581	154	1.644	585	152	156	7	52	5.997	
	Shanghai												9	264	161	72	294	1.676	2.557	305	1.645	469	2.937	1.404	215	444	17	1.938	14.407	
	Shekou												44	441	59	105	26	918	1.340	75	1.188	602	4.180	1.646	243	238	9	422	11.536	
	Singapore		58	6	10								14	586	231	399	82	1.179	1.321	274	1.392	1.033	3.144	1.272	622	296	78	1.352	13.349	
	Xingang-Tianjin													69	186	28	181	961	244	12	340	36	1.708	1.184	185	603		164	5.901	
Europe	Antwerp									4			935	895			473		26	895	1.996		13.536	4.426	883	2.040	74	112	26.295	54.801
	Le Havre												4	82			200			394	520		1.452	371	120	1.620	29		4.792	
	Leixoes													548			27			155	1.820		8.356	126	257	111	171		11.571	
	Lisbon													451			22			5	1.379		9.507	53	220	366	116	24	12.143	
South America	Buenos Aires													427			3			14	871		4.103	379	450	141	72		6.460	16.339
	Rio de Janeiro													13						38	6		275	35					367	
	Santos													232						58	359		3.607	340	192	293	51		5.132	
	São Francisco do Sul													98						38	229		3.456	235	88	184	51	1	4.380	
West Africa	Boma																									4			4	22.350
	Cape Town												6	166	1		2			15	28		2.272	421	12	270			3.193	
	Cotonou			20	1																								21	
	Douala			46	7	4	20	507	89		40									26			7	83		568		22	1.419	
	Durban		20	171	10	143	379						212	86	162	49	27		1.069	179	230	106	2.668	1.717	321	628	11	543	8.731	
	Lagos	1	3	592	41	88	2										38	130					3	2		21			921	
	Libreville																	4								13			17	
	Lobito			6				39	34	1	1																		81	
	Lomé	2	100	160		80		16		18								25										168	569	
	Luanda		2	74	2	170	3	176	98	33	7			210	2			7											784	
	Matadi																1									1			2	
	Pointe Noire		36	450		719		264	53	18	6	3	2		21		399	339					63						2.373	
	Tema		127	1.027	158	1.352	38	1.242	247							6		18	4	4				6		6			4.235	
	Total	3	346	2.552	229	2.570	442	2.244	521	74	54	3	1.252	4.847	1.133	801	2.149	7.450	7.852	2.511	13.480	2.757	65.580	16.256	4.003	8.044	686	5.652	153.491	
		6.142						2.893				3	144.453																	

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011

SA: South America

G.2 Demand NileDutch 2015 per port

Table 119: Forecast of NileDutch 2015 TEU trip matrix per port of the NileDutch's container liner services based on the trade and trade lane forecasts

		Asia						Europe				SA	West Africa																	
	Origen / Destination	Ningbo	Qingdao	Shanghai	Shekou	Singapore	Xingang-Tianjin	Antwerp	Le Havre	Leixoes	Lisbon	Buenos Aires	Boma	Cabinda	Cape Town	Cotonou	Douala	Durban	Lagos	Libreville	Lobito	Lomé	Luanda	Matadi	Namibe	Pointe Noire	Soyo	Tema	Total	
Asia	Ningbo												23	337	37	217	84	1.252	1.074	17	1.371	546	4.074	3.016	66	63		1.307	13.484	91.690
	Qingdao												17	90	438		488	2.104	901	20	889	236	2.516	895	233	239	11	80	9.156	
	Shanghai												14	404	246	110	450	2.565	3.913	467	2.517	718	4.495	2.149	329	679	26	2.966	22.048	
	Shekou												67	675	90	161	40	1.405	2.051	115	1.818	921	6.397	2.519	372	364	14	646	17.654	
	Singapore												21	897	354	611	125	1.804	2.022	419	2.130	1.581	4.812	1.947	952	453	119	2.069	20.316	
	Xingang-Tianjin													106	285	43	277	1.471	373	18	520	55	2.614	1.812	283	923		251	9.031	
Europe	Antwerp												1.431	1.370			724		40	1.370	3.055		20.715	6.773	1.351	3.122	113	171	40.235	83.860
	Le Havre												6	125			306			603	796		2.222	568	184	2.479	44		7.334	
	Leixoes													839			41			237	2.785		12.788	193	393	170	262		17.708	
	Lisbon													690			34			8	2.110		14.549	81	337	560	178	37	18.583	
South America	Buenos Aires													653			5			21	1.333		6.279	580	689	216	110		9.886	25.005
	Rio de Janeiro													20						58	9		421	54					562	
	Santos													355						89	549		5.520	520	294	448	78		7.854	
	São Francisco do Sul													150						58	350		5.289	360	135	282	78	2	6.703	
West Africa	Boma																									6			6	24.085
	Cape Town												9	254	2		3			23	43		3.477	644	18	413			4.886	
	Cotonou																												0	
	Douala							627	110		49									40			11	127		869		34	1.867	
	Durban												324	132	248	75	41		1.636	274	352	162	4.083	2.628	491	961	17	831	12.255	
	Lagos																58	199					5	3		32			297	
	Libreville																	6								20			26	
	Lobito							48	42	1	1																		93	
	Lomé							20		22								38										257	337	
	Luanda							218	121	41	9			321	3			11											723	
	Matadi																2									2			3	
	Pointe Noire							326	66	22	7		3		32		611	519					96						1.683	
	Tema							1.536	305							9		28	6	6				9		9			1.908	
	Total	0	0	0	0	0	0	2.774	644	87	67	0	1.916	7.418	1.734	1.226	3.289	11.401	12.017	3.843	20.629	4.219	100.362	24.878	6.126	12.310	1.050	8.650	224.639	
		0						3.572				0	221.068																	

Table 120: Forecast of NileDutch 2015 TEU trip matrix per port of the NileDutch's container liner services based on the import and export forecasts

		Asia						Europe				SA	West Africa																	
	Origen / Destination	Ningbo	Qingdao	Shanghai	Shekou	Singapore	Xingang-Tianjin	Antwerp	Le Havre	Leixoes	Lisbon	Buenos Aires	Boma	Cabinda	Cape Town	Cotonou	Douala	Durban	Lagos	Libreville	Lobito	Lomé	Luanda	Matadi	Namibe	Pointe Noire	Soyo	Tema	Total	
Asia	Ningbo												22	328	36	212	82	1.219	1.046	16	1.335	532	3.967	2.937	64	61		1.273	13.130	89.282
Asia	Qingdao												16	88	426		475	2.049	878	19	866	229	2.450	872	227	232	10	77	8.916	
Asia	Shanghai												13	393	240	107	438	2.498	3.810	455	2.451	699	4.377	2.092	320	662	25	2.888	21.469	
Asia	Shekou												66	657	88	156	39	1.368	1.997	112	1.770	897	6.229	2.453	362	355	13	629	17.191	
Asia	Singapore												21	873	344	595	122	1.757	1.969	408	2.074	1.539	4.685	1.896	927	441	116	2.015	19.782	
Asia	Xingang-Tianjin													103	277	42	270	1.432	364	18	507	54	2.545	1.764	276	899		244	8.794	
Europe	Antwerp												1.393	1.334			705		39	1.334	2.974		20.171	6.596	1.316	3.040	110	167	39.179	81.658
Europe	Le Havre												6	122			298			587	775		2.164	553	179	2.414	43		7.141	
Europe	Leixoes													817			40			231	2.712		12.452	188	383	165	255		17.243	
Europe	Lisbon													672			33			7	2.055		14.167	79	328	545	173	36	18.095	
South America	Buenos Aires													636			4			21	1.298		6.114	565	671	210	107		9.627	24.348
South America	Rio de Janeiro													19						57	9		410	52					547	
South America	Santos													346						86	535		5.375	507	286	437	76		7.648	
South America	São Francisco do Sul													146						57	341		5.150	350	131	274	76	1	6.527	
West Africa	Boma																									6			6	22.960
West Africa	Cape Town												9	247	1		3			22	42		3.386	627	18	402			4.758	
West Africa	Cotonou			7																									7	
West Africa	Douala			15	2	1	7	171	30		13									39			10	124		846		33	1.292	
West Africa	Durban		7	57	3	48	126						316	128	241	73	40		1.593	267	343	158	3.976	2.559	478	936	16	809	12.174	
West Africa	Lagos		1	197	14	29	1										57	194					4	3		31			531	
West Africa	Libreville																	6								19			25	
West Africa	Lobito			2				13	11																				27	
West Africa	Lomé	1	33	53		27		5		6								37										250	413	
West Africa	Luanda		1	25	1	57	1	59	33	11	2			313	3			10											516	
West Africa	Matadi																1									1			3	
West Africa	Pointe Noire		12	150		239		89	18	6	2		3		31		595	505					94						1.744	
West Africa	Tema		42	342	53	450	13	419	83							9		27	6	6				9		9			1.466	
	Total	1	115	849	76	855	147	756	176	25	18	0	1.866	7.223	1.688	1.194	3.202	11.102	11.701	3.742	20.088	4.108	97.727	24.225	5.965	11.987	1.022	8.423	218.248	
		2.043						975				0	215.262																	

Appendix H : Supply

H.1 NileDutch supply 2011: Complete overview

Table 121: NileDutch supply 2011: Asia – West Africa trade: Far East West Africa container liner service (FEWA)

Operator	Vessel	Trade	Nominal TEU / vessel	14 ton TEU vessel /	Nr of round-trips	TEU capacity 2011	14 ton TEU capacity 2011
NileDutch	AS Palatia	Asia - West Africa	2.526	1.856	1	2.526	1.856
NileDutch	Bonny	Asia - West Africa	2.681	2.060	1	2.681	2.060
NileDutch	City of Beijing	Asia - West Africa	2.564	1.848	1	2.564	1.848
NileDutch	MCP Paphos	Asia - West Africa	618	380	0,5	309	190
NileDutch	NileDutch Beijing	Asia - West Africa	3.421	2.509	4,5	15.395	11.291
NileDutch	NileDutch Durban	Asia - West Africa	2.526	1.856	2	5.052	3.712
NileDutch	NileDutch Guangzhou	Asia - West Africa	2.526	1.856	2	5.052	3.712
NileDutch	NileDutch Luanda	Asia - West Africa	3.091	2.481	1	3.091	2.481
NileDutch	NileDutch Ningbo	Asia - West Africa	2.452	1.874	3,5	8.582	6.559
NileDutch	NileDutch Shanghai	Asia - West Africa	2.474	1.890	5	12.370	9.450
NileDutch	NileDutch Shenzhen	Asia - West Africa	2.470	1.912	3	7.410	5.736
NileDutch	NileDutch Singapore	Asia - West Africa	2.546	1.874	2	5.092	3.748
NileDutch	Stadt Cadiz	Asia - West Africa	2.747	2.220	3	8.241	6.660
Total			**32.642**	**24.616**	**30**	**78.365**	**59.303**

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

Table 122: NileDutch supply 2011: Asia – West Africa trade: South West Africa Express container liner service: (SWAX)

Operator	Vessel	Trade	Nominal TEU / vessel	14 ton TEU vessel /	Nr of round-trips	TEU capacity 2011	14 ton TEU capacity 2011
NileDutch	City of Shanghai[a]	Asia - West Africa	2.564	1.861	1	951	951
Hapag-Lloyd	Corcovado[b]	Asia - West Africa	2.478	1.912	1	100	100
CSCL	CSCL Callao[b]	Asia - West Africa	2.544	1.900	1	100	100
CSCL	CSCL Lima[b]	Asia - West Africa	2.544	1.900	1	100	100
CSCL	CSCL Panama[b]	Asia - West Africa	2.544	1.900	1	100	100
CSCL	CSCL San Jose[b]	Asia - West Africa	2.544	1.900	2	200	200
K Line	Guayaquil Bridge[b]	Asia - West Africa	2.544	1.900	2	200	200
K Line	Jandavid S[b]	Asia - West Africa	2.450	1.897	2	200	200
K Line	Los Andes Bridge[b]	Asia - West Africa	2.553	1.897	1	100	100
NileDutch	NileDutch Durban[a]	Asia - West Africa	2.566	1.853	2	1.902	1.902
NileDutch	NileDutch Guangzhou[a]	Asia - West Africa	2.566	1.853	2	1.902	1.902
NileDutch	NileDutch Hong Kong[a]	Asia - West Africa	2.456	1.830	2	1.902	1.902
NileDutch	NileDutch Singapore[a]	Asia - West Africa	2.474	1.890	1	951	951
NYK	NYK Daniella[a/b]	Asia - West Africa	2.664	1.860	3	1.151	1.151
NYK	NYK Isabel[a/b]	Asia - West Africa	2.664	1.860	3	2.002	2.002
NYK	NYK Paula[a]	Asia - West Africa	2.664	1.860	3	2.853	2.853
NYK	NYK Veronica[a/b]	Asia - West Africa	2.664	1.860	3	2.002	2.002
CSCL	Wadi Alrayan[b]	Asia - West Africa	3.013	2.112	1	100	100
Total			**46.496**	**34.045**	**32**	**16.816**	**16.816**

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

a: Numbers are based on the vessel sharing agreement of the consortium between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. In the agreement NileDutch can use maximum 952 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 952 (applied to data from 01/01/2011-29/08/2011)

b: Numbers are based on the slot agreement of the consortium between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. . In the agreement NileDutch can use maximum 100 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 100 (applied to data from 30/08/2011-31/12/2011)

Table 123: NileDutch supply 2011: Europe – West Africa trade: West Europe – West Africa container liner service (WEWA)

Operator	Vessel	Trade	Nominal TEU / vessel	14 ton TEU vessel /	Nr of round-trips	TEU capacity 2011	14 ton TEU capacity 2011
NileDutch	Benguela	Europe - West Africa	1.300	979	2	2.600	1.958
NileDutch	City of Beijing	Europe - West Africa	2.564	1.848	1	1.282	924
NileDutch	Fiona Rickmers	Europe - West Africa	1.730	1.270	1	1.730	1.270
NileDutch	NileDutch Leopard	Europe - West Africa	3.421	2.433	2	6.842	4.866
NileDutch	NileDutch Durban	Europe - West Africa	2.566	1.853	1	2.566	1.853
NileDutch	Ludwig Schulte	Europe - West Africa	1.740	1.274	5	8.700	6.370
NileDutch	NileDutch Cape Town	Europe - West Africa	2.474	1.890	5	12.370	9.450
NileDutch	NileDutch Congo	Europe - West Africa	1.906	1.400	5	9.530	7.000
NileDutch	NileDutch France	Europe - West Africa	1.688	1.234	4	6.752	4.936
NileDutch	NileDutch Luanda	Europe - West Africa	3.091	2.481	1	3.091	2.481
NileDutch	NileDutch Ningbo	Europe - West Africa	2.452	1.874	3	7.356	5.622
NileDutch	NileDutch Qingdao	Europe - West Africa	1.793	1.312	2	3.586	2.624
NileDutch	NileDutch Shenzen	Europe - West Africa	2.470	1.912	2	4.940	3.824
NileDutch	NileDutch Singapore	Europe - West Africa	2.546	1.874	2	5.092	3.748
NileDutch	Wehr Weser	Europe - West Africa	2.524	1.895	2	5.048	3.790
Total			**34.265**	**25.529**	**38**	**81.485**	**60.716**

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

Table 124: NileDutch supply 2011: Inter West Africa trade: West Africa feeder container liner service (WAFD)

Operator	Vessel	Trade	Nominal TEU / vessel	14 ton TEU vessel /	Nr of round-trips	TEU capacity 2011	14 ton TEU capacity 2011
NileDutch	Ainaftis	Inter West Africa	797	500	3	2.391	1.500
NileDutch	Benguela	Inter West Africa	1.300	979	9	11.700	8.811
NileDutch	Daniela	Inter West Africa	639	360	5	3.195	1.800
NileDutch	MCP Adamas	Inter West Africa	618	380	5	3.090	1.900
NileDutch	MCP Pachna	Inter West Africa	618	380	21	12.978	7.980
NileDutch	MCP Paphos	Inter West Africa	618	380	12	7.416	4.560
NileDutch	NileDutch Cabinda	Inter West Africa	418	300	12	5.016	3.600
NileDutch	NileDutch Nordica	Inter West Africa	418	300	16	6.688	4.800
NileDutch	Siefke	Inter West Africa	510	290	12	6.120	3.480
Total			**5.936**	**3.869**	**95**	**58.594**	**38.431**

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

Table 125: NileDutch supply 2011: South America – West Africa trade: East Coast South America – West Africa container liner service (ECSA)

Operator	Vessel	Trade	Nominal TEU / vessel	14 ton TEU vessel /	Nr of round-trips	TEU capacity 2011	14 ton TEU capacity 2011
Delmas	EM Spetses[c]	South America - West Africa	1.736	1.125	1,5	1455	1.050
NileDutch	Gloria[c]	South America - West Africa	1.730	1.125	6,5	6305	4.550
Delmas	Hansa Augustenburg[c]	South America - West Africa	1.740	1.330	7	6790	4.900
Delmas	Hansa Flensburg[c]	South America - West Africa	1.740	1.330	9	8730	6.300
NileDutch	Ludwig Schulte[c]	South America - West Africa	1.740	1.274	2	1940	1.400
NileDutch	NileDutch Congo[c]	South America - West Africa	1.906	1.400	1	970	700
NileDutch	NileDutch France[c]	South America - West Africa	1.688	1.234	2,5	2425	1.750
Total			12.280	8.818	30	28.615	20.650

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

c: Numbers are based on the vessel sharing agreement between Delmas and NileDutch. In the agreement the nominal TEU capacity is 970 and the 14 ton TEU capacity is 700.

Table 126: NileDutch supply 2011: Overview of all container liner services on all trades

Trade	TEU capacity 2011	14 ton TEU capacity 2011	Share of total TEU capacity 2011	Share of total 14 ton TEU capacity 2011
Asia - West Africa[a/b]	79.138	58.661	62	95.181
Europe - West Africa	28.278	21.243	28	59.519
South America - West Africa[c]	12.280	8.818	30	28.615
Inter West Africa	5.936	3.869	95	58.594
Total	119.696	88.722	119	183.314

Source: NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

a: Numbers are based on the vessel sharing agreement of the consortium between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. In the agreement NileDutch can use maximum 952 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 952 (applied to data from 01/01/2011-29/08/2011)

b: Numbers are based on the slot agreement of the consortium between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. . In the agreement NileDutch can use maximum 100 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 100 (applied to data from 30/08/2011-31/12/2011)

c: Numbers are based on the vessel sharing agreement between Delmas and NileDutch. In the agreement the nominal TEU capacity is 970 and the 14 ton TEU capacity is 700.

H.2 Supply overview per liner service, per service type, and per trade

H.2.1 Asia – East Africa – West Africa

Table 127: Supply overview per liner service, per service type, and per trade: Asia – East Africa – West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yealry nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	Container liner service														
1	Safari Loop 1	Maersk Line / Safmarine / slots : Hamburg Süd	Maersk Line	7	56	6,5	8	6.733	4.988	53.861	39.903	43.882	32.510	351.058	260.082
2	Cheetah	MSC	MSC	7	49	7,4	7	6.291	4.783	44.037	33.480	46.862	35.627	328.031	249.392
3	WAX II	CMA CGM / Slots : Delmas	CMA CGM	8	80	4,6	10	3.360	2.619	33.600	26.194	15.330	11.951	153.300	119.510
4	Safari Loop 3	Maersk Line / Safmarine	Maersk Line	7	35	10,4	5	1.684	1.241	8.422	6.206	17.566	12.944	87.829	64.720
5	ALS	PIL	PIL	17	35	10,4	2	1.303	1.065	2.606	2.130	13.588	11.106	27.177	22.213
	Average liner service			9,2	51,0	7,9	6,4			28.505	21.583			189.479	143.183
	Average vessel			7,0	84,0	0,4		5.465	3.943			23.745	17.132		
	Total					39,4	32,0			142.526	107.913			947.395	715.917
			Trade overview												
			Average liner service	9,2	51,0	7,9	6,4			28.505	21.583			189.479	143.183
			Average vessel	7,0	84,0	0,4		5.465	3.943			23.745	17.132		
			Total			39,4	32			142.526	107.913			947.395	715.917

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.2.2 Asia – South America – West Africa

Table 128: Supply overview per liner service, per service type, and per trade: Asia – South America – West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yealry nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	Container liner service														
1	ASAS 1 / NGX 1	Maersk Line / Hamburg Süd / slots : Safmarine	Hamburg Süd / Maersk Line	7,0	84,0	4,3	12	6.249	4.753	74.986	57.034	27.153	20.652	325.832	247.826
2	CSW	MOL / Slots: Hamburg Süd	MOL	7,0	84,0	4,3	12	4.681	3.133	56.167	37.591	20.338	13.612	244.059	163.342
	Average liner service			7,0	84,0	4,3	12,0			65.577	47.312			284.946	205.584
	Average vessel			7,0	84,0	0,4		5.465	3.943			23.745	17.132		
	Total					8,7	24	10.929	7.885	131.153	94.625	47.491	34.264	569.891	411.168
			Trade overview												
			Average liner service	7,0	84,0	4,3	12,0			65.577	47.312			284.946	205.584
			Average vessel	7,0	84,0	0,4		5.465	3.943			23.745	17.132		
			Total			8,7	24			131.153	94.625			569.891	411.168

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.2.3 Asia – West Africa

Table 129: Supply overview per liner service, per service type, and per trade: Asia – West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yearly nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	Container liner service														
1	FEW 2	Safmarine / Maersk Line	Maersk Line / Safmarine	7	63	5,8	9	3.517	2.433	31.653	21.895	20.376	14.095	183.386	126.852
2	New Discovery	CSAV	CSAV	7	56	6,5	9	3.050	2.247	27.448	20.225	19.878	14.647	178.902	131.824
3	UAEISAS	MSC	MSC	7	35	10,4	6	2.805	2.226	16.827	13.356	29.247	23.213	175.482	139.280
4	ASA	PIL / K Line / Slots: Hanjin Shipping	K Line / PIL	7	49	7,4	6	3.669	2.588	22.012	15.530	27.328	19.280	163.967	115.683
5	Marco Polo II	CSAV	CSAV	7	42	8,7	6	2.602	1.968	15.611	11.805	22.611	17.099	135.667	102.591
6	MEW 1	Maersk Line	Maersk Line	7	63	5,8	9	2.517	1.868	22.656	16.814	14.585	10.824	131.261	97.414
7	FEW 1	Safmarine / Maersk Line	Maersk Line	8	77	4,7	11	2.514	1.867	27.654	20.533	11.917	8.848	131.087	97.332
8	FEW 3	Safmarine / Maersk Line	Maersk Line	7	77	4,7	11	2.511	1.870	27.618	20.569	11.901	8.864	130.916	97.502
9	MESA	Safmarine / Maersk Line	Maersk Line	7	42	8,7	6	2.226	1.750	13.356	10.500	19.345	15.208	116.070	91.250
10	WAX / WSX	CSCL / K Line / Hapag-Lloyd	CSCL / Hapag-Lloyd / K Line	9	70	5,2	8	2.593	1.917	20.742	15.339	13.519	9.998	108.155	79.982
11	SW2	PIL	PIL	7	70	5,2	10	1.755	1.263	17.553	12.631	9.153	6.586	91.526	65.860
12	SWS	PIL	PIL	7	77	4,7	10	1.847	1.391	18.472	13.914	8.756	6.596	87.562	65.957
13	ASAF	Delmas	CMA CGM / Delmas	13	80	4,6	9	1.920	1.462	17.280	13.162	8.760	6.672	78.840	60.052
14	MIDAS	Delmas	CMA CGM / Delmas	8	70	5,2	8	1.773	1.308	14.183	10.464	9.244	6.820	73.954	54.562
15	FAX	Gold Star Line / Slots: Zim	Gold Star Line	10	80	4,6	7	2.060	1.587	14.422	11.108	9.400	7.240	65.800	50.680
16	SWAX[b/c/d]	NYK Line / NileDutch	NileDutch / NYK	11,4	89	4,1	6	2.597	1.853	15.580	11.116	10.649	2.803	63.893	16.816
17	FEWA[b/c]	NileDutch	NileDutch	14,6	89	4,1	6	2.557	1.985	15.340	11.909	10.485	8.140	62.911	48.840
18	AMI	Laurel / PIL / Slots: Zim / Gold Star Line	Gold Star Line / PIL	13	75	4,9	6	1.304	1.000	7.824	6.000	6.346	4.867	38.077	29.200
19	AFEX	CMA CGM / Delmas	CMA CGM / Delmas	10	70	5,2	2	2.510	1.870	5.020	3.740	13.088	9.751	26.176	19.501
	Average liner service			**8,8**	**67,1**	**5,8**	**7,6**			**18.487**	**13.716**			**107.560**	**78.483**
	Average vessel			**8,4**	**66,1**	**0,8**		**2.790**	**2.082**			**16.898**	**12.469**		
	Total					**110,6**	**145**			**351.251**	**260.609**			**2.043.633**	**1.491.178**
	Multipurpose liner service														
1	CWABS	Safmarine / Maersk Line	Safmarine	30,0	30,0	12,2	1	1.052	844	1.052	844	12.799	10.269	12.799	10.269
2	EASWAMS	PIL	PIL	27,0	110,0	3,3	4	971	644	3.884	2.576	3.222	2.137	12.888	8.548
	Average liner service			**28,5**	**70,0**	**7,7**	**2,5**			**2.468**	**1.710**			**12.844**	**9.408**
	Average vessel			**27,6**	**94,0**	**3,1**		**987**	**684**			**5.137**	**3.763**		
	Total					**15,5**	**5**			**4.936**	**3.420**			**25.687**	**18.816**
			Trade overview												
			Average liner service	**10,7**	**67,3**	**6,0**	**7,1**			**16.961**	**12.573**			**98.539**	**71.904**
			Average vessel	**9,0**	**66,9**	**0,9**		**2.740**	**2.044**			**16.575**	**12.230**		
			Total			**126,1**	**150**			**356.187**	**264.029**			**2.069.320**	**1.509.994**

Source: Alphaliner (29/04/2011 and 02/05/2011)

● **: NileDutch's container liner services**

b: The port rotation schedule and vessel's names are obtained from NileDutch's February 2011 sailing schedules. The sailing frequency and duration of rotation are average values based on the roundtrips that had a departure in 2011 and are found in the 2011 and 2012 sailing schedules.

c: The yearly nominal and yearly 14 ton TEU container capacities come from NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

d: a: Numbers are based on the vessel sharing agreement of the consortium in the SWAX container liner service between China Shipping Container Lines (CSCL), Hapag-Lloyd, K Line, NileDutch, and NYK Line. In the agreement NileDutch can use maximum 952 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 952 (applied to data from 01/01/2011-29/08/2011) After this date it become a slot agreement. In the agreement NileDutch can use maximum 100 slots per vessel. Therefore, the Nominal TEU and 14 ton TEU capacities are 100 (applied to data from 30/08/2011-31/12/2011)

H.2.4 Europe – West Africa

Table 130: Supply overview per liner service, per service type, and per trade: Europe – West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yearly nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	Container liner service														
1	ESAS	MSC / slots: Hapag-Lloyd / Stiness Linien	MSC	7	49	7,4	7	6.837	5.155	47.861	36.084	50.931	38.398	356.516	268.789
2	SAECS	Safmarine / Maersk Line / MOL / DAL / slots: SOL	DAL / Maersk Line / MOL / Safmarine	7	49	7,4	7	4.667	3.387	32.666	23.707	34.761	25.228	243.328	176.593
3	WAF2	Safmarine / Maersk Line	Maersk Line / Safmarine	7	28	13,0	6	2.404	1.845	14.424	11.070	31.338	24.051	188.027	144.305
4	EURAF	Delmas	CMA CGM / Delmas	7	35	10,4	6	2.199	1.729	13.193	10.375	22.931	18.033	137.584	108.196
5	WAF1	Safmarine / Maersk Line	Maersk Line	7	28	13,0	4	2.487	1.867	9.948	7.468	32.420	24.338	129.679	97.351
6	WAF3	Safmarine / Maersk Line	Maersk Line	7	28	13,0	4	2.478	1.869	9.912	7.474	32.303	24.357	129.210	97.429
7	WAF6	Safmarine / Maersk Line	Maersk Line / Safmarine	7	42	8,7	6	2.478	1.886	14.868	11.316	21.535	16.390	129.210	98.341
8	(WAF) (HL:MWX)	UASC / Hanjin Shipping / MOL / Slots: Hapag-Lloyd	Hanjin Shipping / MOL / UASC	7	28	13,0	4	2.200	1.663	8.800	6.651	28.679	21.675	114.714	86.701
9	WAF8	Safmarine / Maersk Line	Maersk Line / Safmarine	7	21	17,4	4	1.635	1.209	6.541	4.837	28.422	21.018	113.689	84.072
10	WANRF	MSC	MSC	5	10	36,5	3	1.022	706	3.065	2.118	37.291	25.769	111.873	77.308
11	NIGEX	Delmas	CMA CGM / Delmas	7	42	8,7	6	1.826	1.305	10.957	7.827	15.870	11.337	95.222	68.020
12	NEWAS	MSC	MSC	9	55	6,6	5	2.803	2.216	14.015	11.079	18.602	14.705	93.009	73.524
13	ARN / WAX / NAF	MOL / Hapag-Lloyd / Zim	Hapag-Lloyd / MOL / Zim	7	42	8,7	6	1.770	1.244	10.619	7.461	15.381	10.807	92.284	64.840
14	Battuta Express	Delmas	CMA CGM	7	21	17,4	4	1.251	920	5.004	3.679	21.744	15.986	86.974	63.945
15	WAF5	Safmarine / Maersk Line	Maersk Line	7	49	7,4	7	1.480	1.156	10.358	8.094	11.022	8.613	77.157	60.289
16	Agadir Express	CMA CGM	CMA CGM	7	21	17,4	4	1.050	707	4.198	2.827	18.241	12.284	72.965	49.136
17	WEWA[b/c]	NileDutch	NileDutch	9	54	6,8	5	2.070	1.535	10.350	7.676	14.044	10.415	70.218	52.077
18	WAF7	Safmarine / Maersk Line	Maersk Line	7	28	13,0	3	1.764	1.500	5.292	4.500	22.995	19.554	68.985	58.661
19	Angola Loop	Safmarine / Maersk Line	Maersk Line / Safmarine	10	40	9,1	4	1.682	1.223	6.728	4.892	15.348	11.160	61.393	44.640
20	CES[a]	CMA CGM / OPDR / CoMaNav / IMTC / VACS	CMA CGM / OPDR	7	14	26,1	2	1.063	710	2.126	1.420	27.714	18.511	55.428	37.021
21	EAS	Delmas / Slots: Marfret	CMA CGM	11	45	8,1	4	1.679	1.191	6.715	4.764	13.617	9.660	54.466	38.641
22	KNSM	Maersk Line	Maersk Line	7	21	17,4	3	864	594	2.592	1.783	15.017	10.330	45.051	30.990
23	PAS[a]	Lin Line	Lin Line	7	74	6,1	3	2.111	1.622	6.334	4.866	13.738	10.439	41.215	31.317
24	Guiver Line	Portline	Portline	15	30	12,2	2	1.500	1.068	3.000	2.136	18.250	12.994	36.500	25.988
25	WAF9	Safmarine / Maersk Line	Safmarine	14	28	13,0	2	1.118	700	2.236	1.400	14.574	9.125	29.148	18.250
26	WAS[a]	Safmarine / Maersk Line	Safmarine	11	33	11,0	1	2.226	1.750	2.226	1.750	24.584	19.327	24.584	19.327
27	WAB	Bacoliner	Bacoliner	15	45	8,1	3	650	464	1.950	1.392	5.272	3.764	15.817	11.293
28	Africa expresso	Transinsular / Slots: Portline / MSC	Transinsular	22	22	16,6	1	375	264	375	264	6.222	4.380	6.222	4.380
	Average liner service			8,8	35,1	12,6	4,1			9.513	7.104			95.731	71.122
	Average vessel			8,0	37,7	3,1		2.296	1.715			23.107	17.167		
	Total					353,8	116			266.353	198.910			2.680.467	1.991.424
	ConRo liner service														
1	NEAS	Delmas	Delmas	9,0	45,0	8,1	5	1.343	1.011	6.714	5.054	10.892	8.199	54.458	40.993
2	Southern Express loop	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	10,0	48,0	7,6	7	906	653	6.342	4.569	6.889	4.963	48.226	34.742
3	Central Express loop	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	7,0	40,0	9,1	6	833	599	5.000	3.593	7.604	5.464	45.625	32.784
4	Eurocargo Express	Grimaldi (Napoli)	Grimaldi (Napoli)	17,0	34,0	10,7	2	1.050	759	2.100	1.518	11.272	8.148	22.544	16.295
	Average liner service			10,8	41,8	8,9	5,0			5.039	3.683			42.713	31.204
	Average vessel			9,6	43,5	1,8		1.008	737			8.543	6.241		
	Total					35,6	20			20.156	14.733			170.853	124.814
	Multipurpose liner service														
1	EWAMS[a]	UAL	UAL	5	32	11,4	6	570	358	3.422	2.151	6.505	4.089	39.032	24.531
2	UWAS[a]	EuroAfrica	EuroAfrica	7	47,9	7,6	7	539	373	3.774	2.609	4.108	2.840	28.758	19.879
3	OPEX	Safmarine / Maersk Line	Safmarine	10	60	6,1	5	708	486	3.542	2.429	4.309	2.955	21.547	14.777
4	ACE	Safmarine / Maersk Line	Safmarine	15	60	6,1	3	728	505	2.184	1.516	4.429	3.073	13.286	9.220
	Average liner service			9,3	50,0	7,8	5,3			3.231	2.176			25.656	17.102
	Average vessel			8,3	48,0	1,5		615	414			4.887	3.257		
	Total					31,2	21			12.922	8.704			102.623	68.407
			Trade overview												
			Average liner service	9,1	37,5	11,7	4,4			8.318	6.176			82.054	60.685
			Average vessel	8,2	39,8	2,7		1.907	1.416			18.815	13.915		
			Total			420,6	157			299.431	222.347			2.953.943	2.184.645

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department

b: The port rotation schedule and vessel's names are obtained from NileDutch's February 2011 sailing schedules. The sailing frequency and duration of rotation are average values based on the roundtrips that had a departure in 2011 and are found in the 2011 and 2012 sailing schedules.

c: The yearly nominal and yearly 14 ton TEU container capacities come from NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

H.2.5 Europe – West Africa – South America

Table 131: Supply overview per liner service, per service type, and per trade: Europe – West Africa – South America

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yealry nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	ConRo liner service														
1	NE-WA-ECSA	Grimaldi (Napoli)	Grimaldi (Napoli)	8,0	63,0	5,8	8	850	611	6.800	4.889	4.925	3.540	39.397	28.323
	Average liner service			**8,0**	**63,0**	**5,8**	**8,0**			**6.800**	**4.889**			**39.397**	**28.323**
	Average vessel			**8,0**	**63,0**	**0,7**		**850**	**611**			**4.925**	**3.540**		
	Total					**5,8**	**8**			**6.800**	**4.889**			**39.397**	**28.323**
			Trade overview												
			Average liner service	**8,0**	**63,0**	**5,8**	**8,0**			**6.800**	**4.889**			**39.397**	**28.323**
			Average vessel	**8,0**	**63,0**	**0,7**		**850**	**611**			**4.925**	**3.540**		
			Total			**5,8**	**8**			**6.800**	**4.889**			**39.397**	**28.323**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.2.6 Inter West Africa

Table 132: Supply overview per liner service, per service type, and per trade: Inter West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yealry nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	Container liner service														
1	WAF1[a]	Delmas	CMA CGM	3	6,25	58,4	2	1.095	700	2.190	1.400	63.948	40.880	127.896	81.760
2	DWAFS	CSAV	CSAV	7	28	13,0	4	2.194	1.601	8.774	6.404	28.594	20.870	114.375	83.481
3	West Coast	OACL / Maersk Line / Safmarine / Slots: Mozline	OACL	7	14	26,1	3	1.127	760	3.380	2.280	29.374	19.814	88.121	59.443
4	WAF2SM	Safmarine / Maersk Line	Maersk Line	11	4	30,4	1	713	452	713	452	65.061	41.245	65.061	41.245
5	WAF2[a]	Delmas	CMA CGM	5,5	10,97	33,3	2	887	582	1.773	1.164	29.496	19.365	58.992	38.729
6	WAF1SM	Safmarine / Maersk Line	Maersk Line	7	14	26,1	2	1.078	754	2.155	1.507	28.092	19.645	56.184	39.290
7	TCFS	Maersk Line	Maersk Line	7	7	52,1	1	912	585	912	585	47.554	30.504	47.554	30.504
8	WAF3DO[a]	Delmas	CMA CGM	5	14,87	16,4	2	591	410	1.181	820	14.494	10.064	28.989	20.128
9	WAMFL	Delmas	CMA CGM	14	28	13,0	2	1.083	650	2.166	1.300	14.118	8.473	28.235	16.946
10	AOS	MOL	MOL	14	28	13,0	2	1.062	788	2.123	1.575	13.837	10.266	27.675	20.531
11	N&GF[a]	MSC	MSC	24	24	15,2	1	1.730	1.124	1.730	1.124	26.310	17.094	26.310	17.094
12	IMS	CMA CGM / CoMaNav	CoMaNav	7	7	52,1	1	501	400	501	400	26.124	20.857	26.124	20.857
13	WAF4[a]	Delmas	CMA CGM / CoMaNav	2	7,28	16,7	1	516	270	516	270	25.871	13.537	25.871	13.537
14	WALF	MSC	MSC	7	7	52,1	1	474	336	474	336	24.716	17.505	24.716	17.505
15	A & N	MSC	MSC	20	60	6,1	3	1.126	858	3.378	2.574	6.850	5.220	20.550	15.659
16	Sango	MSC	CMA CGM	20	40	9,1	2	522	388	1.043	777	4.759	3.543	9.517	7.087
	Average liner service			**10,0**	**18,8**	**27,1**	**1,9**			**2.063**	**1.435**			**48.511**	**32.737**
	Average vessel			**10,1**	**22,5**	**14,4**		**1.100**	**766**			**25.872**	**17.460**		
	Total					**433,3**	**30**			**33.009**	**22.967**			**776.171**	**523.795**
	ConRo liner service														
1	CWAS[a]	Bolunda Lines / Slots: Delmas	Boluda Lines	9,0	18,0	10,1	1	394	278	394	278	7.989	5.632	7.989	5.632
	Average liner service			**9,0**	**18,0**	**10,1**	**1,0**			**394**	**278**			**7.989**	**5.632**
	Average vessel			**9,0**	**18,0**	**10,1**		**394**	**278**			**7.989**	**5.632**		
	Total					**10,1**	**1**			**394**	**278**			**7.989**	**5.632**
	Multipurpose liner service														
1	WAF2SM	Safmarine / Maersk Line	Maersk Line	11	4	60,8	2	579	316	1.158	632	52.834	28.835	105.668	57.670
2	DF	MSC	MSC	7	7	52,1	1	965	644	965	644	50.318	33.580	50.318	33.580
3	WAF4[a]	Delmas	CMA CGM / CoMaNav	2	7,28	33,4	2	480	299	959	597	24.041	14.966	48.082	29.932
4	SLLF	MSC	MSC	10	10	36,5	1	965	644	965	644	35.223	23.506	35.223	23.506
5	WAF2[b/c]	NileDutch	NileDutch	34	17	22,0	2	524	323	1.047	646	10.919	6.960	21.838	13.920
6	SAWACS	Safmarine / Maersk Line	Safmarine	15	45	8,1	3	585	445	1.756	1.336	4.748	3.611	14.243	10.833
7	WAF1[b/c]	NileDutch	NileDutch	8	20	18,0	2	469	268	937	535	9.772	4.913	19.544	9.826
8	WAF3DO[a]	Delmas	CMA CGM	5	14,87	8,2	1	519	272	519	272	12.739	6.677	12.739	6.677
9	SAWAMS	UAL	UAL	15	15	24,3	1	379	235	379	235	9.222	5.718	9.222	5.718
10	CWAS[a]	Bolunda Lines / Slots: Delmas	Boluda Lines	9	18	10,1	1	413	320	413	320	8.375	6.489	8.375	6.489
11	CAS	Angola South Line	Angola South Line	25	25	14,6	1	256	169	256	169	3.738	2.467	3.738	2.467
	Average liner service			**12,8**	**16,7**	**26,2**	**1,5**			**850**	**548**			**29.908**	**18.238**
	Average vessel			**9,2**	**18,7**	**15,8**		**550**	**355**			**19.352**	**11.853**		
	Total					**288,3**	**17**			**9.354**	**6.030**			**328.989**	**200.618**
			Trade overview												
			Average liner service	**11,1**	**17,9**	**26,1**	**1,7**			**1.527**	**1.046**			**39.755**	**26.073**
			Average vessel	**9,8**	**21,0**	**14,8**		**891**	**610**			**23.191**	**15.228**		
			Total			**731,7**	**48**			**42.757**	**29.275**			**1.113.149**	**730.044**

Source: Alphaliner (29/04/2011 and 02/05/2011)

●: NileDutch's container liner services

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department

b: The port rotation schedule and vessel's names are obtained from NileDutch's February 2011 sailing schedules. The sailing frequency and duration of rotation are average values based on the roundtrips that had a departure in 2011 and are found in the 2011 and 2012 sailing schedules.

c: The yearly nominal and yearly 14 ton TEU container capacities come from NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01-04-2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

H.2.7 The Mediterranean – West Africa

Table 133: Supply overview per liner service, per service type, and per trade: The Mediterranean – West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14
	Container liner service												
1	**MCWAS**	MSC	MSC	7	42	8,7	8	2.418	1.965	19.346	15.716	21.016	
2	**WMMS**	CMA CGM / CoMaNav / Slots: Arkas Line	CMA CGM	7	14	26,1	2	1.477	1.013	2.954	2.026	38.508	
3	**MMS**	CMA CGM	CMA CGM	7	14	26,1	2	1.412	905	2.823	1.809	36.800	
4	**DIAMS**	Delmas	CMA CGM / Delmas	7	42	8,7	5	1.613	1.169	8.063	5.845	14.014	
5	**PVMSM**	CMA CGM / CoMaNav / Slots: Arkas Line	CMA CGM	7	14	26,1	2	990	648	1.980	1.295	25.811	
	Average liner service			**7,0**	**25,2**	**19,1**	**3,8**			**7.033**	**5.338**		
	Average vessel			**7,0**	**33,2**	**5,0**		**1.851**	**1.405**			**23.181**	
	Total					**95,6**	**19**			**35.166**	**26.691**		
	ConRo liner service												
1	**RORO Med Line[a]**	CMA CGM / CoMaNav / IMTC	CoMaNav / IMTC	5	9	40,6	2	368	259	736	518	14.924	
2	**C - C[a]**	CoMaNav / IMTC	IMTC	3	3	121,7	1	200	139	200	139	24.333	
3	**WMWAM**	Grimaldi (Napoli)	Grimaldi (Napoli)	18	36	10,1	2	684	491	1.368	982	6.935	
	Average liner service			**8,7**	**16,0**	**57,5**	**1,7**			**768**	**546**		
	Average vessel			**9,8**	**18,6**	**34,5**		**461**	**328**			**13.610**	
	Total					**172,4**	**5**			**2.304**	**1.639**		
			Trade overview										
			Average liner service	**7,6**	**21,8**	**33,5**	**3,0**			**4.684**	**3.541**		
			Average vessel	**7,6**	**30,1**	**11,2**		**1.561**	**1.180**			**21.187**	
			Total			**268,0**	**24**			**37.470**	**28.330**		

Source: Alphaliner (29/04/2011 and 02/05/2011)

a: Duration of rotation obtained by Netpas Distance and the experience of the members of NileDutch's operations department

H.2.8 North America – South America – West Africa

Table 134: Supply overview per liner service, per service type, and per trade: North America – South America – West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yearly nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	ConRo liner service														
1	USSAMSN	Nordana Line	Nordana Line	35,0	70,0	5,2	1	1.218	884	1.218	884	6.351	4.608	6.351	4.608
	Average liner service			**35,0**	**70,0**	**5,2**	**1,0**			**1.218**	**884**			**6.351**	**4.608**
	Average vessel			**35,0**	**70,0**	**5,2**		**1.218**	**884**			**6.351**	**4.608**		
	Total					**5,2**	**1**			**1.218**	**884**			**6.351**	**4.608**
			Trade overview												
			Average liner service	**35,0**	**70,0**	**5,2**	**1,0**			**1.218**	**884**			**6.351**	**4.608**
			Average vessel	**35,0**	**70,0**	**5,2**		**1.218**	**884**			**6.351**	**4.608**		
			Total			**5,2**	**1**			**1.218**	**884**			**6.351**	**4.608**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.2.9 North America – West Africa

Table 135: Supply overview per liner service, per service type, and per trade: North America – West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yearly nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	Container liner service														
1	AMEX	MSC / Safmarine / Maersk Line	Maersk Line / MSC / Safmarine	7,0	56,0	6,5	8	2.376	1.799	19.009	14.388	15.487	11.722	123.898	93.779
2	GAL	MACS / Danneburg	MACS	20,0	100,0	1,2	2	1.644	1.452	3.288	2.904	6.001	5.300	12.001	10.600
	Average liner service			**13,5**	**78,0**	**3,9**	**5,0**			**11.149**	**8.646**			**67.950**	**52.189**
	Average vessel			**9,6**	**64,8**	**0,8**		**2.230**	**1.729**			**13.590**	**10.438**		
	Total					**7,7**	**10**			**22.297**	**17.292**			**135.899**	**104.379**
	ConRo liner service														
1	USWARS	Grimaldi (Napoli) / Slots: ACL	Grimaldi (Napoli)	15,0	45,0	8,1	3	800	574	2.400	1.723	6.489	4.658	19.467	13.973
	Average liner service			**15,0**	**45,0**	**8,1**	**3,0**			**2.400**	**1.723**			**19.467**	**13.973**
	Average vessel			**15,0**	**45,0**	**2,7**		**800**	**574**			**6.489**	**4.658**		
	Total					**8,1**	**3**			**2.400**	**1.723**			**19.467**	**13.973**
	Multipurpose liner service														
1	Corex	Maersk Line / Safmarine	Maersk Line	30	60	6,1	5	777	569	3.886	2.846	4.728	3.463	23.640	17.313
2	UAL	UAL	UAL	15	105	3,5	7	599	403	4.190	2.818	2.081	1.400	14.565	9.797
3	GAL	MACS / Danneburg	MACS	20	100	2,4	4	976	704	3.904	2.817	3.562	2.571	14.250	10.283
4	Angorex	Safmarine / Maersk Line	Safmarine	30	90	4,1	3	938	651	2.815	1.954	3.805	2.642	11.416	7.925
5	USSAMS	CSCL / Slots: Hapag-Lloyd	CSAL	27	80	4,6	3	728	521	2.184	1.564	3.322	2.378	9.965	7.135
	Average liner service			**24,4**	**87,0**	**4,1**	**4,4**			**3.396**	**2.400**			**14.767**	**10.490**
	Average vessel			**23,0**	**88,4**	**0,9**		**772**	**545**			**3.356**	**2.384**		
	Total					**20,6**	**22**			**16.979**	**11.999**			**73.836**	**52.452**
			Trade overview												
			Average liner service	**20,5**	**79,5**	**4,6**	**4,4**			**5.210**	**3.877**			**28.650**	**21.351**
			Average vessel	**18,5**	**77,9**	**1,0**		**1.191**	**886**			**6.549**	**4.880**		
			Total			**36,5**	**35**			**41.676**	**31.014**			**229.201**	**170.804**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.2.10 South America – West Africa

Table 136: Supply overview per liner service, per service type, and per trade: South America – West Africa

Rank	Liner service	Carriers	Operators	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yearly nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
	Container liner service														
1	ECSA[b/c/d]	Delmas / NileDutch	CMA CGM / NileDutch	12,6	42,9	8,5	3	1.737	1.261	5.210	3.784	19.077	6.883	57.230	20.650
	Average liner service			12,6	42,9	8,5	3,0			5.210	3.784			57.230	20.650
	Average vessel			12,6	42,9	2,8		1.737	1.261			19.077	6.883		
	Total					8,5	3			5.210	3.784			57.230	20.650
	Multipurpose liner service														
1	SATWACS	Clipper Shipping Line / Nigerbras / Nigeria America Line	Clipper Shipping Line	40,0	40,0	9,1	1	639	360	639	360	5.831	3.285	5.831	3.285
	Average liner service			40,0	40,0	9,1	1,0			639	360			5.831	3.285
	Average vessel			40,0	40,0	9,1		639	360			5.831	3.285		
	Total					9,1	1			639	360			5.831	3.285
			Trade overview												
			Average liner service	26,3	41,5	8,8	2,0			2.925	2.072			31.530	11.967
			Average vessel	19,5	42,2	4,4		1.462	1.036			15.765	5.984		
			Total			17,6	4			5.849	4.144			63.061	23.935

Source: Alphaliner (29/04/2011 and 02/05/2011)

: NileDutch's container liner services

b: The port rotation schedule and vessel's names are obtained from NileDutch's February 2011 sailing schedules. The sailing frequency and duration of rotation are average values based on the roundtrips that had a departure in 2011 and are found in the 2011 and 2012 sailing schedules.

c: The yearly nominal and yearly 14 ton TEU container capacities come from NileDutch's Shipnet Agency liner System (SNALS) database, data from 01/01/2007 to 01/04/2011 and NileDutch's Soft Ship Line database, data from 01/04/2011 to 31/12/2011.

e: Numbers are based on the vessel sharing agreement between Delmas and NileDutch. In the agreement the nominal TEU capacity is 970 and the 14 ton TEU capacity is 700.

H.2.11 Market overview

Table 137: Supply overview: Market overview

Market overview	Sailing frequency (days)	Duration of rotation (days)	Sailings per year	Total vessels	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity per liner service	Total 14 ton TEU capacity per liner service	Average yearly nominal TEU capacity per vessel	Average yearly 14 ton TEU capacity per vessel	Total yearly nominal TEU capacity per liner service	Total yearly 14 ton TEU capacity per liner service
Average liner service	10,8	45,0	14,2	5,4			15.834	11.680			106.996	77.961
Average vessel	9,5	53,1	3,4		2.205	1.630			17.599	12.731		
Total			1.620,1	451			922.541	679.537			7.552.800	5.432.475

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3 Supply overview per operator group per trade, and per liner service type.

H.3.1 Asia – South America – West Africa

Table 138: Supply overview per operator's group, liner service type and trade: Asia – South America – West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yealry nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yealry nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yealry Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	Container liner service														
1	Hamburg Süd	11	7,0	0,4	4,0	6.140	4.670	67.536	51.372	26.678	20.293	293.460	223.224	3,5%	3,6%
2	MOL	12	7,0	0,4	4,3	4.681	3.133	56.167	37.591	20.338	13.612	244.059	163.342	2,9%	2,7%
3	Maersk Group	1	7,0	0,4	0,4	7.450	5.662	7.450	5.662	32.372	24.603	32.372	24.603	0,4%	0,4%
	Total	**24**	**7,0**	**0,4**	**8,7**	**5.465**	**3.943**	**131.153**	**94.625**	**23.745**	**17.132**	**569.891**	**411.168**	**6,7%**	**6,7%**
	Trade overview														
	Total	**24**	**7,0**	**0,4**	**8,7**	**5.465**	**3.943**	**131.153**	**94.625**	**23.745**	**17.132**	**569.891**	**411.168**	**6,7%**	**6,7%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.2 Asia – West Africa

Table 139: Supply overview per operator's group, liner service type and trade: Asia – West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yealry nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yealry nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yealry Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	Container liner service														
1	Maersk Group	62	7,3	0,8	50,5	3.084	2.273	191.230	140.931	18.739	13.836	1.161.818	857.807	13,7%	13,9%
2	MSC Group	13	7,0	1,4	17,9	4.682	3.603	60.864	46.836	38.732	29.898	503.512	388.671	5,9%	6,3%
3	CSAV Group	15	7,0	1,0	15,2	2.871	2.135	43.059	32.030	20.971	15.628	314.569	234.415	3,7%	3,8%
4	CMA CGM Group	26	9,6	0,6	15,8	2.464	1.887	64.073	49.049	11.618	8.883	302.061	230.971	3,6%	3,8%
5	PIL Group	27	8,4	0,9	25,3	1.808	1.337	48.829	36.109	10.143	7.500	273.863	202.510	3,2%	3,3%
6	K Line	6	7,7	1,0	6,3	3.359	2.427	20.151	14.563	23.119	16.666	138.714	99.994	1,6%	1,6%
7	Zim Group	10	10,9	0,7	7,0	1.901	1.444	19.006	14.438	8.811	6.689	88.109	66.886	1,0%	1,1%
8	NileDutch	9	13,5	0,7	6,2	2.548	1.938	22.928	17.445	8.859	6.361	79.727	57.248	0,9%	0,9%
9	CSCL	5	9,0	0,7	3,3	2.638	1.942	13.189	9.712	13.754	10.128	68.771	50.641	0,8%	0,8%
10	NYK Line	3	11,4	0,7	2,1	2.664	1.860	7.992	5.580	15.692	2.803	47.077	8.408	0,6%	0,1%
11	Hapag-Lloyd	1	9,0	0,7	0,7	2.456	1.830	2.456	1.830	12.806	9.542	12.806	9.542	0,2%	0,2%
	Total	**177**	**8,4**	**0,8**	**150,0**	**2.790**	**2.082**	**493.777**	**368.522**	**16.898**	**12.469**	**2.991.028**	**2.207.095**	**35,2%**	**35,9%**
	Multipurpose liner service														
1	PIL Group	4	27,0	0,8	3,3	971	644	3.884	2.576	3.222	2.137	12.888	8.548	0,2%	0,1%
2	Maersk Group	1	30,0	12,2	12,2	1.052	844	1.052	844	12.799	10.269	12.799	10.269	0,2%	0,2%
	Total	**5**	**27,6**	**3,1**	**15,5**	**987**	**684**	**4.936**	**3.420**	**5.137**	**3.763**	**25.687**	**18.816**	**0,3%**	**0,3%**
	Trade overview														
	Total	**182**	**9,0**	**0,9**	**165,5**	**2.740**	**2.044**	**498.713**	**371.942**	**16.575**	**12.230**	**3.016.716**	**2.225.911**	**35,5%**	**36,2%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.3 Europe – West Africa

Table 140: Supply overview per operator's group, liner service type and trade: Europe – West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yealry nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yealry nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yealry Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	Container liner service														
1	Maersk Group	50	7,6	2,9	143,7	2.156	1.634	107.786	81.707	23.484	17.765	1.174.190	888.238	13,8%	14,4%
2	MSC Group	15	7,3	3,4	50,6	4.329	3.285	64.941	49.281	37.426	27.975	561.397	419.621	6,6%	6,8%
3	CMA CGM Group	23	7,7	3,1	71,8	1.602	1.172	36.846	26.956	18.904	13.704	434.782	315.198	5,1%	5,1%
4	MOL	7	7,0	1,9	13,0	2.798	1.916	19.587	13.411	25.222	17.505	176.553	122.532	2,1%	2,0%
5	NileDutch	5	9,4	1,4	6,8	2.070	1.535	10.350	7.676	14.044	10.415	70.218	52.077	0,8%	0,8%
6	Lin Lines	3	7,0	2,0	6,1	2.111	1.622	6.334	4.866	13.738	10.439	41.215	31.317	0,5%	0,5%
7	Portline	2	15,0	6,1	12,2	1.500	1.068	3.000	2.136	18.250	12.994	36.500	25.988	0,4%	0,4%
8	DAL	1	7,0	1,1	1,1	4.500	3.420	4.500	3.420	33.520	25.476	33.520	25.476	0,4%	0,4%
9	UASC	1	7,0	3,3	3,3	2.452	1.801	2.452	1.801	31.964	23.477	31.964	23.477	0,4%	0,4%
10	Hapag-Lloyd	2	7,0	1,4	2,9	1.731	1.200	3.462	2.399	15.043	10.424	30.086	20.848	0,4%	0,3%
11	Hanjin Shipping	1	7,0	3,3	3,3	2.078	1.650	2.078	1.650	27.088	21.509	27.088	21.509	0,3%	0,3%
12	OPDR	1	7,0	13,0	13,0	1.008	720	1.008	720	26.280	18.771	26.280	18.771	0,3%	0,3%
13	Bacoliner	3	15,0	2,7	8,1	650	464	1.950	1.392	5.272	3.764	15.817	11.293	0,2%	0,2%
14	Zim Group	1	7,0	1,4	1,4	1.684	1.231	1.684	1.231	14.635	10.698	14.635	10.698	0,2%	0,2%
15	Transinsular	1	22,0	16,6	16,6	375	264	375	264	6.222	4.380	6.222	4.380	0,1%	0,1%
	Total	**116**	**8,0**	**3,1**	**353,8**	**2.296**	**1.715**	**266.353**	**198.910**	**23.107**	**17.167**	**2.680.467**	**1.991.424**	**31,5%**	**32,4%**
	ConRo liner service														
1	Grimaldi (Napoli) Group	15	9,7	1,8	27,5	896	645	13.442	9.679	7.760	5.588	116.395	83.821	1,4%	1,4%
2	Maersk Group	5	9,0	1,6	8,1	1.343	1.011	6.714	5.054	10.892	8.199	54.458	40.993	0,6%	0,7%
	Total	**20**	**9,6**	**1,8**	**35,6**	**1.008**	**737**	**20.156**	**14.733**	**8.543**	**6.241**	**170.853**	**124.814**	**2,0%**	**2,0%**
	Multipurpose liner service														
1	UAL	6	5,0	1,9	11,4	570	358	3.422	2.151	6.505	4.089	39.032	24.531	0,5%	0,4%
2	Maersk Group	8	11,9	1,5	12,2	716	493	5.726	3.945	4.354	3.000	34.833	23.997	0,4%	0,4%
3	EuroAfrica	7	7,0	1,1	7,6	539	373	3.774	2.609	4.108	2.840	28.758	19.879	0,3%	0,3%
	Total	**21**	**8,3**	**1,5**	**31,2**	**615**	**414**	**12.922**	**8.704**	**4.887**	**3.257**	**102.623**	**68.407**	**1,2%**	**1,1%**
	Trade overview														
	Total	**157**	**8,2**	**2,7**	**420,6**	**1.907**	**1.416**	**299.431**	**222.347**	**18.815**	**13.915**	**2.953.943**	**2.184.645**	**34,8%**	**35,5%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.4 Europe – West Africa – West Africa

Table 141: Supply overview per operator's group, liner service type and trade: Europe – West Africa – West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yealry nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yealry nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yealry Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	ConRo liner service														
1	Grimaldi (Napoli) Group	8	8,0	0,7	5,8	850	611	6.800	4.889	4.925	3.540	39.397	28.323	0,5%	0,5%
	Total	**8**	**8,0**	**0,7**	**5,8**	**850**	**611**	**6.800**	**4.889**	**4.925**	**3.540**	**39.397**	**28.323**	**0,5%**	**0,5%**
	Trade overview														
	Total	**8**	**8,0**	**0,7**	**5,8**	**850**	**611**	**6.800**	**4.889**	**4.925**	**3.540**	**39.397**	**28.323**	**0,5%**	**0,5%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.5 Inter West Africa

Table 142: Supply overview per operator's group, liner service type and trade: Inter West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yealry nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yealry nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yealry Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	Container liner service														
1	CMA CGM Group	12	8,7	16,6	199,1	781	511	9.370	6.131	25.469	16.587	305.624	199.044	3,6%	3,2%
2	Maersk Group	7	7,6	19,2	134,7	1.023	689	7.160	4.824	36.703	24.354	256.921	170.481	3,0%	2,8%
3	CSAV Group	4	7,0	3,3	13,0	2.194	1.601	8.774	6.404	28.594	20.870	114.375	83.481	1,3%	1,4%
4	MSC Group	5	18,2	14,7	73,4	1.116	807	5.582	4.034	14.315	10.051	71.576	50.257	0,8%	0,8%
5	MOL	2	14,0	6,5	13,0	1.062	788	2.123	1.575	13.837	10.266	27.675	20.531	0,3%	0,3%
	Total	**30**	**10,1**	**14,4**	**433,3**	**1.100**	**766**	**33.009**	**22.967**	**25.872**	**17.460**	**776.171**	**523.795**	**9,1%**	**8,5%**
	ConRo liner service														
1	Boluda Lines	1	9,0	10,1	10,1	394	278	394	278	7.989	5.632	7.989	5.632	0,1%	0,1%
	Total	**1**	**9,0**	**10,1**	**10,1**	**394**	**278**	**394**	**278**	**7.989**	**5.632**	**7.989**	**5.632**	**0,1%**	**0,1%**
	Multipurpose liner service														
1	Maersk Group	5	13,4	13,8	68,9	583	394	2.914	1.968	23.982	13.701	119.911	68.503	1,4%	1,1%
2	MSC Group	2	8,5	44,3	88,6	965	644	1.930	1.288	42.770	28.543	85.540	57.086	1,0%	0,9%
3	CMA CGM Group	3	3,0	13,9	41,6	493	290	1.478	869	20.274	12.203	60.821	36.609	0,7%	0,6%
4	NileDutch	4	3,7	5,2	20,9	496	295	1.984	1.181	10.345	6.158	41.381	24.632	0,5%	0,4%
5	UAL	1	15,0	24,3	24,3	379	235	379	235	9.222	5.718	9.222	5.718	0,1%	0,1%
6	Boluda Lines	1	9,0	10,1	10,1	413	320	413	320	8.375	6.489	8.375	6.489	0,1%	0,1%
7	Angola South Line	1	25,0	14,6	14,6	256	169	256	169	3.738	2.467	3.738	2.467	0,0%	0,0%
	Total	**17**	**9,2**	**15,8**	**269,1**	**550**	**355**	**9.354**	**6.030**	**19.352**	**11.853**	**328.987**	**201.504**	**3,9%**	**3,3%**
	Trade overview														
	Total	**48**	**9,8**	**14,8**	**712,5**	**891**	**610**	**42.757**	**29.275**	**23.191**	**15.228**	**1.113.148**	**730.931**	**13,1%**	**11,9%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.6 The Mediterranean - West Africa

Table 143: Supply overview per operator's group, liner service type and trade: The Mediterranean - West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yearly nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yearly nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yearly Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	Container liner service														
1	CMA CGM Group	10	7,0	8,5	85,2	1.409	983	14.090	9.827	25.727	17.457	257.273	174.566	3,0%	2,8%
2	MSC Group	8	7,0	1,1	8,7	2.418	1.965	19.346	15.716	21.016	17.072	168.126	136.580	2,0%	2,2%
3	Maersk Group	1	7,0	1,7	1,7	1.730	1.148	1.730	1.148	15.035	9.977	15.035	9.977	0,2%	0,2%
	Total	**19**	**7,0**	**5,0**	**95,6**	**1.851**	**1.405**	**35.166**	**26.691**	**23.181**	**16.901**	**440.433**	**321.122**	**5,2%**	**5,2%**
	Conro liner service														
1	IMTC	2	4,0	71,0	141,9	320	225	640	450	21.089	14.736	42.178	29.472	0,5%	0,5%
2	Grimaldi (Napoli) Group	2	18,0	5,1	10,1	684	491	1.368	982	6.935	4.980	13.870	9.959	0,2%	0,2%
3	CMA CGM Group	1	5,0	20,3	20,3	296	207	296	207	12.004	8.400	12.004	8.400	0,1%	0,1%
	Total	**5**	**9,8**	**34,5**	**172,4**	**461**	**328**	**2.304**	**1.639**	**13.610**	**9.566**	**68.052**	**47.831**	**0,8%**	**0,8%**
	Trade overview														
	Total	**24**	**7,6**	**11,2**	**268,0**	**1.561**	**1.180**	**37.470**	**28.330**	**21.187**	**15.373**	**508.486**	**368.953**	**6,0%**	**6,0%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.7 North America – South America – West Africa

Table 144: Supply overview per operator's group, liner service type and trade: North America – South America – West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yearly nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yearly nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yearly Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	ConRo liner service														
1	Nordana Line	1	35,0	5,2	5,2	1.218	884	1.218	884	6.351	4.608	6.351	4.608	0,1%	0,1%
	Total	**1**	**35,0**	**5,2**	**5,2**	**1.218**	**884**	**1.218**	**884**	**6.351**	**4.608**	**6.351**	**4.608**	**0,1%**	**0,1%**
	Trade overview														
	Total	**1**	**35,0**	**5,2**	**5,2**	**1.218**	**884**	**1.218**	**884**	**6.351**	**4.608**	**6.351**	**4.608**	**0,1%**	**0,1%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.8 North America – West Africa

Table 145: Supply overview per operator's group, liner service type and trade: Asia – West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yealry nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yealry nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yealry Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	Container liner service														
1	MSC Group	4	7,0	0,8	3,3	3.008	2.335	12.031	9.338	19.604	15.216	78.416	60.864	0,9%	1,0%
2	Maersk Group	4	7,0	0,8	3,3	1.745	1.263	6.978	5.050	11.370	8.229	45.482	32.915	0,5%	0,5%
3	MACS	2	20,0	0,6	1,2	1.644	1.452	3.288	2.904	6.001	5.300	12.001	10.600	0,1%	0,2%
	Total	**10**	**9,6**	**0,8**	**7,7**	**2.230**	**1.729**	**22.297**	**17.292**	**13.590**	**10.438**	**135.899**	**104.379**	**1,6%**	**1,7%**
	Conro liner service														
1	Grimaldi (Napoli) Group	3	15,0	2,7	8,1	800	574	2.400	1.723	6.489	4.658	19.467	13.973	0,2%	0,2%
	Total	**3**	**15,0**	**2,7**	**8,1**	**800**	**574**	**2.400**	**1.723**	**6.489**	**4.658**	**19.467**	**13.973**	**0,2%**	**0,2%**
	Multipurpose liner service														
1	Maersk Group	8	30,0	1,3	10,1	838	600	6.701	4.800	4.382	3.155	35.056	25.238	0,4%	0,4%
2	UAL	7	15,0	0,5	3,5	599	403	4.190	2.818	2.081	1.400	14.565	9.797	0,2%	0,2%
3	MACS	4	20,0	0,6	2,4	976	704	3.904	2.817	3.562	2.571	14.250	10.283	0,2%	0,2%
4	CSAL	3	27,0	1,5	4,6	728	521	2.184	1.564	3.322	2.378	9.965	7.135	0,1%	0,1%
	Total	**22**	**23,0**	**0,9**	**20,6**	**772**	**545**	**16.979**	**11.999**	**3.356**	**2.384**	**73.836**	**52.452**	**0,9%**	**0,9%**
	Trade overview														
	Total	**35**	**18,5**	**1,0**	**36,5**	**1.191**	**886**	**41.676**	**31.014**	**6.549**	**4.880**	**229.201**	**170.804**	**2,7%**	**2,8%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.9 South America – West Africa

Table 146: Supply overview per operator's group, liner service type and trade: South America – West Africa

Rank	Operator group	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yealry nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yealry nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yealry Nominal TEU capacity	Share of yearly 14 ton TEU capacity
	Container liner service														
1	CMA CGM Group	2	12,6	2,8	5,7	1.740	1.330	3.480	2.660	14.308	6.883	28.615	13.766	0,3%	0,2%
1	NileDutch	1	12,6	2,8	2,8	1.730	1.124	1.730	1.124	28.615	6.883	28.615	6.883	0,3%	0,1%
	Total	**3**	**12,6**	**2,8**	**8,5**	**1.737**	**1.261**	**5.210**	**3.784**	**19.077**	**6.883**	**57.230**	**20.650**	**0,7%**	**0,3%**
	Multipurpose liner service														
1	Clipper Shipping Line	1	40,0	9,1	9,1	639	360	639	360	5.831	3.285	5.831	3.285	0,1%	0,1%
	Total	**1**	**40,0**	**9,1**	**9,1**	**639**	**360**	**639**	**360**	**5.831**	**3.285**	**5.831**	**3.285**	**0,1%**	**0,1%**
	Trade overview														
	Total	**4**	**19,5**	**4,4**	**17,6**	**1.462**	**1.036**	**5.849**	**4.144**	**15.765**	**5.984**	**63.061**	**23.935**	**0,7%**	**0,4%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

H.3.10 Market overview

Table 147: Supply overview: Market overview

Market Overview	Total vessels	Average sailing frequency per operator group	Average sailing per year per vessel	Sum of Sailing per year	Average nominal TEU capacity per vessel	Average 14 ton TEU capacity per vessel	Total nominal TEU capacity	Total 14 ton TEU capacity	Average yealry nominal TEU capacity	Average yearly 14 ton TEU capacity	Total yealry nominal TEU capacity	Total yearly 14 ton TEU capacity	Share of yealry Nominal TEU capacity	Share of yearly 14 ton TEU capacity
Total	**483**	**9,5**	**3,4**	**1.640,4**	**2.205**	**1.630**	**1.065.067**	**787.450**	**17.599**	**12.731**	**8.500.194**	**6.149.278**	**100,0%**	**100,0%**

Source: Alphaliner (29/04/2011 and 02/05/2011)

Appendix I : Regression analysis: Estimation method of least squares for a power function and a quadratic functions

I.1 Power function

When having a set of data and the trend of the data needs to be described, one can use the regression analysis estimation method of least squares. The trend of these data can be described by a lot of functions. Linear, polynomial, logarithmic and power functions are a few examples of how the trend can be described. To explain the principle of the estimation method of least squares a power function will be used as described by Thompson (2007).

A power function can be described by the formula:

$$\hat{y} = ax^b \tag{53}$$

a : Regression coefficient to be defined

b : Regression coefficient to be defined

The data consists of points: $(x_1, y_1), \ldots, (x_n, y_n)$

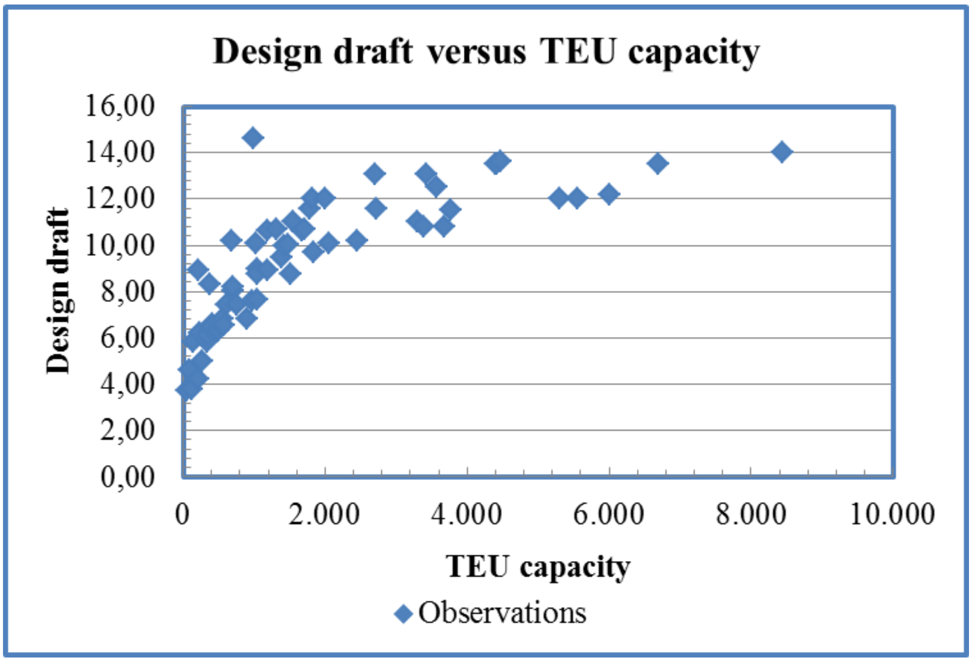
The data in Table 148, which is also plotted in Figure 147, will now be used as an example. The x values represent TEU capacity and the y values the design draft.

Table 148: Observations of TEU capacities and design draft of container vessels

i	x_i	y_i	i	x_i	y_i	i	x_i	y_i	i	x_i	y_i	i	x_i	y_i	i	x_i	y_i	i	x_i	y_i
1	60	3,70	10	341	6,08	19	584	6,57	28	1.033	10,09	37	1.472	10,03	46	2.061	10,10	55	3.764	11,50
2	89	4,63	11	372	8,32	20	621	7,45	29	1.048	8,98	38	1.512	8,75	47	2.446	10,20	56	4.409	13,52
3	122	3,80	12	403	6,40	21	676	10,18	30	1.050	8,78	39	1.550	11,00	48	2.714	13,09	57	4.419	13,50
4	136	5,82	13	414	6,61	22	699	8,04	31	1.050	7,65	40	1.684	10,66	49	2.728	11,59	58	4.469	13,62
5	211	4,25	14	420	6,50	23	700	8,22	32	1.190	10,62	41	1.713	10,70	50	3.300	11,00	59	5.302	12,00
6	212	8,95	15	478	6,35	24	749	7,44	33	1.196	8,91	42	1.777	11,56	51	3.398	10,80	60	5.551	12,00
7	232	6,20	16	498	6,30	25	908	6,80	34	1.317	10,70	43	1.816	12,00	52	3.430	13,06	61	6.000	12,20
8	270	5,00	17	515	6,56	26	976	7,60	35	1.388	9,50	44	1.835	9,70	53	3.568	12,50	62	6.690	13,50
9	341	5,82	18	550	6,85	27	985	14,60	36	1.416	10,00	45	1.997	12,00	54	3.681	10,80	63	8.450	14,00

Source: Janssens and Otto (2008)

Figure 147: Plot observations design draft versus TEU capacity



Source: Janssens and Otto (2008)

The next step is to find values for the regression coefficients a and b to obtain the best fit possible to the data.

Not for all input values (x_i), the observation value (y_i) is the same as the value obtained of the predicted formula for a power function. The error of this difference is named residual value (ε_i) and is given by next formula:

$$\varepsilon_i = y_i - \left(a \cdot x_i^b\right) \qquad 54$$

To find the best value for the parameters a and b to minimize the errors as much as possible the partial derivative is taken twice for respectively a and b from the sum of all errors to the power two. This can be expressed as:

$$\frac{\partial E^2}{\partial a} = 0 \qquad 55$$

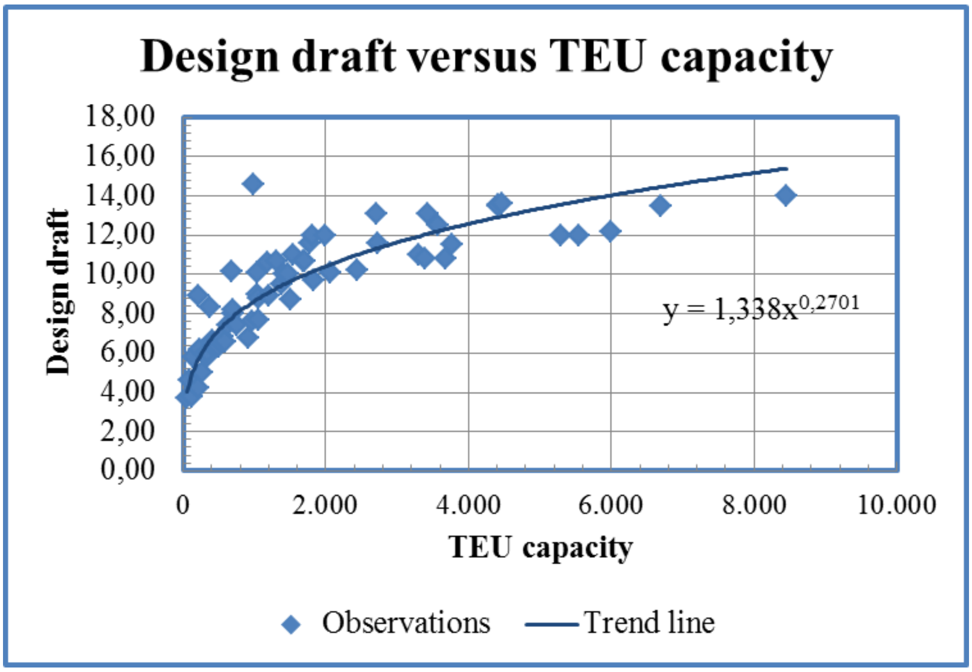
$$\frac{\partial E^2}{\partial b} = 0 \qquad 56$$

This results in next formulas for b and a:

$$b = \frac{n \cdot \sum_{i=1}^{n}\left(\ln(x_i)\cdot\ln(y_i)\right) - \sum_{i=1}^{n}\ln(x_i)\cdot\sum_{i=1}^{n}\ln(y_i)}{n \cdot \sum_{i=1}^{n}\left(\ln(x_i)^2\right) - \sum_{i=1}^{n}\left(\ln(x_i)^2\right)} = 0,2701 \qquad 57$$

$$a = e^{\frac{\sum_{i=1}^{n}\ln(y_i) - b\cdot\sum_{i=1}^{n}\ln(x_i)}{n}} = 1,338 \qquad 58$$

Figure 148: Plot observations design draft versus TEU capacity with power trend line.



Source: Janssens and Otto (2008)

I.2 Quadratic function

When having a set of data and the trend of the data need to be described, one can use the regression analysis estimation method of least squares. The trend of these data can be described by a lot of functions. Linear, polynomial, logarithmic and power functions are a few examples of how the trend can be described. To explain the principle of the estimation method of least squares a quadratic function will be used as described by Lay (2006).

The quadratic function is of the form:

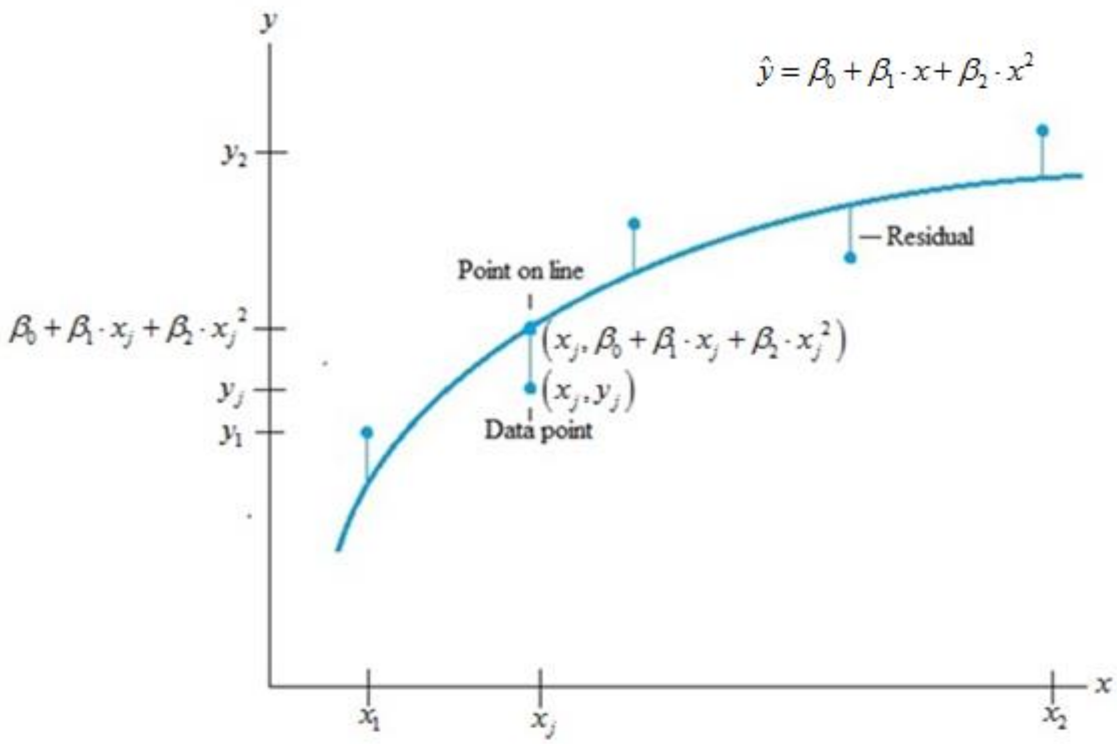
$$\hat{y} = \beta_0 + \beta_1 \cdot x + \beta_2 \cdot x^2 \qquad 59$$

The data consists of points: $(x_1, y_1), \ldots, (x_n, y_n)$

The next step is to find values for the regression coefficients β_0, β_1, and β_2 to obtain the best fit possible to the data.

When looking at line $\hat{y} = \beta_0 + \beta_1 \cdot x + \beta_2 \cdot x^2$ in Figure 149 each prediction value of $\hat{y}$ is obtained by the prediction $\beta_0 + \beta_1 \cdot x_j + \beta_2 \cdot x_j^{\,2}$. The difference between the observation value (y_j) and the predicted $\hat{y}$ -value ($\beta_0 + \beta_1 \cdot x_j + \beta_2 \cdot x_j^{\,2}$) is called residual (ε)

Figure 149: Estimation method of least squares: Fitting a line to data



In case there are residuals the equations will be:

$$
\begin{aligned}
&y_1 = \beta_0 + \beta_1 \cdot x_1 + \varepsilon_1 \\
&y_2 = \beta_0 + \beta_1 \cdot x_2 + \varepsilon_2 \\
&\ldots \\
&y_n = \beta_0 + \beta_1 \cdot x_n + \varepsilon_n
\end{aligned}
\qquad 60
$$

Now the system can be written as:

$$X\beta = y. \qquad 61$$

X represents the design matrix, β is the parameter vector, and y is the observation vector. Their contents are as follows:

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \ldots \\ y_n \end{bmatrix},\ X = \begin{bmatrix} 1 & x_1 & x_1^2 \\ 1 & x_2 & x_1^2 \\ \ldots & \ldots & \ldots \\ 1 & x_n & x_n^2 \end{bmatrix},\ \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \end{bmatrix},\ \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \ldots \\ \varepsilon_n \end{bmatrix}$$

Next Lay (2006:427) used a theorem in case there a no residuals: “The set of least squares solution of $A \cdot x = b$ coincides with the nonempty set of solution of the normal equation $A^T \cdot A \cdot x = A^T \cdot b$.” Here A is preplaced by X, x by β, and b by y as this is commonly used in statistical analysis of scientific and engineering data.

The normal equation now is:

$$X^T \cdot X \cdot \beta = X^T \cdot y. \qquad 62$$

This results in:

$$\begin{bmatrix} 1 & 1 & \ldots & 1 \\ x_1 & x_2 & \ldots & x_n \\ x_1^2 & x_2^2 & \ldots & x_n^2 \end{bmatrix} \cdot \begin{bmatrix} 1 & x_1 & x_1^2 \\ 1 & x_2 & x_2^2 \\ 1 & \ldots & \ldots \\ 1 & x_n & x_n^2 \end{bmatrix} \cdot \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & \ldots & 1 \\ x_1 & x_2 & \ldots & x_n \\ x_1^2 & x_2^2 & \ldots & x_n^2 \end{bmatrix} \cdot \begin{bmatrix} y_1 \\ y_2 \\ \ldots \\ y_n \end{bmatrix} \qquad 63$$

Next the regression coefficients β_0, β_1, and β_2 can be obtained by performing row operation on augmented matrix obtained by:

$$\left[X^T \cdot X \middle| y \right] \qquad 64$$

This looks like:

$$\left[\begin{bmatrix} 1 & 1 & ... & 1 \\ x_1 & x_2 & ... & x_n \\ x_1^2 & x_2^2 & ... & x_n^2 \end{bmatrix} \cdot \begin{bmatrix} 1 & x_1 & x_1^2 \\ 1 & x_2 & x_2^2 \\ 1 & ... & ... \\ 1 & x_n & x_n^2 \end{bmatrix} \middle| \begin{bmatrix} 1 & 1 & ... & 1 \\ x_1 & x_2 & ... & x_n \\ x_1^2 & x_2^2 & ... & x_n^2 \end{bmatrix} \cdot \begin{bmatrix} y_1 \\ y_2 \\ ... \\ y_n \end{bmatrix}\right] \quad 65$$

After the row operations a 3x4 matrix is obtained which is:

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & \beta_0 \\ 0 & 1 & 0 & \beta_1 \\ 0 & 0 & 1 & \beta_2 \end{array}\right] \quad 66$$

Thus the regression coefficients β_0 and β_1 can be found in column 4.

In case there are residuals, the residual vector (ε) which contains each residual corresponding to a point of the data needs to be taken into account. The residual vector (ε) is obtained by:

$$\varepsilon = y - X \cdot \beta \quad 67$$

The matrix that needs to be resolved will be:

$$\left[\begin{bmatrix} 1 & 1 & ... & 1 \\ x_1 & x_2 & ... & x_n \\ x_1^2 & x_2^2 & ... & x_n^2 \end{bmatrix} \cdot \begin{bmatrix} 1 & x_1 & x_1^2 \\ 1 & x_2 & x_2^2 \\ 1 & ... & ... \\ 1 & x_n & x_n^2 \end{bmatrix} \middle| \begin{bmatrix} 1 & 1 & ... & 1 \\ x_1 & x_2 & ... & x_n \\ x_1^2 & x_2^2 & ... & x_n^2 \end{bmatrix} \cdot \begin{bmatrix} y_1 - \varepsilon_1 \\ y_2 - \varepsilon_2 \\ ... \\ y_n - \varepsilon_n \end{bmatrix}\right] \quad 68$$

After the row operations a 3x4 matrix is obtained which also is:

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & \beta_0 \\ 0 & 1 & 0 & \beta_1 \\ 0 & 0 & 1 & \beta_2 \end{array}\right] \quad 69$$

In case the original data only consists of three points or the points are as such so all the points are on the graph the solution is an exact fit, in case there are points, which do not lie on the graph, the solution is an approximate fit.

I.3 Testing for significance

Testing for significance can be done by calculating the T-value and the standard error.

T-value

$$t = \frac{\bar{x}_n - \mu}{\frac{s_n}{\sqrt{n}}}$$

- t: t-value
- $\bar{x}_n$: Sample mean of dataset
- μ: expectation
- s_n:Sample standard deviation
- n:number of data in data set

Standard error

$$SE = \frac{s_n}{\sqrt{n}}$$

- SE : Standard error

- s_n:Sample standard deviation
- n:number of data in data set

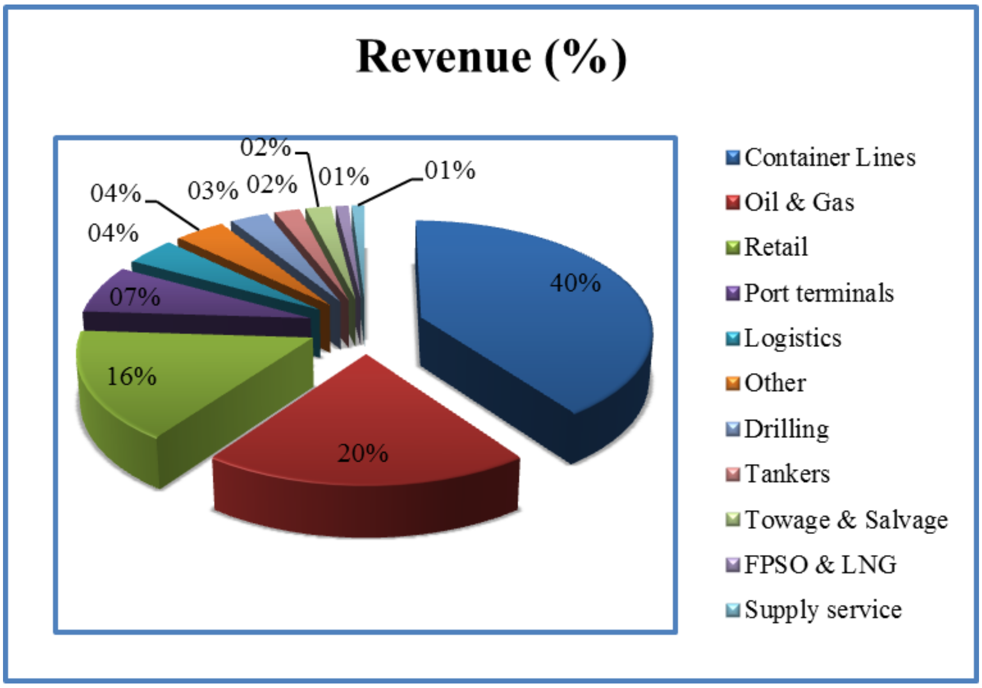
Appendix J : Shipping strategy

J.1 Very large competitors

J.1.1 A.P. Møller Maersk group

According to A.P. Møller Maersk group's annual report (2011) the company is active in lots of segments: container shipping, tanker, FPSO[35] & LNG[36] carriers, RoRo[37] carriers, the oil & gas, drilling, port terminals, supply service, towage & salvage, container manufacturing, logistics, retail, air cargo, and banking segments. Providing door-to-door container transport services with their logistics department are important. The segment of container line is good for almost half the revenue of the group ($25.1bn of $60.2bn). Together with the port terminals, oil & gas carriers, and drilling vessels they form the main focus of the group. They also owned the Odense Steel Shipyard, which is closed down after the last vessel delivery, which was in 2012. How the revenue is spread over the various segments can be seen in Figure 150. A.P. Møller Maersk group is a big and aggressive player in the market. They do not want to operate vessels older than 21 years although they still might make money, but it is inconsistent with their top quality policy. They strive for market leadership. Defending their competitive position is so important that they even accept relatively modest rates at times. They have a constant strive for low costs, high quality, standing close to the customer, minimum risks, safety, reliability, flexibility, and sustainability. They do this with care for the climate and the environment.

Figure 150: Revenue of 2011 for the A.P. Møller Maersk Group

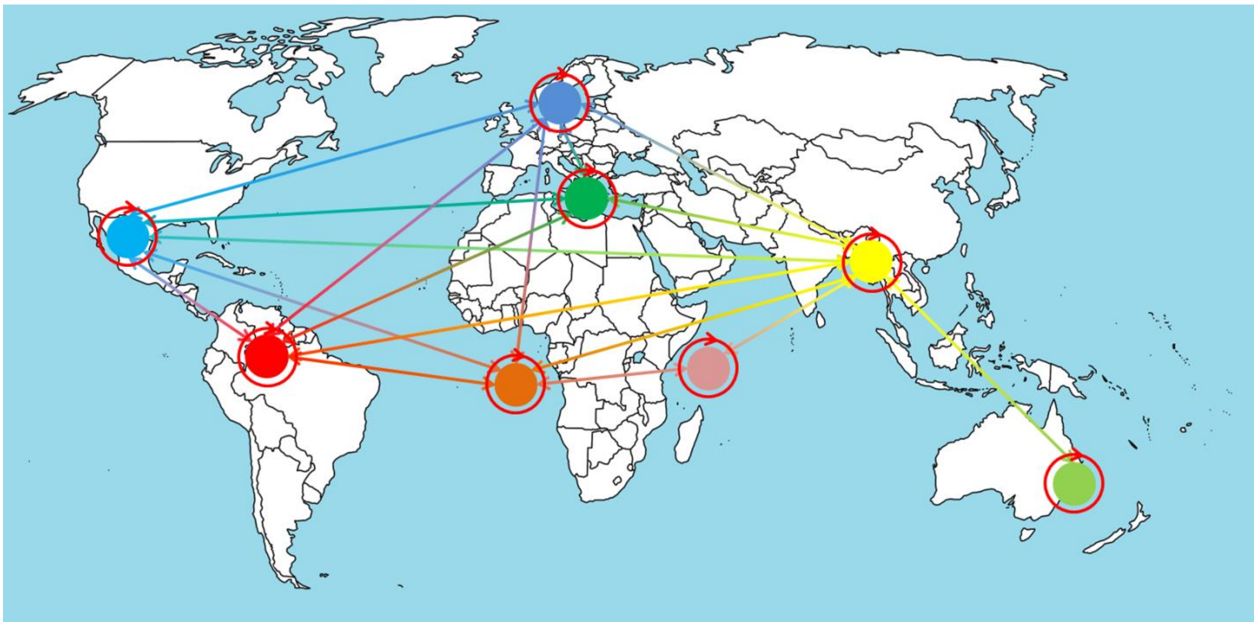


Source: Group annual report 2011 (2011)

[35] FPSO: Floating Production Storage and Offloading unit.
[36] Liquefied Natural Gas
[37] RORO: Roll-On Roll-Off, transportation of vehicles

According to Maersk Line's company fact sheet (24/05/2013) and Alphaliner (27/07/2011) the container line segment consists of seven container shipping companies: Maersk Line, Mercantile Cargo Consolidators (MCC), Mercosul Line, Ocean African Container Lines (OACL) (51% share and has Mozline as a subsidiary), Safmarine, Seago Line, and Det Forenede Dampskibs- Selskab (DFDS) (31% share). The latter five container shipping companies support Maersk line with their regional liner and feeder container liner services. Maersk Line is active in all the regions in the world, MCC in South America, Mercosul Line in Namibia, OACL in South Africa, Safmarine in all the regions in the world, Seago Line in Europe, The Mediterranean, and the Black Sea, and DFDS in Europe. This gives the container line segment of A.P. Møller Maersk group world coverage. An overview of the trades where Maersk's container lines is active can be seen in Figure 151. Maersk container lines are also in a constant quest to enter newly developing container shipping markets.

Figure 151: Trades Maersk's container lines



Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

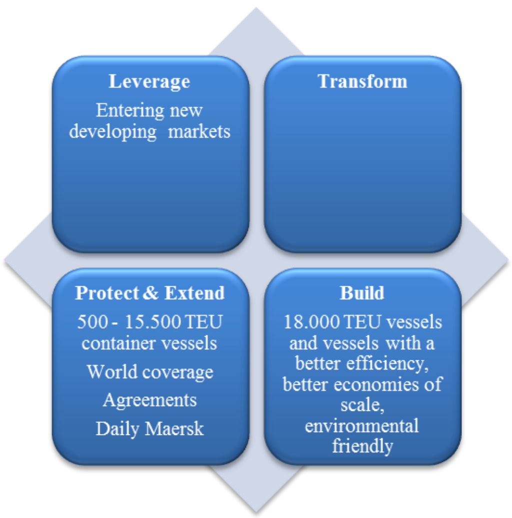
According to Alphaliner's top 100 and order book (27/07/2011) Maersk Container Lines uses 636 container vessels (210 owned and 426 chartered) for their container liner services. Their nominal TEU capacities range from 500TEU to 15.550TEU. They have 54 vessels on order and have ten more options. Among their orders there are container vessels that have higher nominal TEU capacities than the ones present in their fleet. More details about the orders and options can be found in Table 149. Maersk Container Lines also has vessels sharing agreements or slot agreements with various other operators or carriers.

Table 149: Maersk Container Lines: Orders and options

A.P. Møller - Maersk Group	# vessels	TEU	Total TEU
Orders	20	18.000	360.000
	13	7.450	96.850
	16	4.496	71.936
	1	1.052	1.052
	4	1.047	4.188
Total orders	**54**		**534.026**
Options	10	18.000	180.000
Total options	**10**		**180.000**
Total	**64**		**714.026**

Source: Alphaliner (27/07/2011)

Figure 152: Conceptual model: Maersk's container lines



According to Maersk Line's company fact sheet (24/05/2013), They want their newly built container vessels to have the best economies of scales, efficiency and environmental friendliness in the future. A good hull, engine and propeller design needs to result in less fuel consumption, and less carbon dioxide emissions per transported container. By putting up the cradle-to-cradle project the containers vessels can be recycled to make new vessels and vessels parts. For their container liner services, they strive to be the most reliable container line and the market leader. In the future, they want to improve this even further with the Daily Maersk container liner service on the trade between Asia and Europe. There will be a daily sailing in each port and a guaranteed arrival date of the container. Their conceptual model can be seen in Figure 152.

Figure 153: Portfolio model: A.P. Møller Maersk group

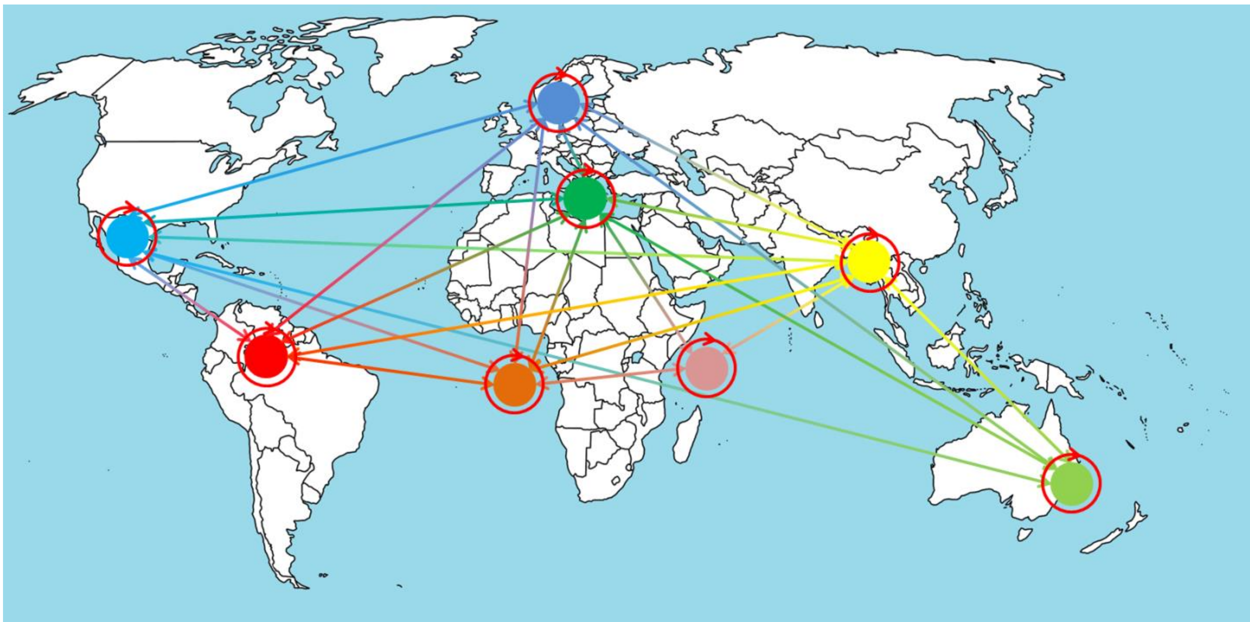
When looking at all the types of segments in the group, taking their share in the group into account, and the duration of their agreements or projects, it becomes clear that the A.P. Møller Maersk group works in a lot of commodity markets but also non-commodity markets which are spread all over the world. Because they are active in basically the entire world they can easily move away from political risks if they are exposed to them. This results in a portfolio strategy with a very stable political situation. Because the company is active in a great amount of segments, which are not all part of the container transport chain a container passes along, the A.P. Møller Maersk group is very stable. This results in the portfolio model of Figure 153.

J.1.2 MSC Group

According to MSC (24/06/2013) and Alphaliner (27/07/2011), The Mediterranean Shipping Company Group (MSC Group) is active in two segments: container lines and cruise lines. Its container lines are MSC and West Europe Container Lines (WEC lines). The cruise line is named MSC cruises. They also provide door-to-door container transport services with their logistics department.

MSC is active in all the regions in the world. WEC Lines on the other hand is active in the European region. Together these two container shipping companies serve practically the entire world. An overview of the trades in which MSC's container lines are active can be seen in Figure 154. MSC's container lines are also in a constant quest to enter newly developing container shipping markets.

Figure 154: Trades MSC's container lines



Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

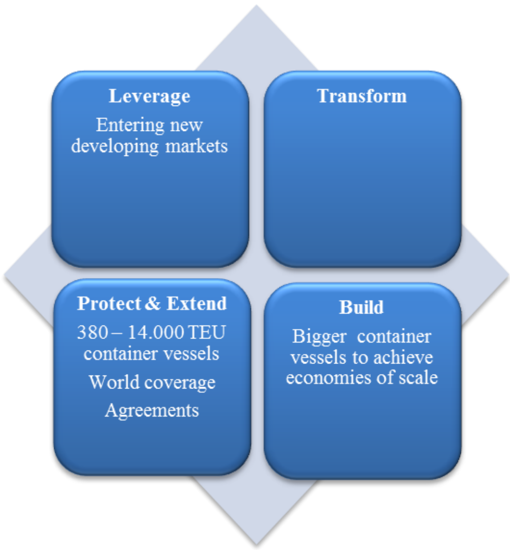
According to Alphaliner's top 100 and order book (27/07/2011) the fleet of the container lines consist of 472 container vessel out of which 213 are owned and 259 are chartered. The container vessel's nominal TEU capacity range is from 380TEU to 14.000TEU. There are 47 orders and four more options. More details about the orders and options can be seen in Table 150. MSC container line has vessels sharing agreements and slot agreements with other operators.

Table 150: MSC container lines: Orders and options

MSC	# vessels	TEU	Total TEU
Orders	4	14.000	56.000
	8	13.092	104.736
	5	13.050	65.250
	6	13.000	78.000
	1	12.552	12.552
	6	8.948	53.688
	6	8.800	52.800
	6	8.762	52.572
	5	5.550	27.750
Total orders	**47**		**503.348**
Options	4	9.000	36.000
Total options	**4**		**36.000**
Total	**51**		**539.348**

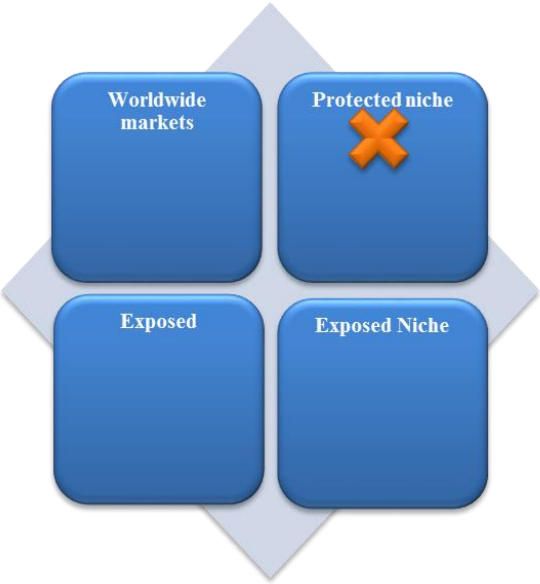
Source: Alphaliner (27/07/2011)

Figure 155: Conceptual model: MSC's container line



Their conceptual model can be seen in Figure 155. The portfolio strategy of the MSC group as can be seen in Figure 156 is the result of the group's activities all over the world. In case there is a political instability in a country, this country can easily be avoided without bringing the company in much danger of lack of income. Therefore, this makes the company highly politically stable. The cruise segment is a non-commodity market, but the container segments is commodity based and, as about 50% of the container vessels are owned, the cash flow is stable due to the hedging advantage of the charter prices.

Figure 156: Portfolio model MSC Group

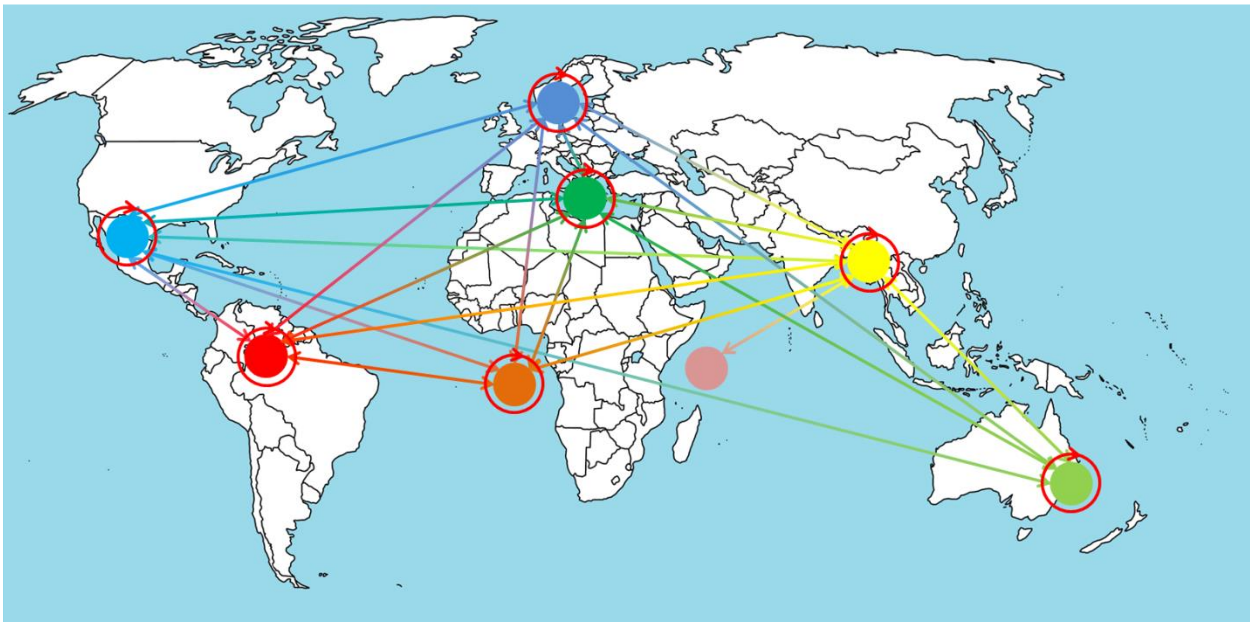


J.1.3 CMA CGM Group

According to CMA CGM (30/05/2013) and Alphaliner (27/07/2011) Compagnie Maritime d'Affrètement - Compagnie Générale Maritime (CMA CGM) is active in twelve segments: logistics, container lines, container terminals, barging, railing, trucking, container depots, warehouses, insurance brokerage, container vessel cruising, yacht cruising, and tour operating. They also provide door-to-door container transport services with their logistics department.

The container lines segment consist of eight container lines: Australian National Lines (ANL), Cheng Lie Navigation Company (CNC Line), CMA CGM, Compagnie Marocaine de Navigation (CoMaNav), Delmas, MacAndrews, United States Line (US Line). ANL is active in the Oceania region. CNC Line is active in the Asian region. CMA CGM is active in all the regions in the world. CoMaNav is active the European, The Mediterranean, and West African regions. Delmas is active in the West African region. MacAndrews is active in the European region. US Line is active in the North American region. An overview of the trades in which CMA CGM's container lines are active can be seen in Figure 157. CMA CGM's container lines are also in a constant quest to enter newly developing container shipping markets.

Figure 157: Trades CMA CGM's container lines



Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

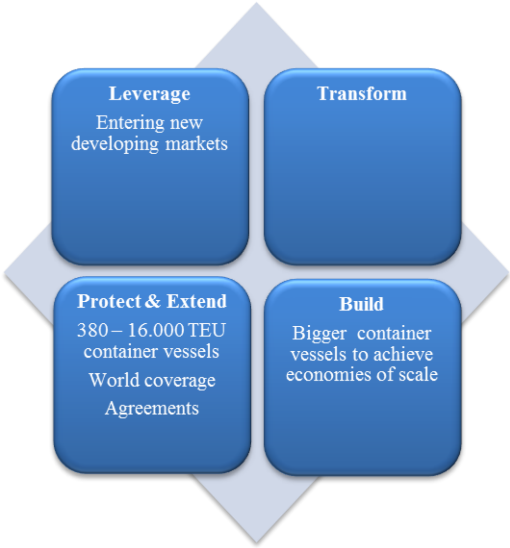
According to Alphaliner's top 100 and order book (27/07/2011) CMA CGM's container lines have 390 container vessels (95 owned and 295 chartered). The container vessels range in nominal TEU capacity from 100TEU to 13.800TEU. They also have 17 orders. Among their orders, there are container vessels that have higher nominal capacities than the ones in their fleet. More information about the orders can be found in Table 151. CMA CGM container lines have vessels sharing agreements and slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 158.

Table 151: CMA CGM container lines: Orders

CMA CGM Group	# vessels	TEU	Total TEU
Orders	3	16.000	48.000
	8	12.552	100.416
	4	8.428	33.712
	2	3.600	7.200
Total orders	**17**		**189.328**

Source: Alphaliner (27/07/2011)

Figure 158: Conceptual model: CMA CGM's container lines



The portfolio strategy of the MSC group as can be seen in

Figure 159 is the result of the group's activities all over the world. A lot of segments are active worldwide, but some are limited to France such as the barging and warehouse segments or are limited to Europe or the Middle East like the railing, trucking, and the container depot segment. This results in a politically stable situation. Because they are mainly active in the container transport chain market, makes the cash flow stable. The yacht cruising and tour operating segment also contribute to a stable cash flow.

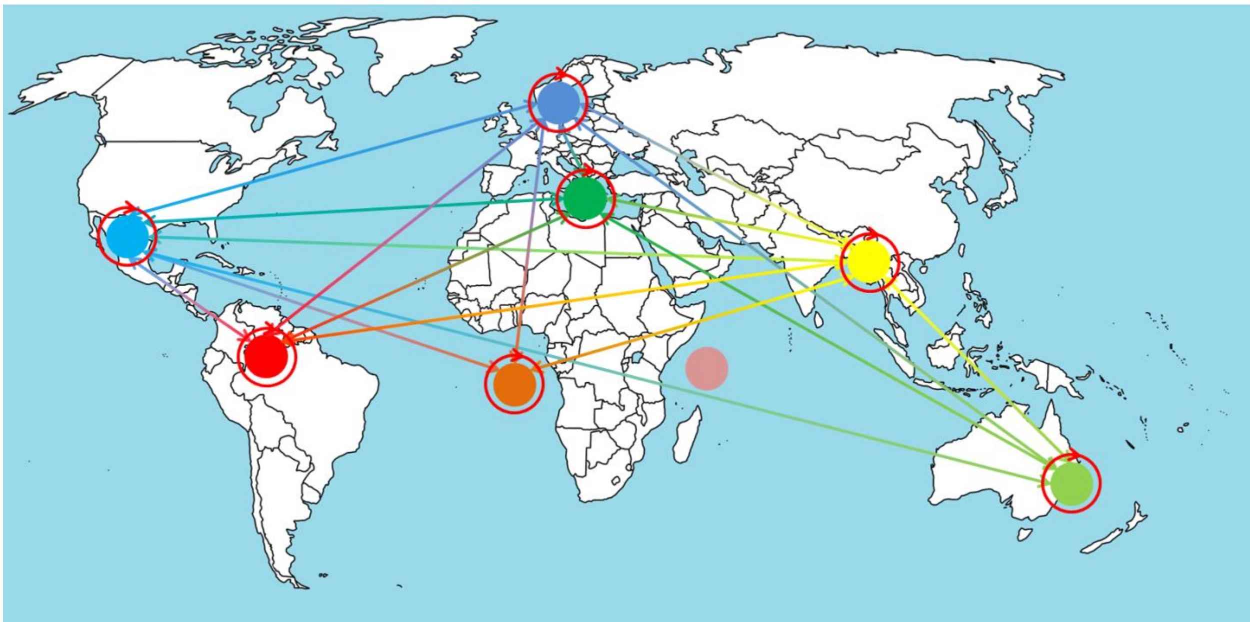
Figure 159: Portfolio model: CMA CGM Group

J.2 Large competitors

J.2.1 Hapag-Lloyd

According to Hapag-Lloyd (20/06/2013) and Alphaliner (27/07/2011) the owners of Hapag-Lloyd are the Albert Ballin consortium (77.96%, consisting of the City of Hamburg, Kühne Maritime, Signal Iduna, HSH Nordbank, M.M.Warburg Bank and Hanse Merkur) and the TUI AG (22.04%). They also provide door-to-door container transport services with their logistics department. They are a container shipping company active in Asia, Europe, The Mediterranean, North America, Oceania, South America, and West Africa. The trades in which their container liner services are active can be seen in Figure 160.

Figure 160: Trades Hapag-Lloyd



Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

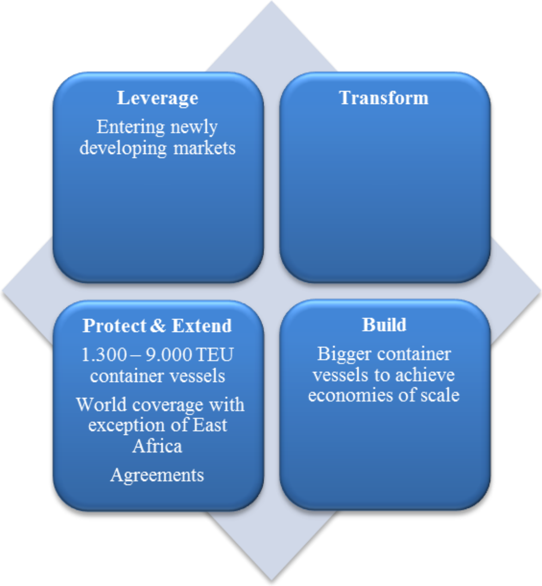
According to Alphaliner's top 100 and order book (27/07/2011) Hapag-Lloyd uses 143 container vessels (56 owned and 87 chartered) for these container liner services. Their nominal TEU capacities range from 1.300TEU to 9.000TEU. They have eleven vessels on order. Among their orders, there are container vessels that have higher nominal TEU capacities than the ones present in their fleet. More details about the orders can be found in Table 152. Hapag-Lloyd often has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 161.

Table 152: Hapag-Lloyd: Orders and options

Hapag-Lloyd	# vessels	TEU	Total TEU
Orders	10	13.100	131.000
	1	1.758	1.758
Total orders	11		132.758

Source: Alphaliner (27/07/2011)

Figure 161: Conceptual model: Hapag-Lloyd



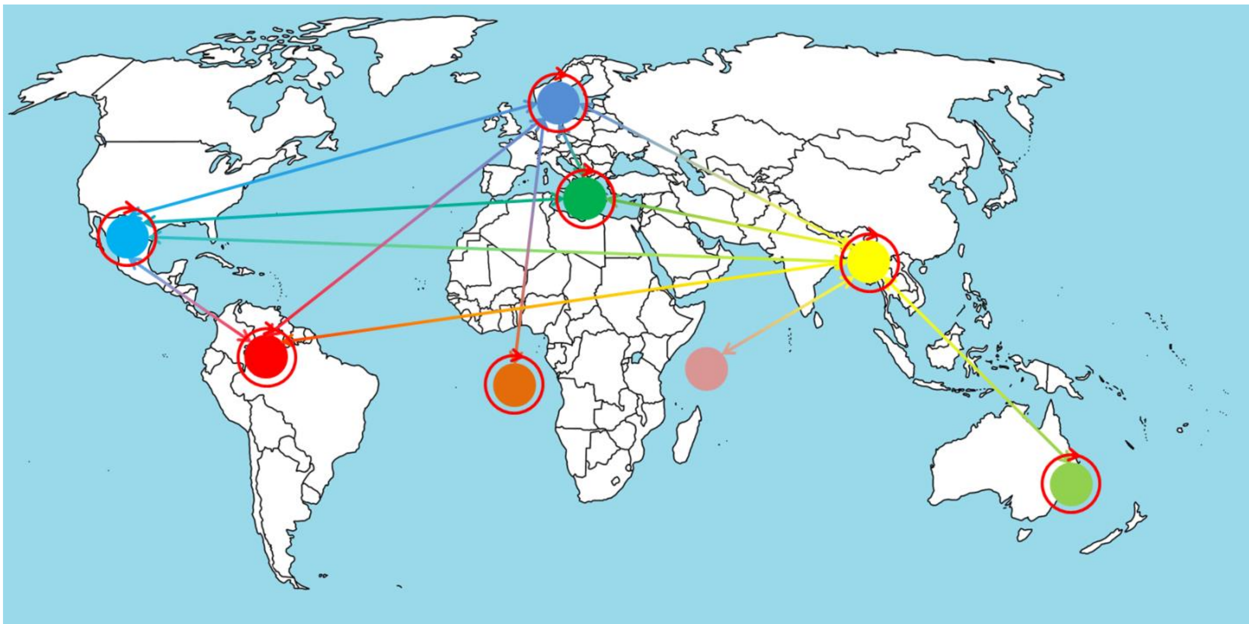
Their portfolio model as can be seen in Figure 162 shows that they are political stable due to the fact that they have worldwide container liner services with exception of East Africa. In case a country becomes political unstable and therefore needs to be avoided, would not affect the company that much. Their cash flows are stable. This due to the fact that they are only active in the commodity oriented container shipping market and because about 39% of their vessels are owned. This way the benefit from the hedging of the charter prices.

Figure 162: Portfolio model: Hapag-Lloyd

J.2.2 Hanjin Shipping

According to Hanjin Shipping (19/06/2013) and Alphaliner (27/07/2011) Hanjin shipping is a company active is five different segments: container shipping, bulk shipping, port terminals, ships repair yard, and logistics. They also provide door-to-door container transport services with their logistics department. In the container shipping segment, they are active in Asia, East Africa, Europe, North America, The Mediterranean, Oceania, South America and West Africa. The trades in which their container liner services are active can be seen in Figure 163.

Figure 163: Trades Hanjin Shipping



Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

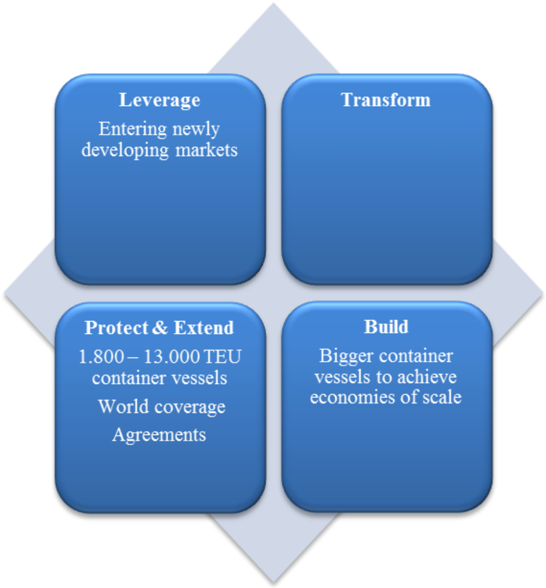
According to Alphaliner's top 100 and order book (27/07/2011) Hanjin Shipping uses 108 container vessels (40 owned and 68 chartered) for these container liner services. Their nominal TEU capacities range from 800TEU to 13.100TEU. They have 32 vessels on order. Among their orders, there are container vessels that have higher nominal TEU capacities than the ones present in their fleet. More details about the orders can be found in Table 153. Hanjin shipping has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 164.

Table 153: Hanjin Shipping: Orders

Hanjin Shipping	# vessels	TEU	Total TEU
Orders	5	13.102	65.510
	7	10.000	70.000
	4	9.954	39.816
	4	8.586	34.344
	4	4.600	18.400
	8	3.560	28.480
Total orders	**32**		**256.550**

Source: Alphaliner (27/07/2011)

Figure 164: Conceptual model: Hanjin Shipping



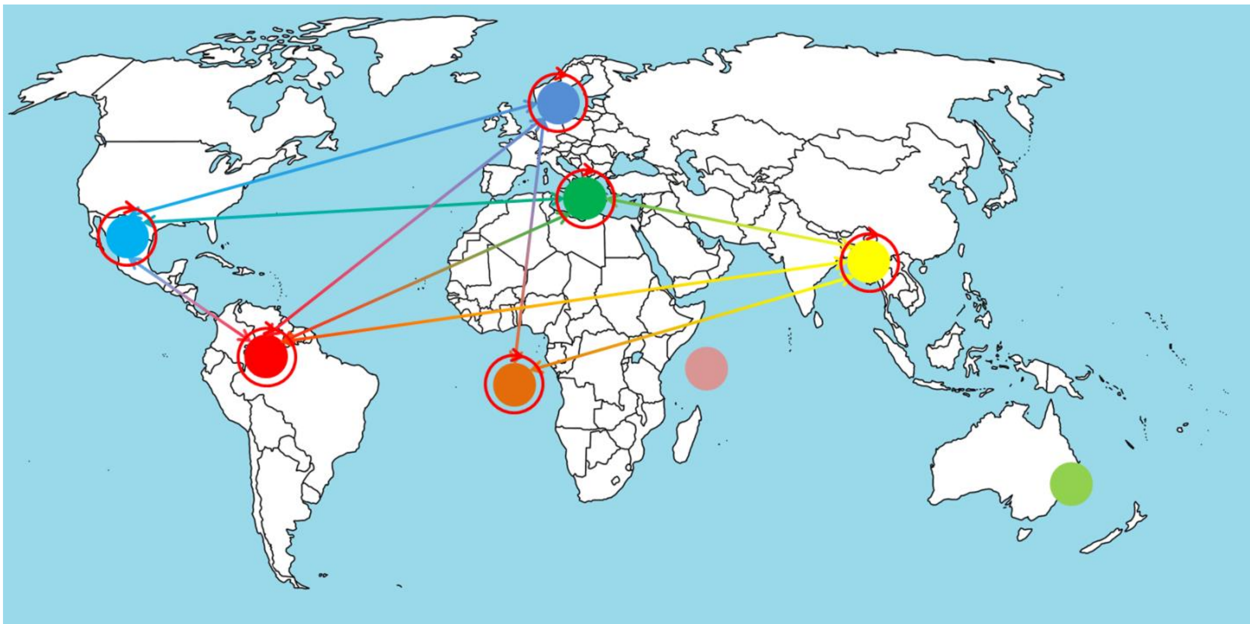
The Portfolio can be seen in Figure 165. Hanjin shipping has 63% of it vessels on charter. Due to hedging of the charter prices the cash flow is stable. Because the cash flow also comes from various commodity oriented shipping segments and the non-commodity oriented ship repair, the cash flow is stable. Because the Group is active in all the regions in the world, the company will not be influenced a lot in case a country becomes politically unstable. So one can say that its political situation is very stable.

Figure 165: Portfolio model: Hanjin Shipping

J.2.3 CSAV Group

According to CSAV (17/06/2013) and Alphaliner (27/07/2011), Compañía Sud Americana de Vapores Grupo (CSAV Group) is active in several shipping segments such as bulk, cars, and containers. They provide door-to-door container transport services with their logistics department. Their main focus is on container shipping. The group consists of four companies: CSAV, CSAV Norasia, Libra Brasil, and Libra Uruguay. CSAV is active in Asia, Europe, The Mediterranean, North America, South America, and West Africa. CSAV Norasia is active in Asia, and Europe. Libra Brasil is active in North America and South America. Libra Uruguay is active in Asia, Europe, The Mediterranean, North America, South America, and West Africa. Therefore, the container liner services of the group are between the regions of Asia, Europe, The Mediterranean, North America, South America, and West Africa. The trades used for their connections can be seen in Figure 166.

Figure 166: Trades CSAV' container line



Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

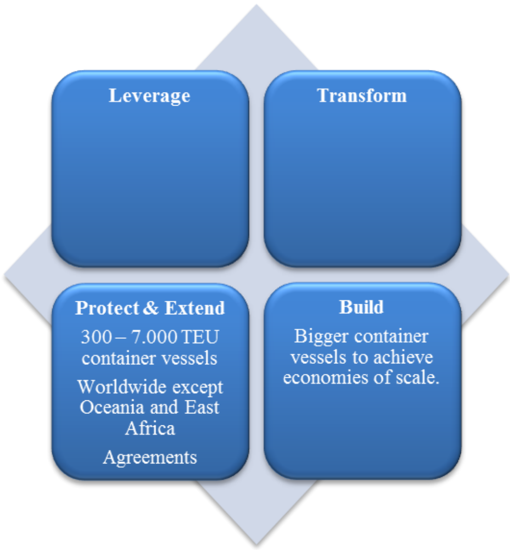
According to Alphaliner's top 100 and order book (27/07/2011) CSAV group uses 131 container vessels (ten owned and 121 chartered) for their container liner services. Their nominal TEU capacities range from 850TEU to 7.000TEU. They have twelve vessels on order and have eight more options. Among their orders, there are container vessels that have higher nominal TEU capacities than the ones present in their fleet. More details about the orders and options can be found in Table 154.

Table 154: CSAV Group: Orders and options

CSAV Group	# vessels	TEU	Total TEU
Orders	4	9.000	36.000
	7	8.000	56.000
	1	6.589	6.589
Total orders	**12**		**98.589**
Options	4	9.000	36.000
	4	8.000	32.000
Total options	**8**		**68.000**
Total	**20**		**166.589**

Source: Alphaliner (27/07/2011)

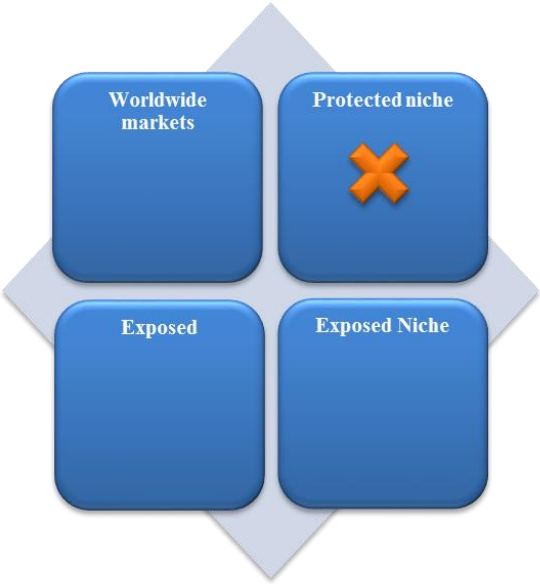
Figure 167: Conceptual model: CSAV's container lines



CSAV Group often has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 167.

Their portfolio model as can be seen in Figure 168 shows a company of which the cash flow is stable as only ten out of 130 container vessels are owned. This makes their cash flow stable. The political situation of the company is stable. This because they are active in several regions in the world.

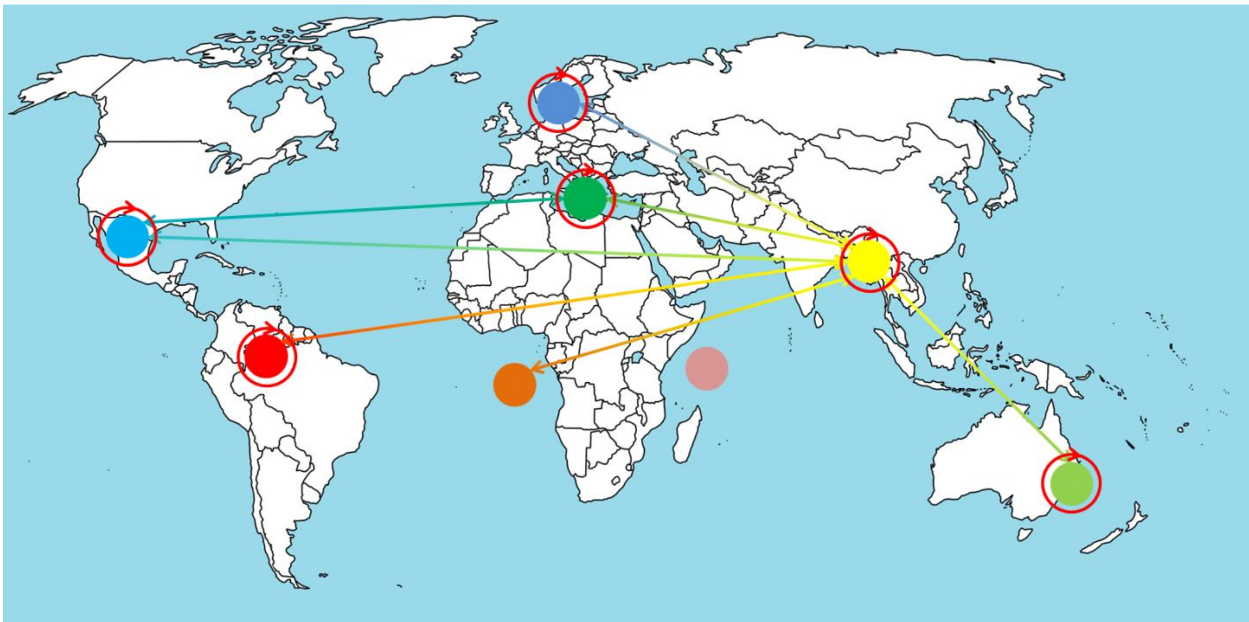
Figure 168: Portfolio model: CSAV Group



J.2.4 CSCL

According to CSCL (17/06/2013) and Alphaliner (27/07/2011), China Shipping Container Lines (CSCL) is active in segments as logistics, container shipping, air cargo, railing, trucking, container terminals, and warehousing. This way they can manage complete container transport chains of companies and provide door-to-door container transport services with their logistics department. In their container shipping segments they are active in Asia, Europe, The Mediterranean, North America, Oceania, South America, and West Africa. An overview on which trades their container liner services are located at can be seen in Figure 169.

Figure 169: Trades CSCL



Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

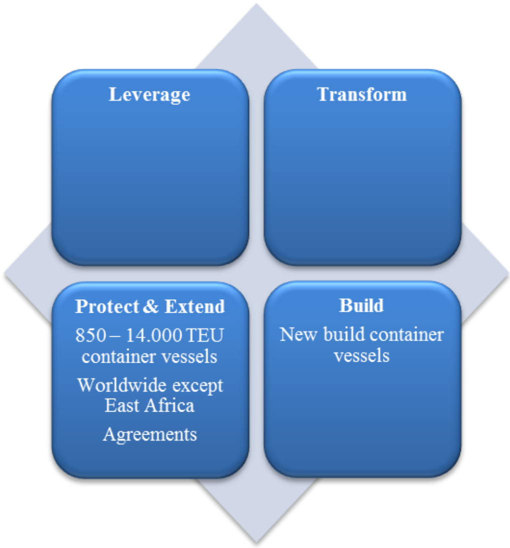
According to Alphaliner's top 100 and order book (27/07/2011) CSCL uses 142 container vessels (76 owned and 66 chartered) for their container liner services. Their nominal TEU capacities range from 300TEU to 14.000TEU. They have twelve vessels on order. More details about the orders can be found in Table 155. CSCL often has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 170.

Table 155: CSCL: Orders

CSCL	# vessels	TEU	Total TEU
Orders	4	14.074	56.296
	8	4.700	37.600
Total orders	**12**		**93.896**

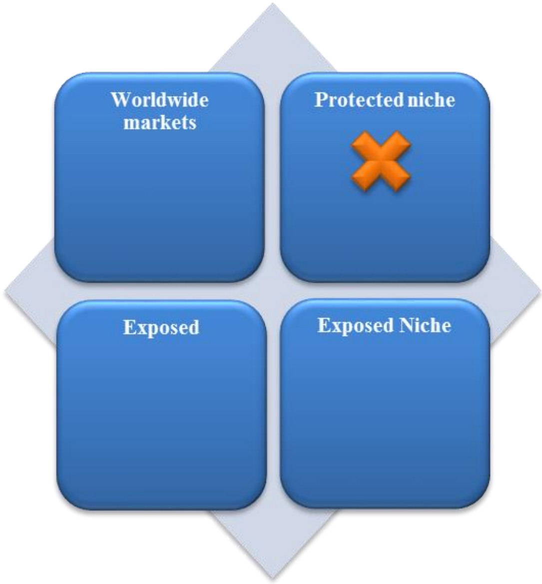
Source: Alphaliner (27/07/2011)

Figure 170: Conceptual model: CSCL



Their portfolio model can be seen in Figure 171. Because they are only active in the commodity oriented shipping market, but have an almost fifty-fifty balance between their owned and chartered vessels, their cash flow is stable. Because they are active in the entire world, with exception of East Africa, but the others segments are situated in China their political situation is stable.

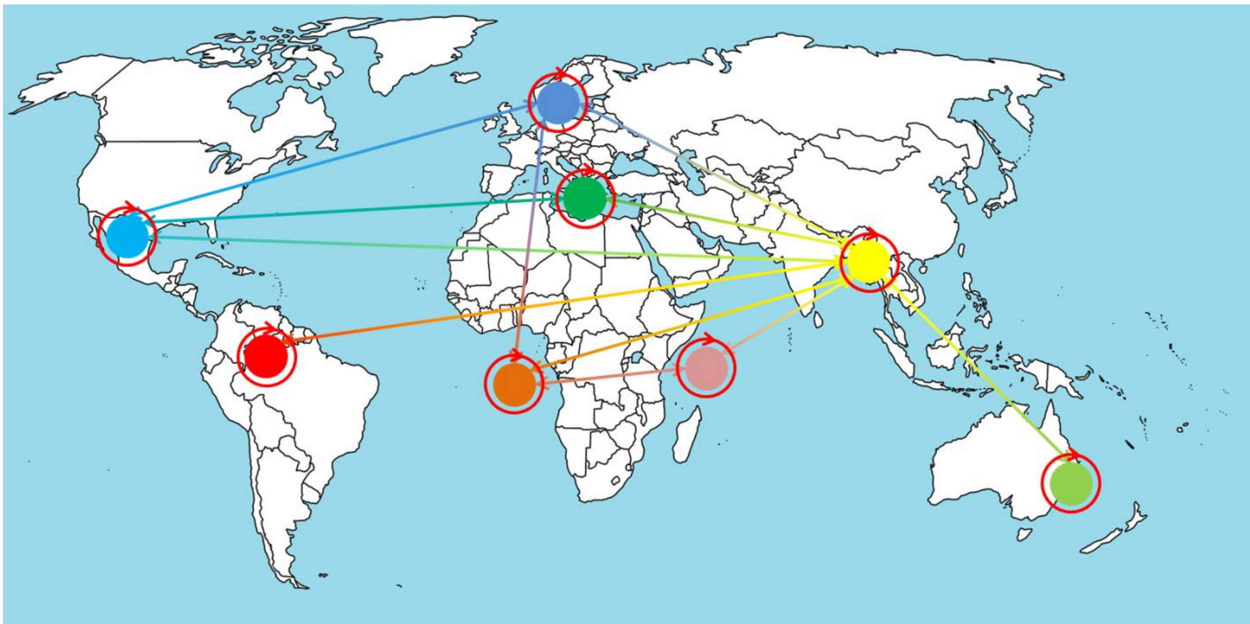
Figure 171: Portfolio model: CSCL



J.2.5 MOL Group

According to MOL (24/06/2013) and Alphaliner (27/07/2011), Mitsui Osaka Shosen Kaisha Lines Group (MOL Group) is active in nine segments: bulk carriers, tankers, LNG carriers, car carriers, container vessels, port terminals, logistics, cruise vessels, and ferries & coastal liners. They provide door-to-door container transport services with their logistics department. Within the container segment, they are active in Asia, East Africa, Europe, The Mediterranean, North America, Oceania, South America, and West Africa. In which trades their container liner services are active can be seen in Figure 172.

Figure 172: Trades MOL



Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

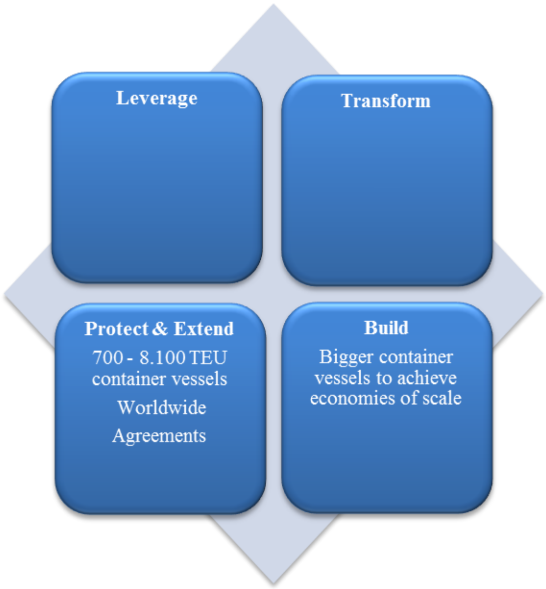
According to Alphaliner's top 100 and order book (27/07/2011) MOL uses 102 container vessels (36 owned and 66 chartered) for these container liner services. Their nominal TEU capacities range from 700TEU to 8.100TEU. They have thirteen vessels on order. Among their orders, there are container vessels that have higher nominal TEU capacities than the ones present in their fleet. More details about the orders and options can be found in Table 156. MOL has vessel sharing agreements and slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 173.

Table 156: MOL: Order and Options

MOL	# vessels	TEU	Total TEU
Orders	5	14.000	70.000
	2	8.600	17.200
	6	5.605	33.630
Total orders	13		120.830

Source: Alphaliner (27/07/2011)

Figure 173: Conceptual model: MOL



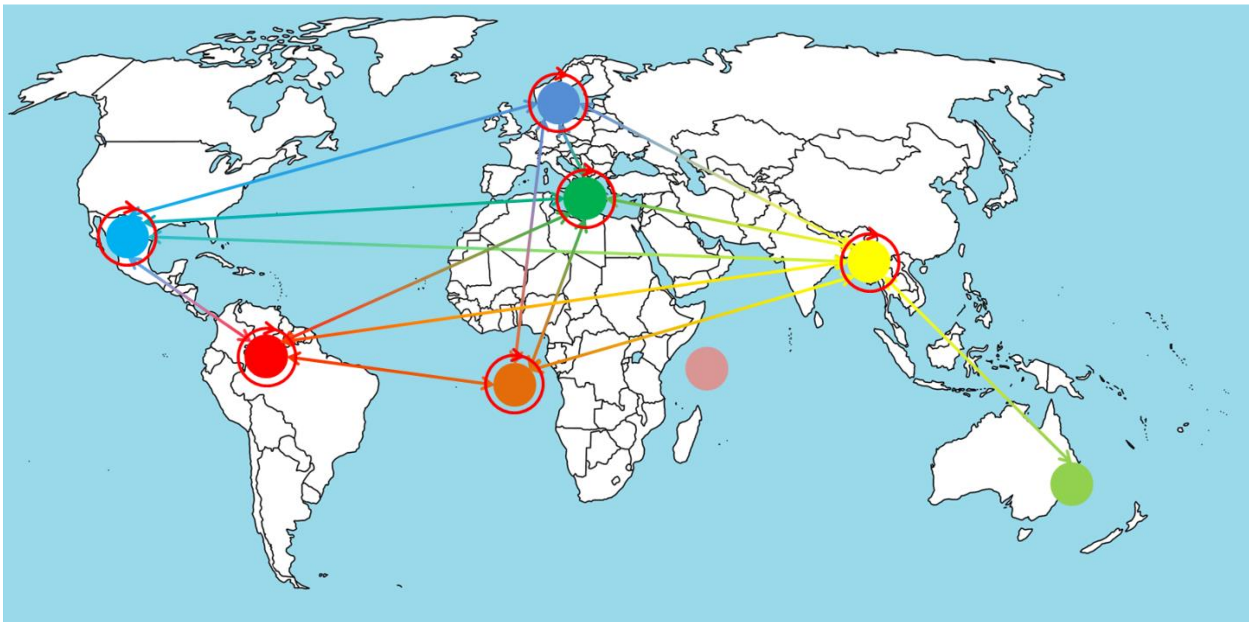
Their portfolio model can be seen in Figure 174. Because the company is active in the entire world with their container liner services, the company will not be much hindered in case a country becomes unstable. Therefore, the political situation is very stable. The cash flows is stable because the MOL Group is active in both commodity and non-commodity markets. About 50% of their vessels are chartered so they benefit from a stable cash flow due to hedged charter prices.

Figure 174: Portfolio model: MOL Group

J.2.6 Zim Group

According to Zim (04/06/2013) and Alphaliner (27/07/2011), the Zim group consists of three subsidiaries: Gold Star Line, Laurel Navigation, and Zim. They provide door-to-door container transport services with their logistics department. Gold Star Line is active in the regions of Asia, Oceania and West Africa. Laurel navigation is active in Asia and Zim is active worldwide except in East Africa. The trades in which the container liner services of these three container shipping companies are active, can be seen in Figure 175.

Figure 175: Trades Zim



Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

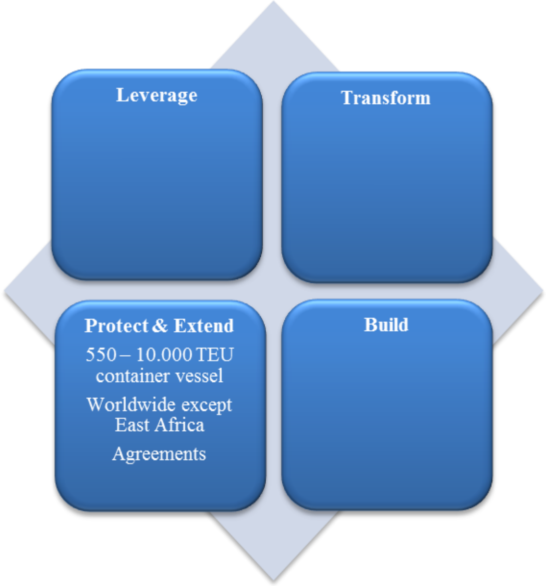
According to Alphaliner's top 100 and order book (27/07/2011) Zim Group uses 100 container vessels (34 owned and 66 chartered) for their container liner services. Their nominal TEU capacities range from 550TEU to 10.000TEU. They have thirteen vessels on order. Among their orders, there are container vessels that have higher nominal TEU capacities than the ones present in their fleet. More details about the orders can be found in Table 157. The Zim Group has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 176.

Table 157: Zim: Orders and options

Zim	# vessels	TEU	Total TEU
Orders	9	12.552	112.968
	4	10.062	40.248
Total orders	13		153.216

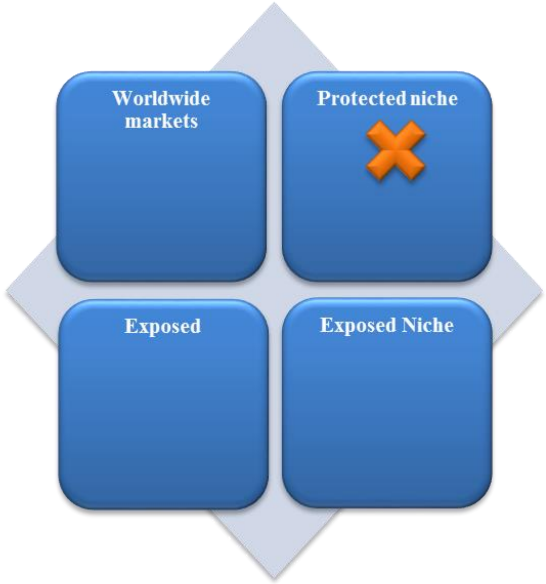
Source: Alphaliner (27/07/2011)

Figure 176: Conceptual model: Zim Group



Their portfolio model can be seen in Figure 177. It shows a stable political situation because they are active worldwide except in East Africa. Therefore, in case a country will become unstable, they will not encounter too much trouble. Their cash flow is stable. This due to the fact that about 30% of their fleet are owned vessels. For their chartered container vessels they benefit from stable cash flows due to hedged charter prices. They are only active in container shipping, which is commodity based.

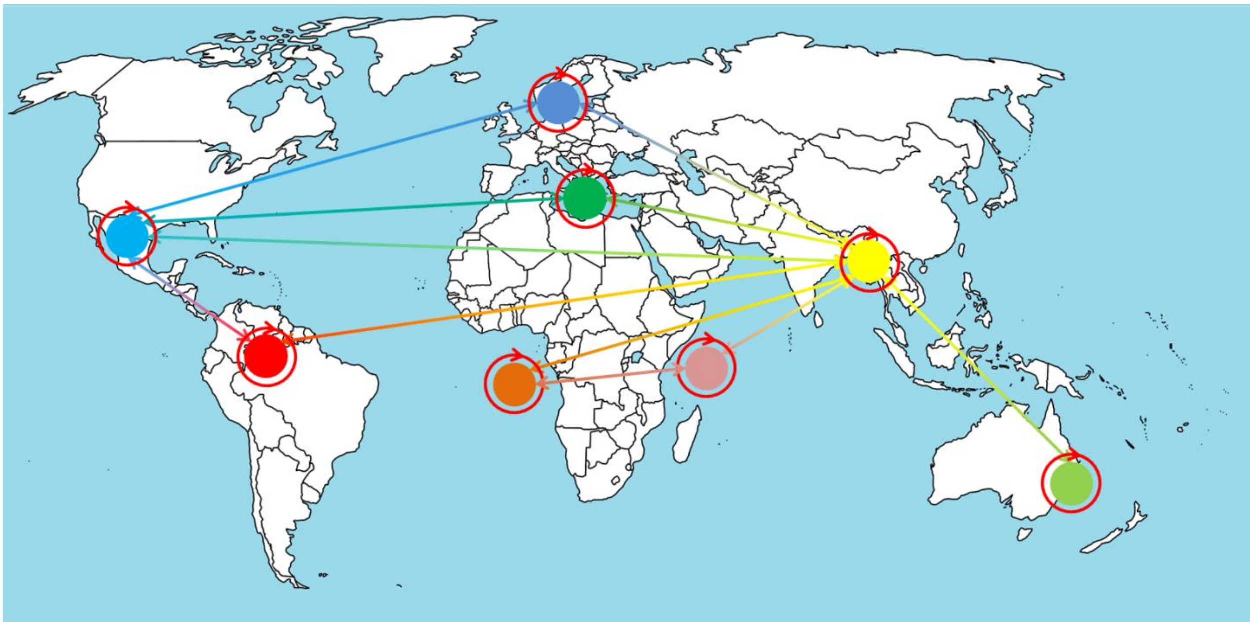
Figure 177: Portfolio model: Zim Group



J.2.7 NYK Group

According to NYK Line (01/07/2013) and Alphaliner (27/07/2011), Nippon Yusen Kabushiki Kaisha Group (NYK Group) is active in a lot of segments: container shipping, dry bulk, tankers, LNG carriers, car carriers, ore carriers, wood chip carriers, cruise vessels, port terminals, trucking, air cargo, logistics, warehousing, and real estate. They provide door-to-door container transport services with their logistics department. In the container shipping segment of NYK Line is active in Asia, Europe, East Africa, The Mediterranean, Oceania, North America, South America, and West Africa. Figure 178 indicates the trades in which the container liner services are active.

Figure 178: Trades NYK Line



Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

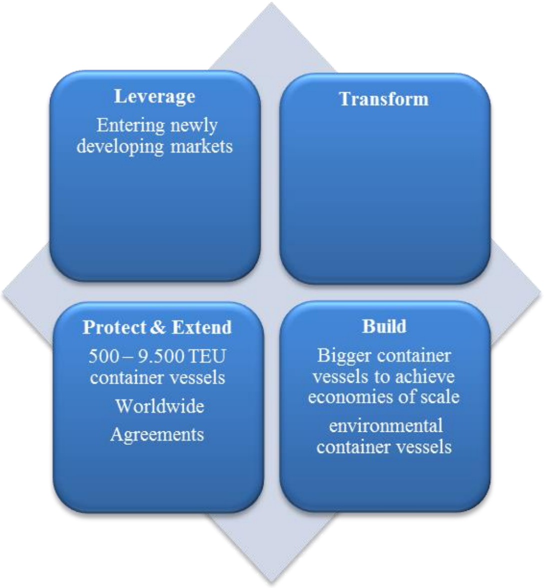
According to Alphaliner's top 100 and order book (27/07/2011) NYK Line uses 102 container vessels (58 owned and 44 chartered) for these container liner services. Their nominal TEU capacities range from 500TEU to 9.500TEU. They have six vessels on order. Among their orders, there are container vessels that have higher nominal TEU capacities than the ones present in their fleet. They also put the emphasis on environmental friendly container vessels. More details about the orders can be found in Table 158. NYK Line has vessel sharing agreements and slot agreements with other operators and carriers. The conceptual model of NYK Line can be seen in Figure 179.

Table 158: NYK Line: Orders and options

NYK Line	# vessels	TEU	Total TEU
Orders	4	13.100	52.400
	2	4.538	9.076
Total orders	**6**		**61.476**

Source: Alphaliner (27/07/2011)

Figure 179: Conceptual model: NYK Line



The group's portfolio model can be seen in Figure 180. It indicates a political situation with a very high stability and a highly stable cash flow. The political situation is very stable because the company is active all over the world so in case of a country becoming instable the company will not be influenced by it. The cash flow is stable because the company owns about 57% of its container vessels. Adding to their stable cash flow are their activities in a lot of commodity based segments and a few non-commodity based markets such as the cruise segment and real estate.

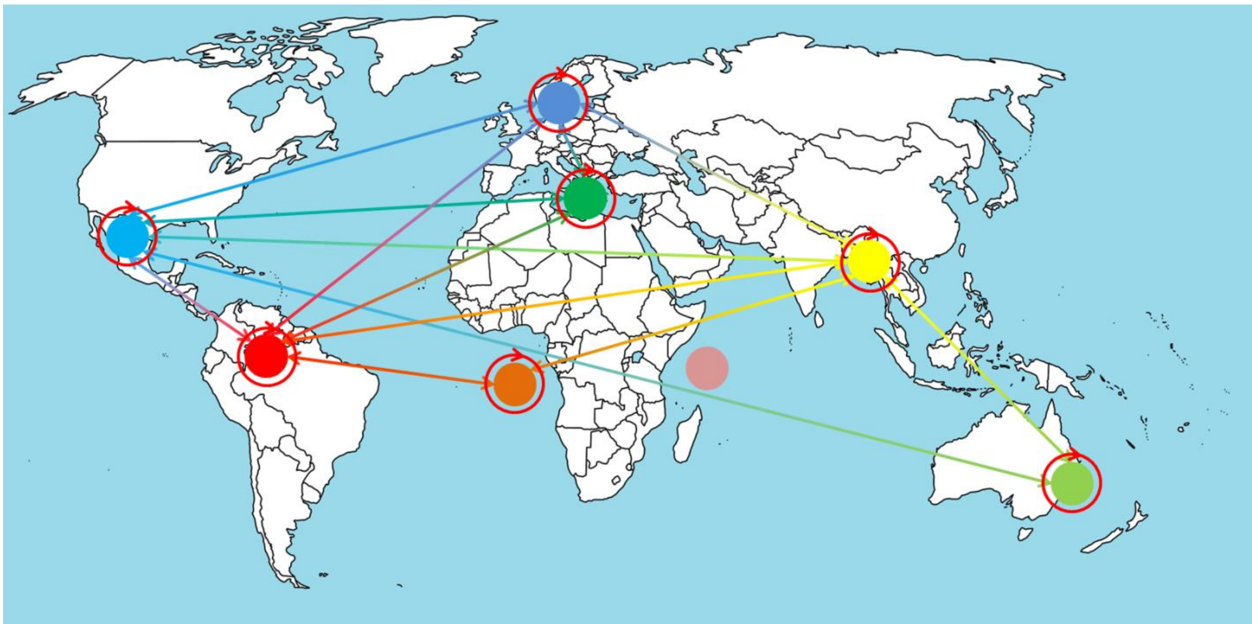
Figure 180: Conceptual model: NYK Group

J.2.8 Hamburg Süd Group

According to Hamburg Süd group (18/06/2013) Alphaliner (27/07/2011) the Hamburg Süd Group is active in shipping and travel & event management. Their shipping segments consist of container shipping (Hamburg Süd), Bulk shipping, and tankers. The latter two are done by Aliabulk, which is a joint venture between Rudolf. A. Oetker and Hamburg Süd. They also have a segment in logistics with the company Columbus Logistic service. This way they can provide door-to-door container transport services with their logistics department. There is a segment in ship management with the company Columbus Shipmagement that is responsible for the ship management of the vessels within the Hamburg Süd Group and for third parties. The travel & event management segments consist of the company Hamburg Süd Travel Agency that organises business journeys and trips, and the company Columbus Tours Events that organises business events.

The container shipping services of the group are located in Asia, Europe, the Mediterranean, North America, Oceania, South America, and West Africa. In which trades their container liner services are active can be seen in Figure 181.

Figure 181: Trades Hamburg Süd's container line

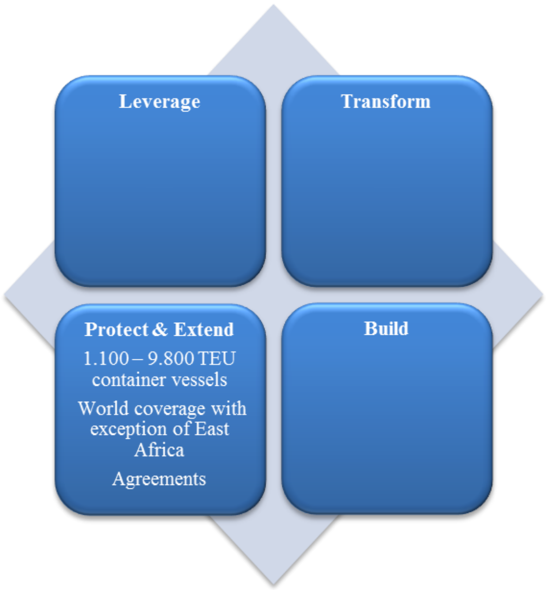


Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

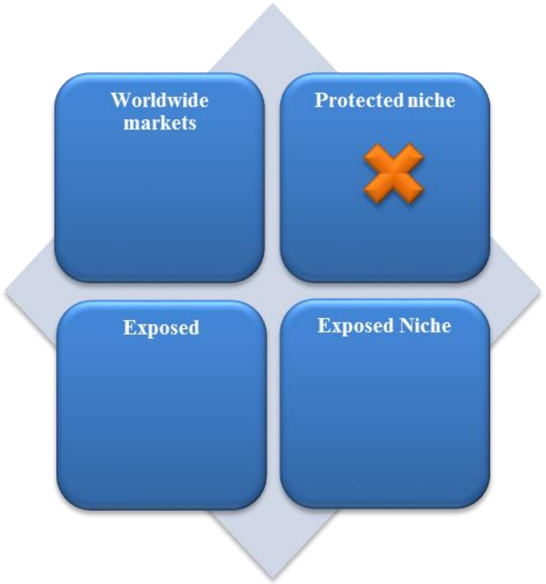
: Trade within the region

Figure 182: Conceptual model: Hamburg Süd



According to Alphaliner's top 100 and order book (27/07/2011) Hamburg Süd uses 115 container vessels (44 owned and 77 chartered) for their container liner services. Their nominal TEU capacities range from 1.100TEU to 9.800TEU. Hamburg Süd often has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual modal can be seen in Figure 182.

Figure 183: Portfolio model: Hamburg Süd Group

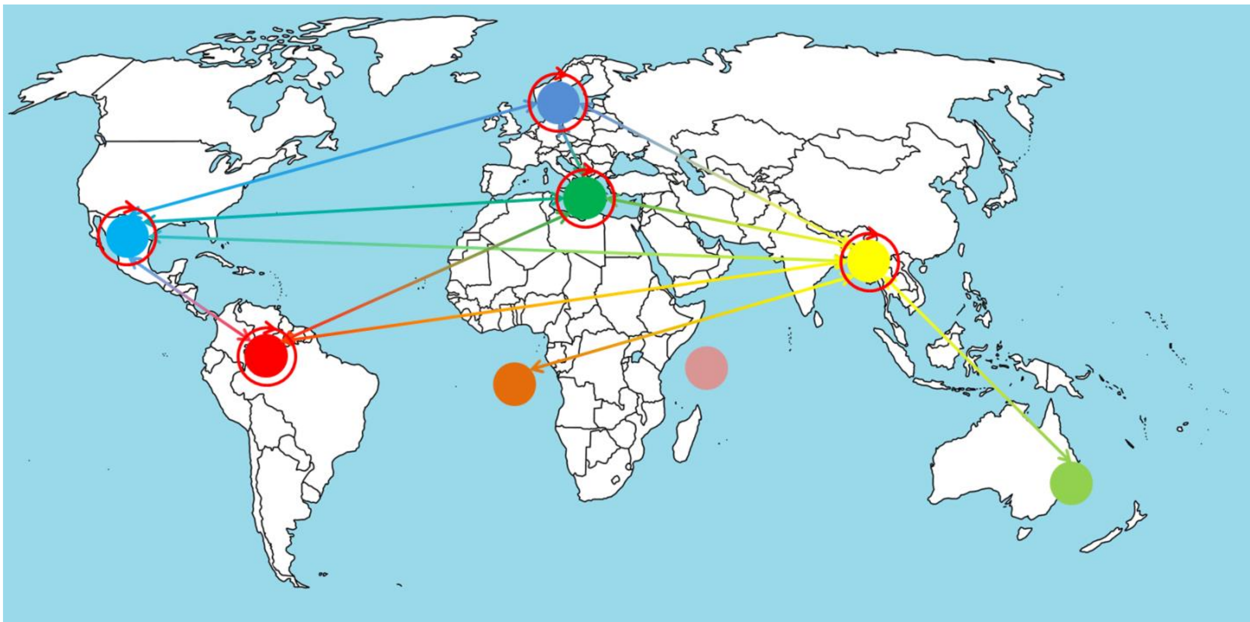


The portfolio model of the group can be seen in Figure 183. Because the cash flow comes from various commodity oriented shipping segments and about less than half the vessels are owned, the cash flow is quite stable. Because the company is also active in the non-commodity oriented market of ship management and travel & event management. The non-commodity segments have a positive effect on the cash flow, which results in a slightly unstable cash flow. Because the group is active in all the regions in the world except for East Africa, the company will not be influenced a lot in case a country becomes politically unstable. So one can say that its political situation is stable.

J.2.9 K Line Group

According to K Line (20/06/2013) and Alphaliner (27/07/2011), Kawasaki Kisen Kaisha Group (K Line Group) is active in different segments of shipping and logistics. They have car carriers, CNG carriers[38], container vessels, drill ships, dry bulk carriers, heavy lift ships, LNG carriers[39], LNG FPSOs[40], LPG carriers, and product tankers. They also have port terminals and a logistic department, which is active in air cargo, land transport, and warehousing. They provide door-to-door container transport services with their logistics department. With their container liner services, they are active in Asia, Europe, The Mediterranean, North America, South America and West Africa. The trades in which they are active with their container liner services can be seen in Figure 184.

Figure 184: Trades K Line



Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

According to Alphaliner's top 100 and order book (27/07/2011) K Line uses 78 container vessels (39 owned and 39 chartered) for their container liner services. Their nominal TEU capacities range from 540TEU to 9.000TEU. They have six vessels on order. More details about the orders can be found in Table 159. K Line has vessel sharing agreements or slot agreements with other operators or carriers. For the future they are focusing on entering newly developing markets. Their conceptual model can be seen in Figure 185.

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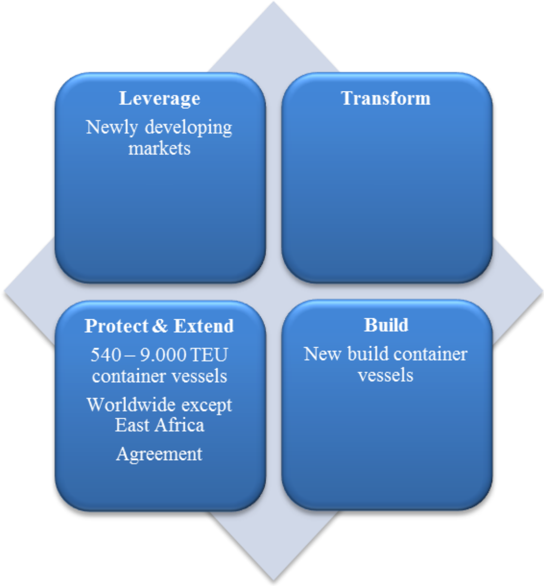
[38] CNG Carrier: Compressed Natural Gas
[39] LNG carrier: Liquefied Natural Gas
[40] LNG FPSO: Liquefied Natural Gas Floating Production, Storage, and Offloading unit

Table 159: K Line: Orders and options

K Line	# vessels	TEU	Total TEU
Orders	5	9.040	45.200
	1	4.520	4.520
Total orders	6		49.720

Source: Alphaliner (27/07/2011)

Figure 185: Conceptual model: K line



Their portfolio model can be seen in Figure 186. Because their segments are active worldwide, they will not experience a lot of problems when a country becomes unstable. By consequence, their political situation is very stable. Because their segments are mainly active on commodity oriented markets instead of non-commodity oriented markets and 50% of their container vessels is chartered, their cash flow is slightly stable.

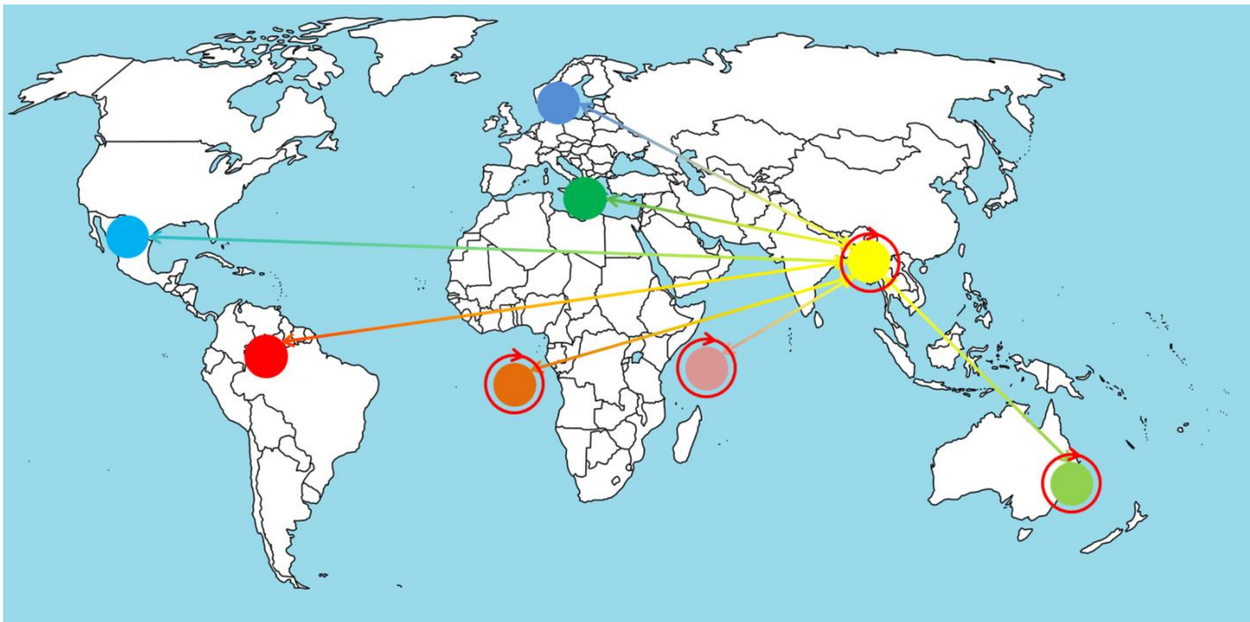
Figure 186: Portfolio model: K Line Group

J.2.10 PIL Group

According to PIL Group (01/07/2013) and Alphaliner (27/07/2011), the group is active in logistics, container shipping, container depots, and container manufacturing. They also provide door-to-door container transport services with their logistics department.

There are five container shipping companies active in the container shipping segments of the PIL Group. These five companies are: Pacific International Lines (PIL), Advance Container Line (ACL), Pacific Direct Line (PDL), Pacific Eagle Line (PEL), and Malaysia Shg Corp. PIL is active in the Asian, East African, European, the Mediterranean, North American, Oceania, West African, South American regions. Advance Container Line (ACL) is active in East Africa and Asia. The Company continues to stay on the lookout to enter new markets. Pacific Direct Line (PDL) is active in Oceania and is also involved in strategic alliances. Pacific Eagle Line (PEL) is active in Asia. Malaysia Shg Corp. is active in Asia. PIL Group's container lines are also in a constant quest to enter newly developing container shipping markets.

Figure 187: Trades PIL' container lines



Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

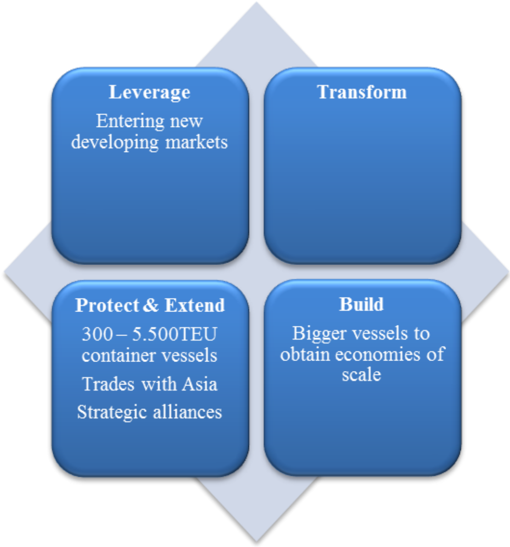
According to Alphaliner's top 100 and order book (27/07/2011) PIL Group has 139 container vessels (93 owned and 46 chartered). The container vessels range in nominal capacity from 300TEU to 5.500TEU. They also have twenty orders and two options. Among their orders, there are container vessels with nominal capacities of 6.500TEU. This is more than the largest container vessels present in their fleet. More information about the orders and options can be found in Table 160. PIL container lines have vessels sharing agreements and slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 188.

Table 160 PIL Group Container lines: Order and options

PIL	# vessels	TEU	Total TEU
Orders	4	6.500	26.000
	4	4.250	17.000
	4	2.800	11.200
	8	1.400	11.200
Total orders	**20**		**65.400**
Options	2	2.800	5.600
Total options	**2**		**5.600**
Total	**22**		**71.000**

Source: Alphaliner (27/07/2011)

Figure 188: Conceptual model PIL Group: Container lines



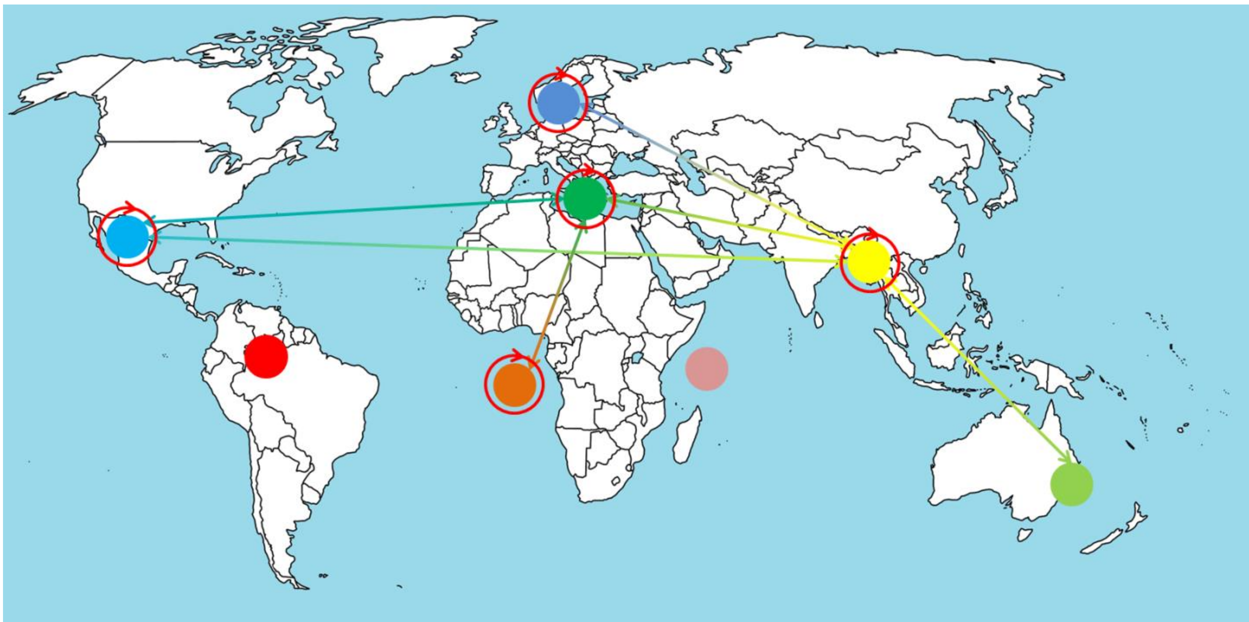
The portfolio strategy of the PIL Group as can be seen in Figure 189 is the result of the group's container activities in all parts of the world linked to China. The logistic, container depot and container manufacturing segments are active in Asia. In case Asia becomes unstable, this can lead to instability, but generally spoken the company is quite politically stable. Because about two thirds of the container vessels are owned and they are also active in the non-commodity based container manufacturing market, they have a very stable cash flow.

Figure 189: Portfolio model: PIL Group

J.2.11 UASC

According to UASC (04/07/2013) and Alphaliner (27/07/2011), United Arad Shipping Company (UASC) is active in the container shipping market. They are active in the regions of Asia, Europe, the Mediterranean, Oceania, North America and West Africa. The trades in which their container liner services are active can be seen in Figure 190.

Figure 190: Trades UASC

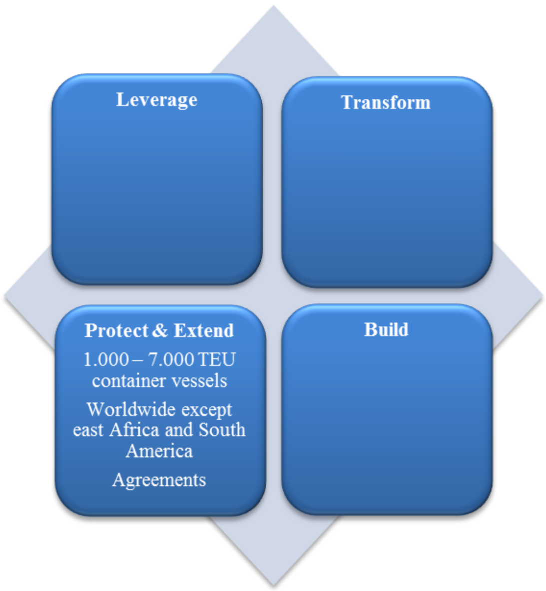


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

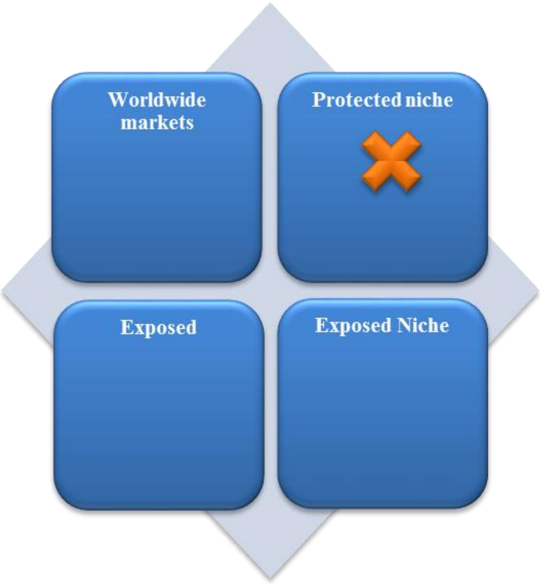
: Trade within the region

Figure 191: Conceptual model: UASC



According to Alphaliner's top 100 and order book (27/07/2011) UASC uses 56 container vessels (28 owned and 28 chartered) for their container liner services. Their nominal TEU capacities range from 1.000TEU to 7.000TEU. UASC has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 191.

Figure 192: Portfolio model: UASC



Their portfolio model can be seen in Figure 192. It shows that the cash flow is stable because the company is only active in the commodity based container shipping market and their vessels are fifty-fifty owned and chartered. This way they benefit from the positive effect hedging has on the cash flow. Politically the company is stable because they are active in various regions in the world, so they will not be affected too much in case a country becomes unstable.

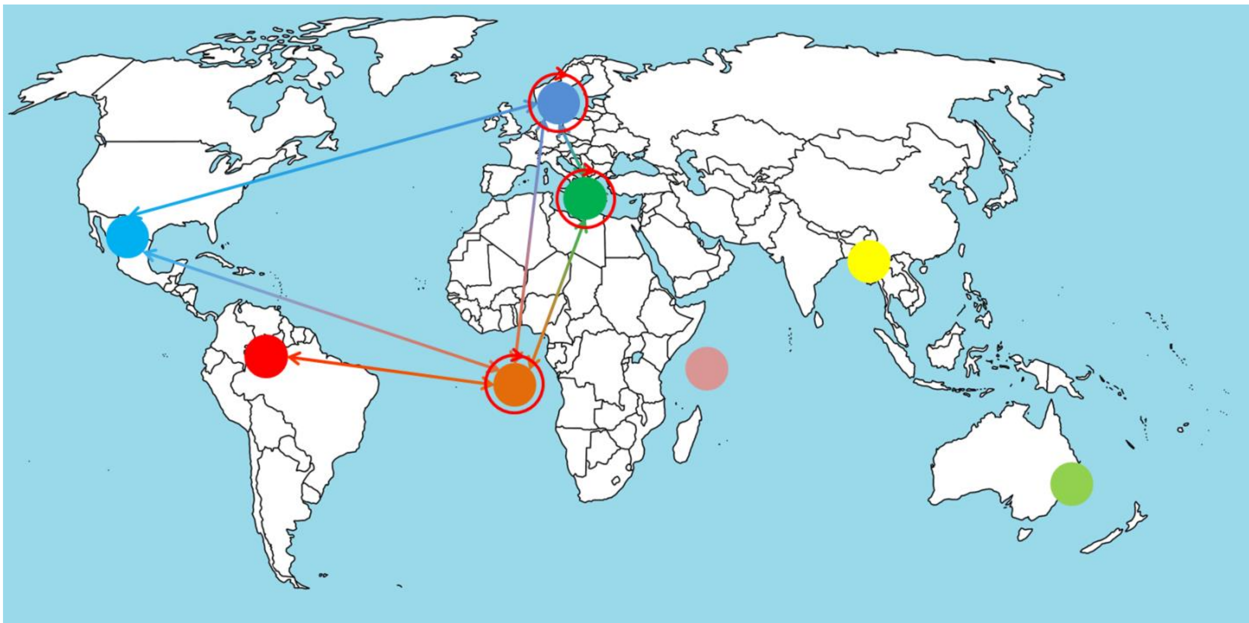
J.3 Medium competitors

J.3.1 Grimaldi (Napoli) Group

According to Grimaldi Group (2011), the Grimaldi (Napoli) Group is active in different segments: bulk shipping, cars, passengers, cruise ferries, container terminals, and logistics. They provide door-to-door container transport services with their logistics department. In the shipping segment eight companies are active: Grimaldi Compagnia di Navigazione (Grimaldi), Atlantica di Navigazione (Atlantica), Industria Armamento Meridionale (Inarme), Atlantic Container Line (ACL), Malta Motorways of the Sea (MMS), Minoan Lines, Finnlines, and Grimaldi & Suardiaz Lines. The container terminal segments consist of 19 terminals that are spread over various ports in the world, and there are four logistic companies: Automar, EMIL, SAL, and ACL.

The shipping segment transports vehicles, containers, and passengers in Europe, The Mediterranean, North America, South America, and West Africa. An overview of the trades in which the container liner services which can transport containers can be seen in Figure 193.

Figure 193: Trades Grimaldi (Napoli)



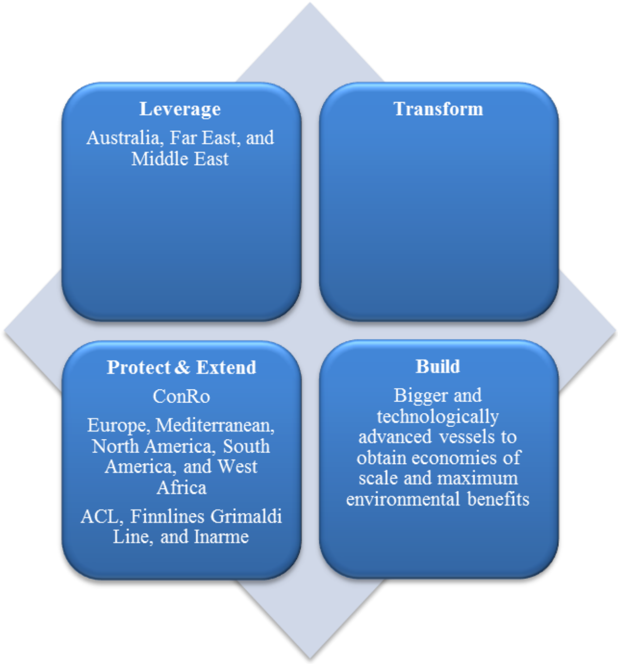
Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

Their focus is mainly on RoRo[41] and passenger transport. For the RoRo segment, they are the global leader. To make them very flexible in the market the vessels used for their liner services are often chosen to transport a combination of vehicles, containers or passengers. For these 41 ConRo vessels[42], 24 RoPax vessels[43], fifteen PCTC[44], eight PCC vessel[45], and four cruise ferries are used. Eight more PCC are ordered. According to Alphaliner (2011) only four vessels in their fleet, which can transport container, are chartered, the remainder is owned. For the future, they like to deploy as large and technologically advanced vessels as possible to obtained economies of scale and maximum environmental benefits. For the RoRo segment, they like to start liner services in Australia, Far East, and Middle East.

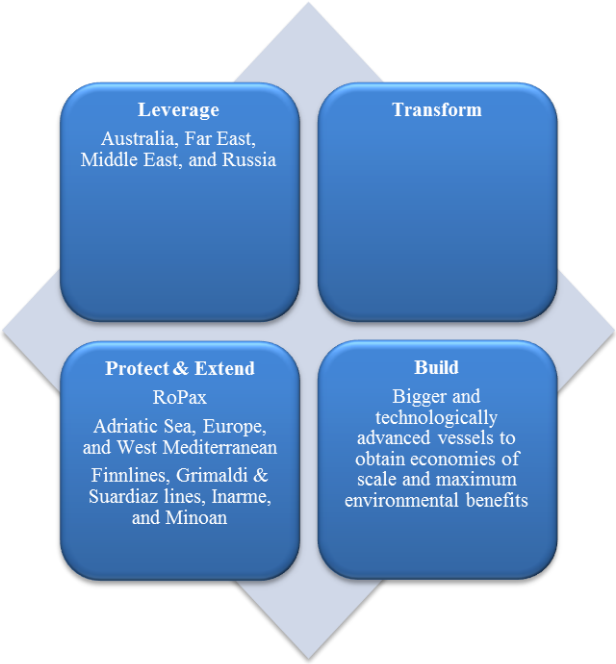
Figure 194: Conceptual model: Grimaldi (Napoli) Group: ConRo



Grimaldi Compagnia di Navigazione (Grimaldi Lines) is owned by the Grimaldi (Napoli) Group and active on the trades between Europe – West Africa, Europe – West Africa – South America, South America - West Africa, North America – West Africa, and The Mediterranean – West Africa. The vessels used in the liner services on these trades are ConRo vessels, PCTCs, and PCCs. Grimaldi Lines holds stakes in all the group's shipping companies as well as the main port terminals (Antwerp, Hamburg, Wallhamn, Lagos, Dakar)

41 RoRo: Roll-On Roll-Off, transportation of vehicles
42 ConRo vessel: Container and Roll On Roll Off vessel
43 RoPax vessel: Roll On Roll Off and passenger ferries
44 PCTC: Pure Car and Truck Carriers
45 PCC vessel: Pure Car Carrier

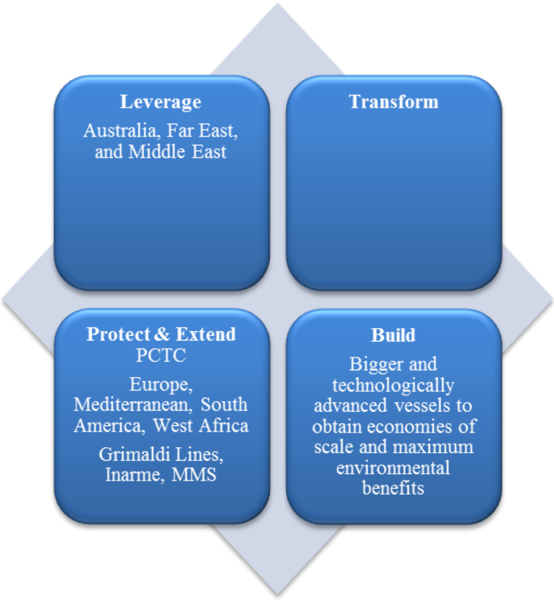
Figure 195: Conceptual model: Grimaldi (Napoli) Group: RoPax



Atlantica di Navigazione (Atlantica) is owned by the Grimaldi (Napoli) Group and active on the trades between Europe – The Mediterranean, and in the West The Mediterranean. The vessels used in the liner services on these trades are ConRo vessels, PCTCs, PCCs, RoPax vessels, and ferries. For the future, they want to extend their liner services to the Middle East, Far East, and Australia.

Industria Armamento Meridionale (Inarme) is owned by the Grimaldi (Napoli) Group and provides vessels for Grimaldi Lines and Atlantica. It is also active on the West The Mediterranean market with ConRo vessels.

Figure 196: Conceptual model: Grimaldi (Napoli) Group: PCTC

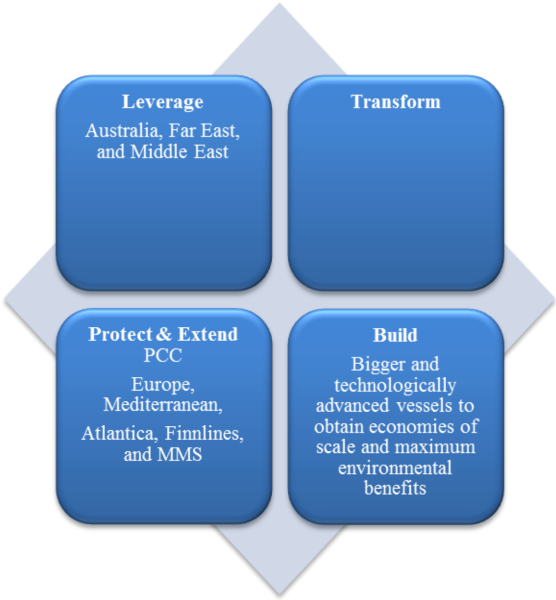


Atlantic Container Line (ACL) is owned by the Grimaldi. (Napoli) Group and together with Grimaldi lines active on the Europe – West Africa and North America – West Africa trades with ConRo vessels. For the future, they want to enter in the Middle East, Far East and Australian market.

Malta Motorways of the Sea (MMS) is owned by the Grimaldi (Napoli) Group and active in the West The Mediterranean market with PCTCs and PCCs.

Minoan Lines is owned for 90% of its capital share by the Grimaldi (Napoli) Group. They are active in the Adriatic Sea in The Mediterranean with RoPax vessels.

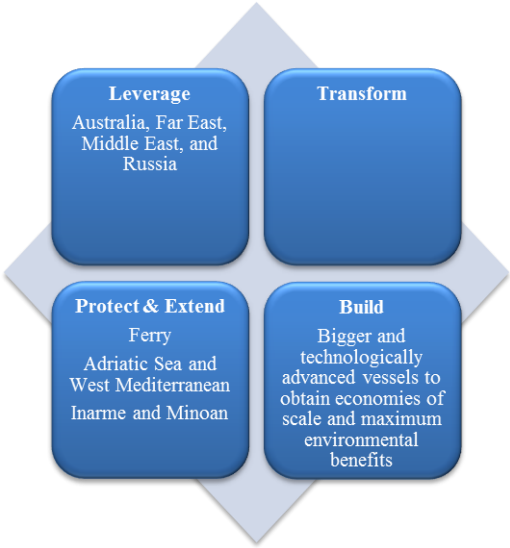
Figure 197: Conceptual model: Grimaldi (Napoli) Group: PCC



Finnlines is stock listed in Finland. Grimaldi Lines has a 59.23% capital share and Inarme 11.69%. Therefore, the Grimaldi (Napoli) Group has a 70.92% capital share in Finnlines. The company is active in the Baltic Sea, the North Sea and the Bay of Biscay. For their liner services, they use ConRo vessels, RoPax vessels, PCTCs, and PCCs. For the future, they want to enter in the Russian market and open new routes according the market's opportunities.

Grimaldi & Suardiaz Lines is a joint venture between Atlantica and Flota Suardiaz. It has a RoPax liner service between Barcelona and Livorno in the Western The Mediterranean sea.

Figure 198: Conceptual model: Grimaldi (Napoli) Group: Ferry



Because five types of vessels are used in the shipping segments, five conceptual models are made per ship type. They can be found in Figure 194, Figure 195, Figure 196, Figure 197, and Figure 198.

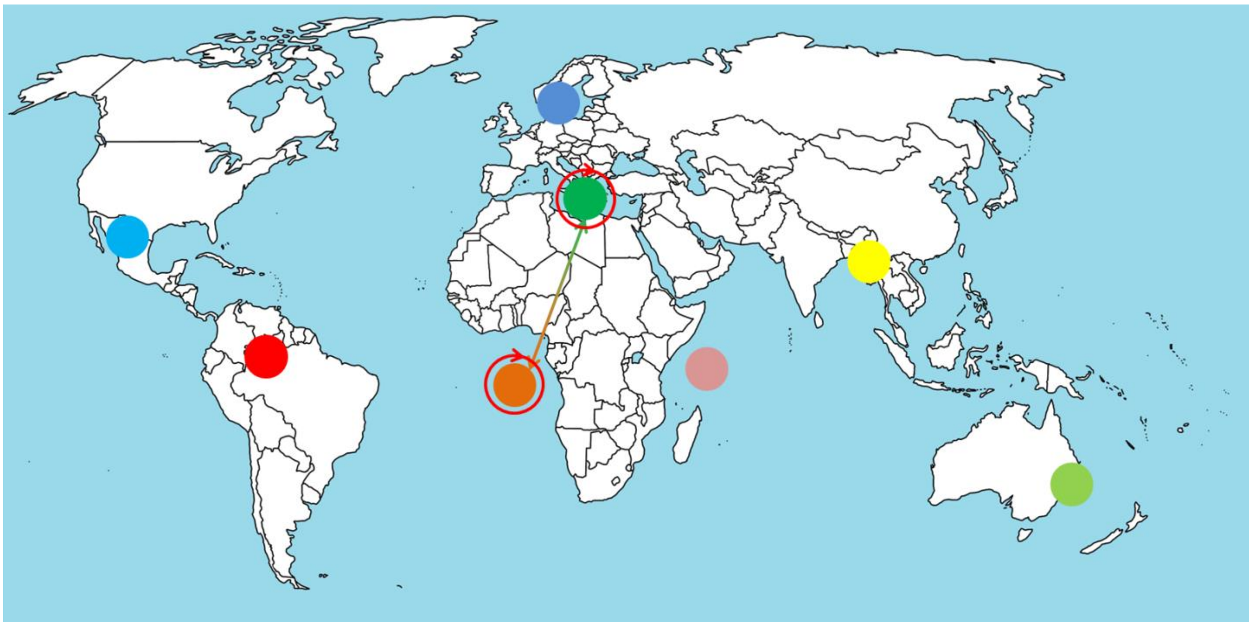
Figure 199: Portfolio model: Grimaldi (Napoli) Group

The portfolio strategy of the Grimaldi (Napoli) Group as can be seen in Figure 199 is the result of the group's activities in Europe, The Mediterranean, North America, South America, and West Africa. The RoRo segment is active in all these regions, but the passenger related liner services are limited to Europe and The Mediterranean. This makes the company politically stable. When looking at the cash flows of the segments, very few vessels are chartered in their fleet and the company is only active on commodity markets. This indicates that the cash flows are very stable.

J.3.2 Arkas Line

According to Arkas Line (03/06/2013) and Alphaliner (27/07/2011), the company is active in a lot of segments such as in logistics, container shipping, air cargo, railing, trucking, bunkering, port terminals, warehousing, insurances, and tourism. They provide door-to-door container transport services with their logistics department. Their container shipping activities are located in The Mediterranean and West Africa as can be seen in Figure 200.

Figure 200: Trades Arkas

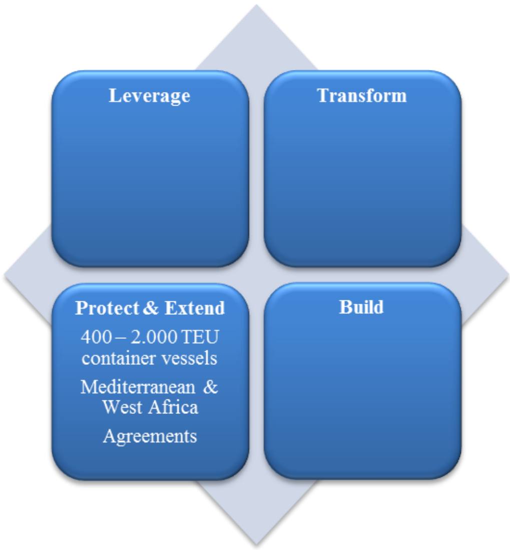


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

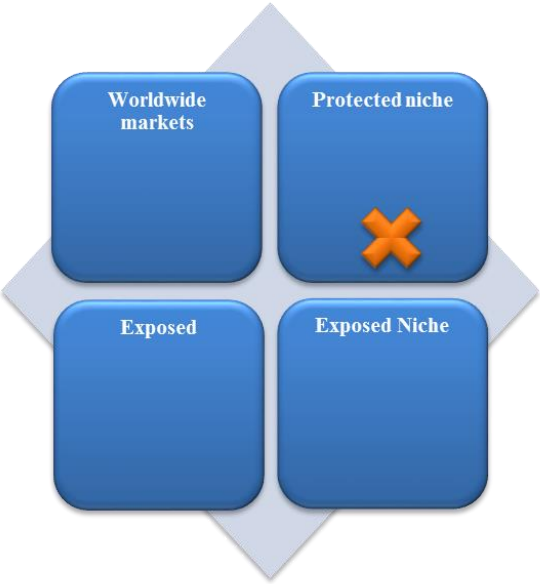
: Trade within the region

Figure 201: Conceptual model Arkas



According to Alphaliner's top 100 and order book (27/07/2011) Arkas uses 22 container vessels (thirteen owned and nine chartered) for these container liner services. Their nominal TEU capacities range from 400TEU to 2.000TEU. Arkas has vessel sharing agreements and slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 201.

Figure 202: Portfolio model: Arkas

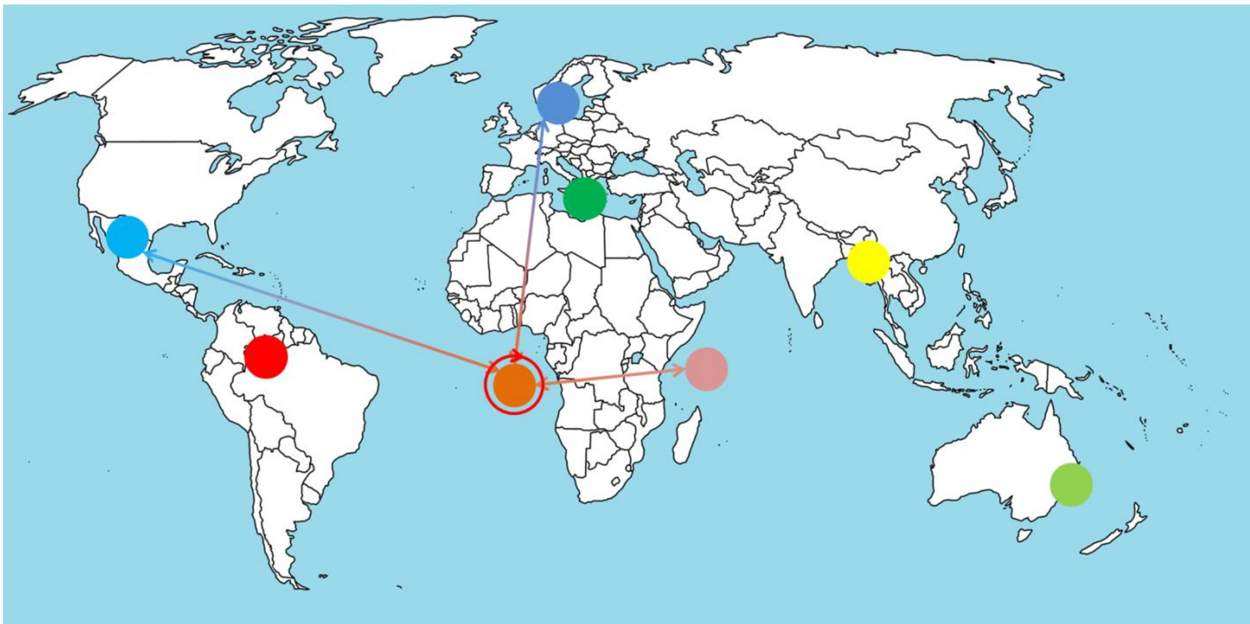


Their portfolio model can be seen in Figure 202. Because the company is active in a lot of segments of the container transport chain and also in segments outside the container market, they are very commodity oriented. About 60% of their container vessels are owned. This makes their cash flow stable. Because the company is active in the Mediterranean, Middle East, and West Africa, their political situation is slightly stable.

J.3.3 MACS

According to MACS (21/06/2013) and Alphaliner (27/07/2011) Maritime Carriers (MACS) is a shipping company, which transports containers, project cargoes, RoRo, heavy lifts, general cargo, dry and liquid bulk with multipurpose vessels. They provide door-to-door container transport services with their logistics department. They are active in the regions of East Africa, Europe, North America, and West Africa. In which trades their multiporposer liner services are active can be seen in Figure 203.

Figure 203: Trades MACS

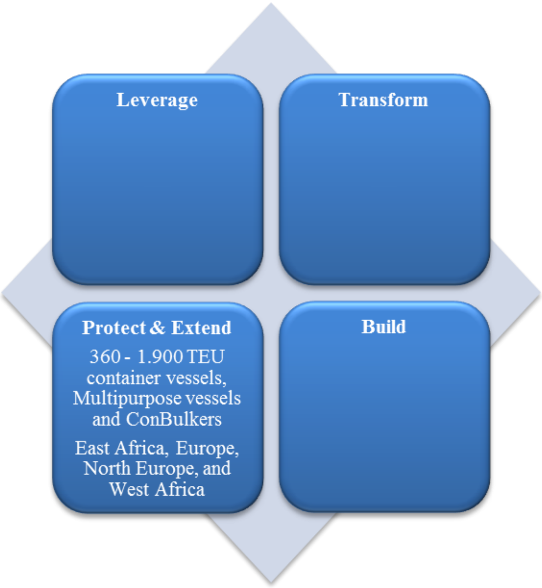


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

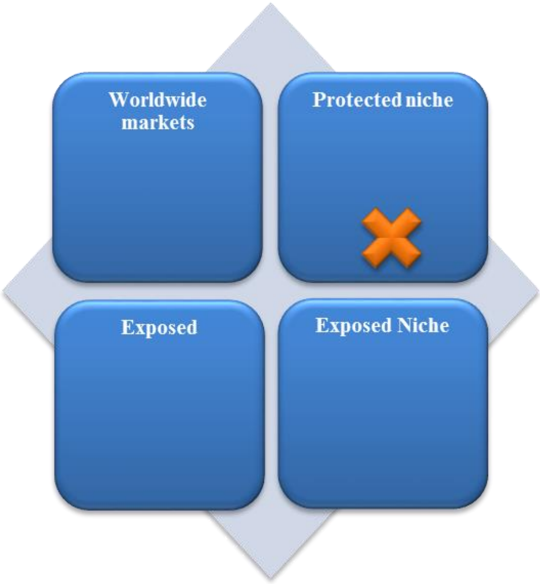
Figure 204: Conceptual model: MACS



According to Alphaliner's top 100 and order book (27/07/2011) MACS uses two container vessels, two ConBulkers, and eleven multipurpose vessels (four vessels are owned and eleven chartered) for their liner services. Their nominal TEU capacities range from 360TEU to 1.900TEU. Their conceptual model can be seen in Figure 204.

MACS' portfolio model can be seen in Figure 205. The political situation is quite stable as the multipurpose liner services of MACS are linked to West Africa. The cash flow is stable as almost all vessels are chartered and the company is only active in commodity markets.

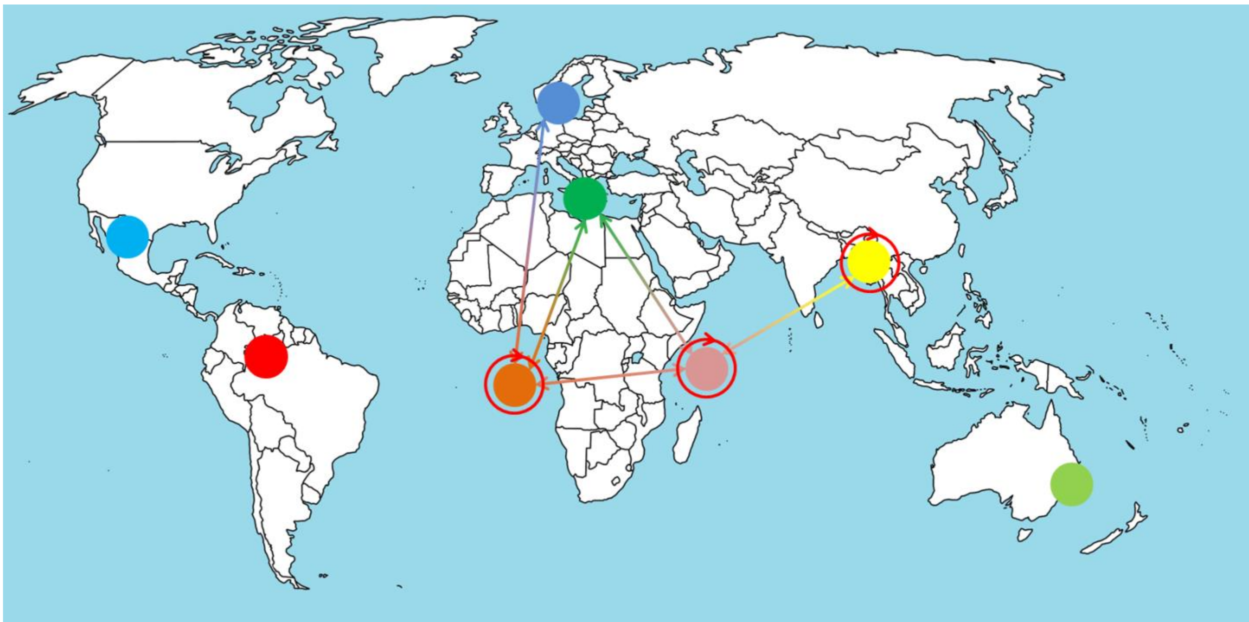
Figure 205: Portfolio model: MACS



J.3.4 DAL

According to DAL (17/06/2013) and Alphaliner (27/07/2011), Deutsche Afrika Linien (DAL) is active in several shipping segments such as containers, tankers, and bulk. It is also active in ship management and has a travel agency. Within the container shipping market, they are active in Asia, East Africa, Europe, the Mediterranean, and West Africa. The trades in which they have container liner services to connect these regions can be seen in Figure 206.

Figure 206: Trades DAL

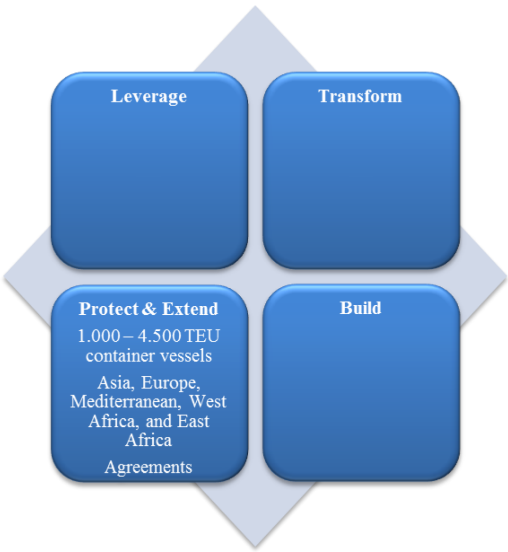


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

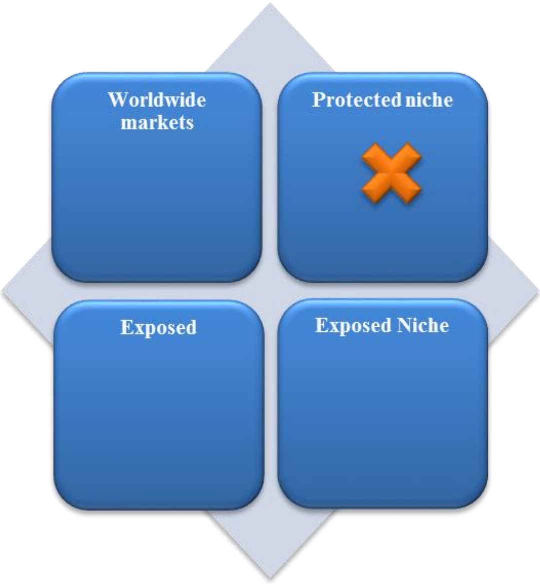
: Trade within the region

Figure 207: Conceptual model: DAL



According to Alphaliner's top 100 and order book (27/07/2011) DAL uses eight container vessels (one owned and seven chartered) for their container liner services. Their nominal TEU capacities range from 1.100TEU to 4.500TEU. DAL has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 207.

Figure 208: Portfolio model: DAL

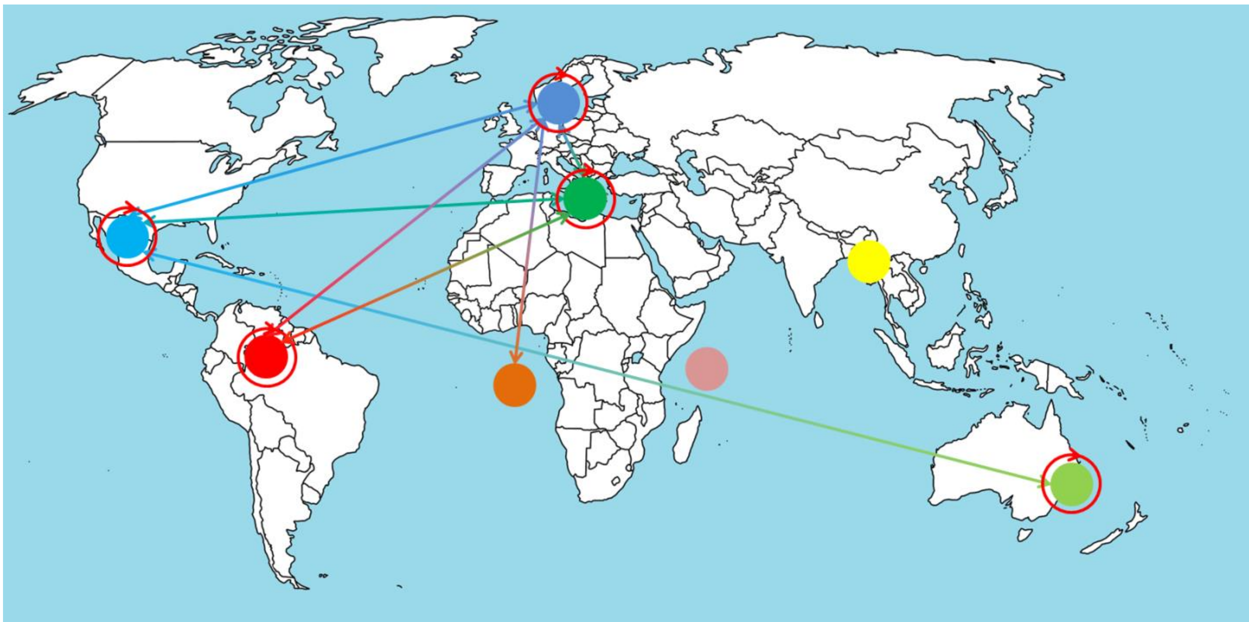


The portfolio model as shown in Figure 208 indicates that the political situation is stable. The stable political situation is due to the presence in a lot of regions. Because the company is mainly active in the commodity oriented shipping market with almost only chartered vessels and because the travel agency segment is not large enough to work its positive influence on the stability of the cash flows. The cash flow of the company is therefore stable.

J.3.5 Marfret Group

According to Marfret (21/06/2013) and Alphaliner (27/07/2011), the Marfret group is active in different segments of shipping. They are active as a container shipping company by the ship management company Marseille Fret and the ship operating company Marfret. A ship brokers company named Broker shipping, charters vessels back to Marseille Fret and Marfret, but also to third parties charters. Broker shipping is half owned by Marseille Fret and half owned by George Brocklehurst. The company Somartrans takes care of stevedoring. They also have four warehouses in France. They do provide door-to-door container transport services with their logistics department. For their container shipping activities, they are active in Europe, the Mediterranean, North America, Oceania, South America, and West Africa. The trades in which their container liner services are active can be seen in Figure 209.

Figure 209: Trades Marfret



Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

According to Alphaliner's top 100 and order book (27/07/2011) Marfret uses eight container vessels (seven owned and one chartered) for these container liner services. Their nominal TEU capacities range from 140TEU to 2.800TEU. Marfret has vessel sharing agreements and slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 210.

Figure 210: Conceptual model: Marfret

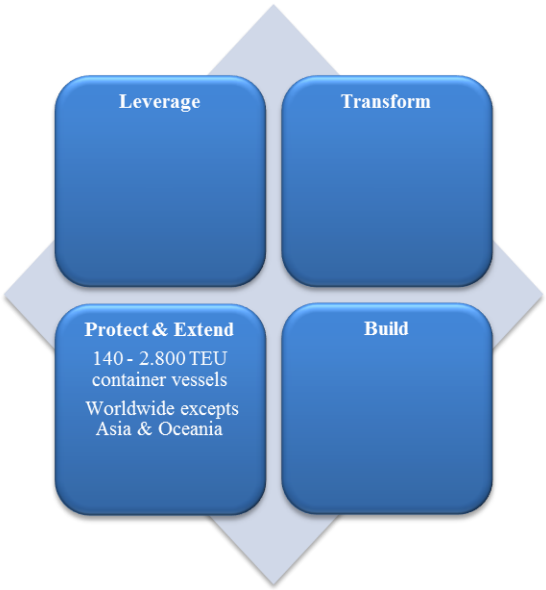
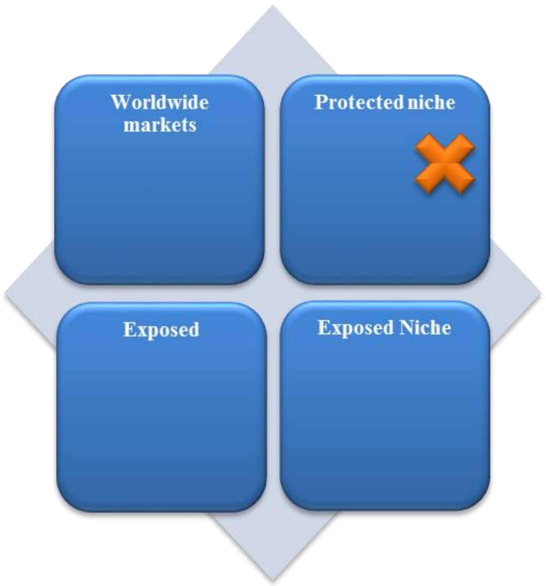


Figure 211: Portfolio model: Marfret Group



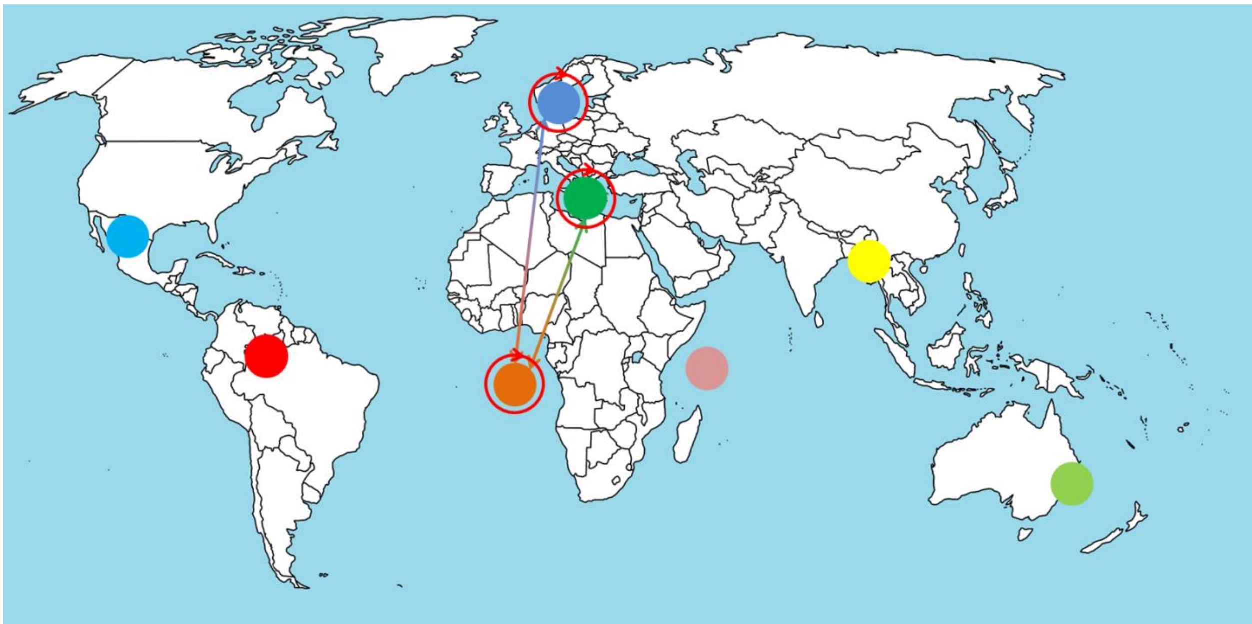
Their portfolio model can be seen in Figure 211. The cash flow is very stable as 87,5% all the vessels are owned and because the company is also active in the non-commodity oriented ship brokerage market, besides the commodity oriented shipping market. The political situation is stable as the company will not experience too much influence in case a country becomes politically unstable.

J.4 Small competitors

J.4.1 OPDR

According to OPDR (01/07/2013) and Alphaliner (27/07/2011), Oldenburg-Portugiesische Dampschiffahrts Reederei (OPDR) is active in the segments of container shipping, RoRo, logistics, trucking, railing, and barging. They provide door-to-door container transport services with their logistics department. For their container shipping activities, they are active in the regions of Europe, the Mediterranean, and West Africa. The trades in which their container liner services are active can be seen in Figure 212.

Figure 212: Trades OPDR

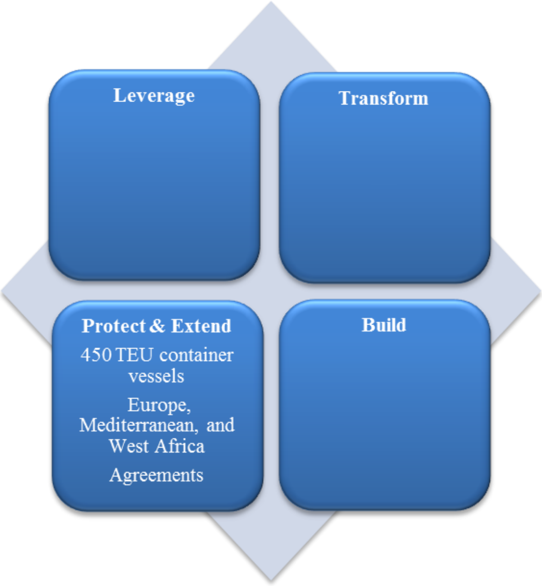


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

Figure 213: Conceptual model: OPDR



According to Alphaliner's top 100 and order book (27/07/2011) OPDR uses twelve container vessels (seven owned and five chartered) for their container liner services. Their nominal TEU capacities are 450TEU. OPDR has vessel sharing agreements or slot agreements with other operators or carriers. Their conceptual model can be seen in Figure 213.

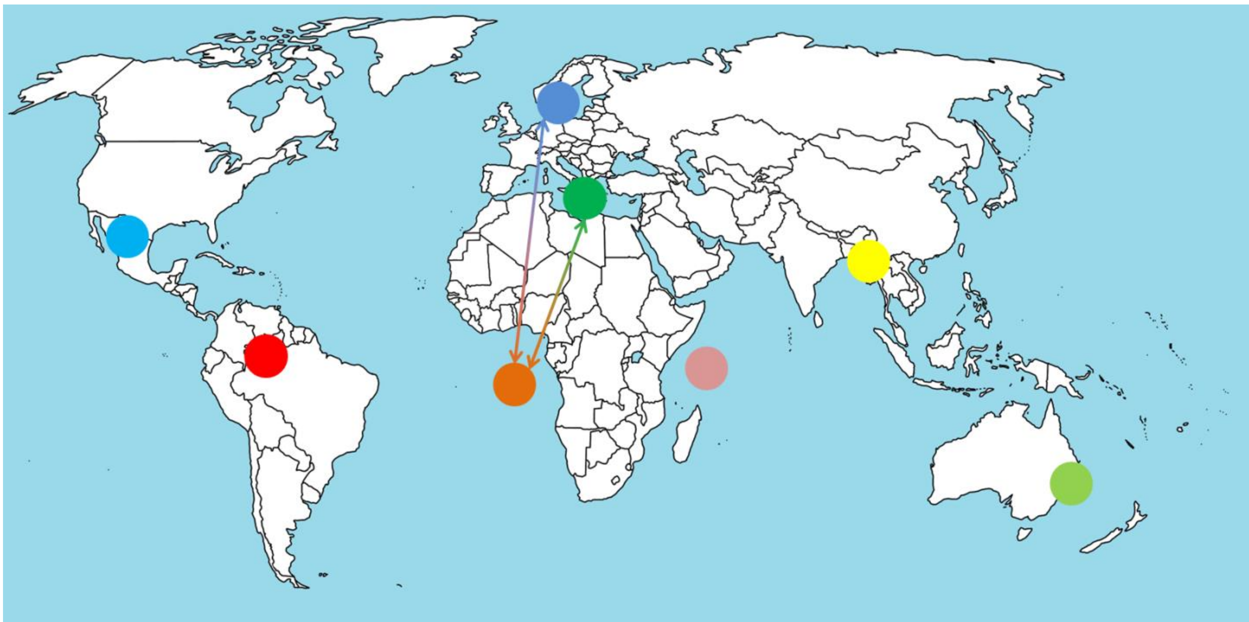
Their portfolio model can be seen in Figure 214. The cash flow is stable as the company is active in a commodity-based market. 58,3% of its vessels are owned, which results in a stable cash flow. The political situation is a bit stable as the transport of container and RoRo is between Europe and West Africa and The Mediterranean and West Africa.

Figure 214: Portfolio model: OPDR

J.4.2 Boluda Lines

According to Boluda (04/06/2013) and Alphaliner (27/07/2011), Boluda Lines is active in six different segments: container shipping, tankers, port terminals, warehousing, trucking, and towage & salvage. They provide door-to-door container transport services with their logistics department. Their container shipping segment is active in West Africa with connections to Europe and The Mediterranean as can be seen in Figure 215.

Figure 215: Trades Boluda Lines

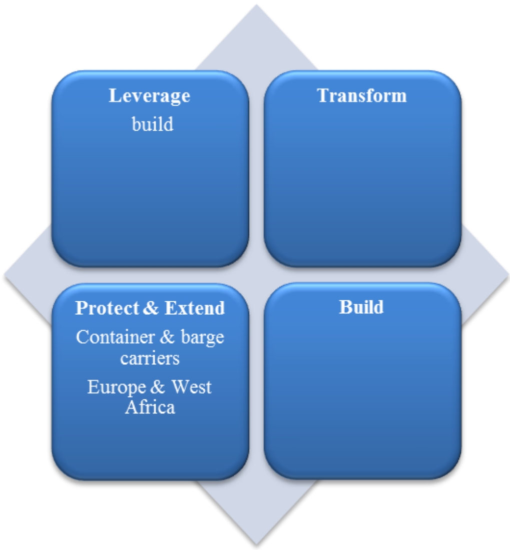


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

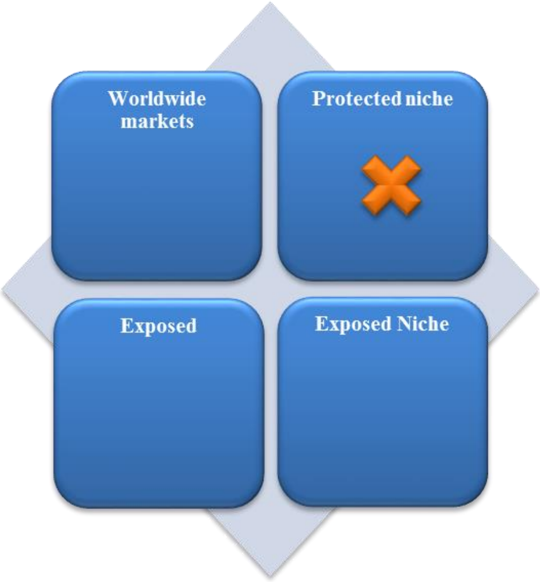
: Trade within the region

Figure 216: Conceptual model: Boluda Lines



According to Alphaliner's top 100 and order book (27/07/2011) Boluda Lines uses eight container vessels (six owned and two chartered) for their container liner services. Their nominal TEU capacities range from 400TEU to 1.250TEU. Boluda Lines has a vessel sharing agreement with OPDR in one of their Europe – West Africa container liner services. Their conceptual model can be seen in Figure 216.

Figure 217: Portfolio model: Boluda Lines

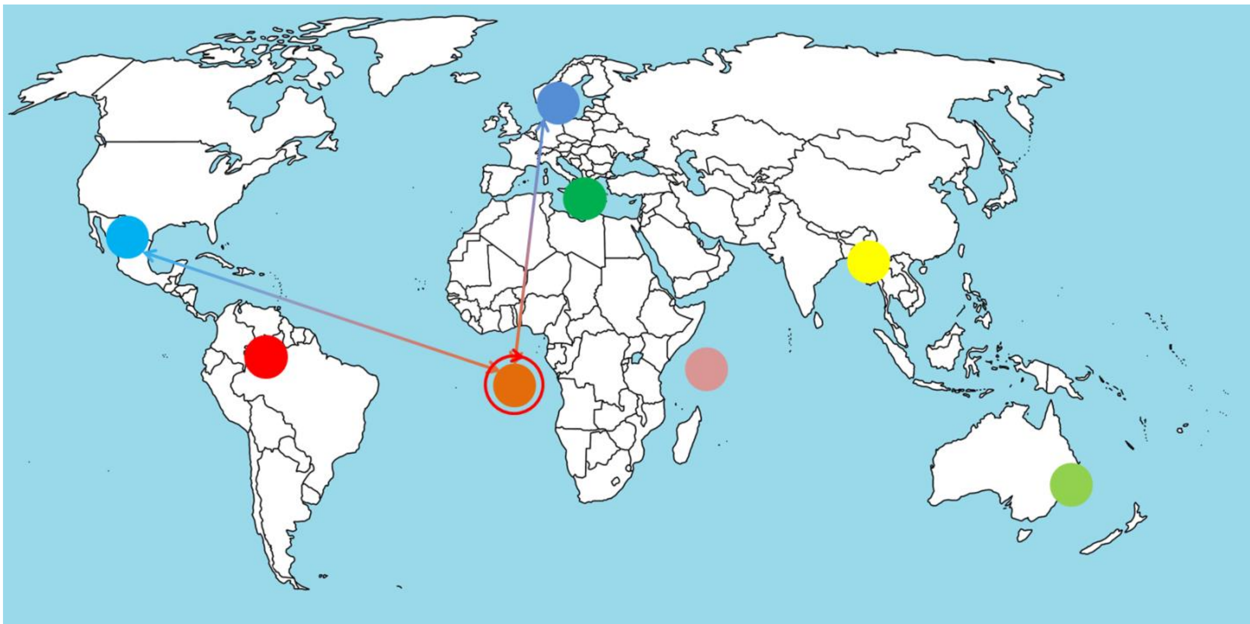


The portfolio model of Boluda Lines as can be seen in Figure 217 shows that with a presence on the entire Spanish coast, Portugal, France, Italy, West Africa and Latin America they are politically stable. Because they are mainly active in commodity oriented markets, but 75% owned vessel, and are active in the towage & salvage segment which is non-commodity oriented their cash flow is stable.

J.4.3 UAL

According to Universal Africa Lines (03/07/2013) and Alphaliner (27/07/2011), Universal Africa Lines (UAL) is a shipping company, which transports containers and general cargo with multipurpose vessels. They provide door-to-door container transport services with their logistics department. Their multipurpose liner services are active in Europe, North America, and West Africa. The trades in which their multipurpose liner services are active can be seen in Figure 218.

Figure 218: Trades UAL

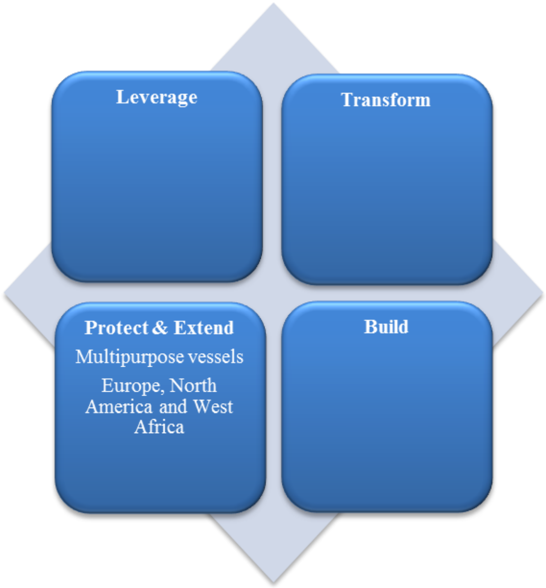


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

Figure 219: Conceptual model: UAL



According to Alphaliner's top 100 and order book (27/07/2011) UAL uses eleven chartered multipurpose vessels. Their nominal TEU capacities range from 100TEU to 700TEU. Their conceptual model can be seen in Figure 219.

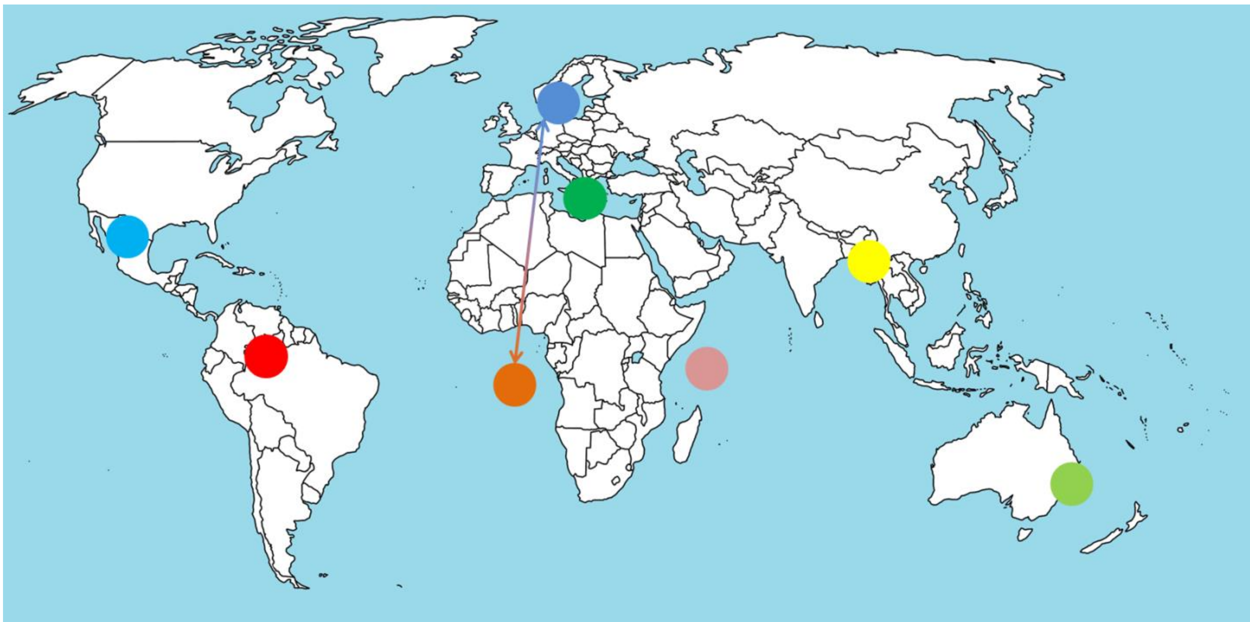
Their portfolio model as can be seen in Figure 220 shows a quite stable cash flow. This because the company is only active in a commodity based market and they only use chartered vessels. The political situation is quite stable as the company is active in Europe, North America and West Africa.

Figure 220: Portfolio model: UAL

J.4.4 Lin Lines

According to Lin Lines (21/06/2013) and Alphaliner (27/07/2011), Lin Lines is a shipping company, which transports containers from Europe to West Africa as can be seen in Figure 221.

Figure 221: Trades Lin Lines

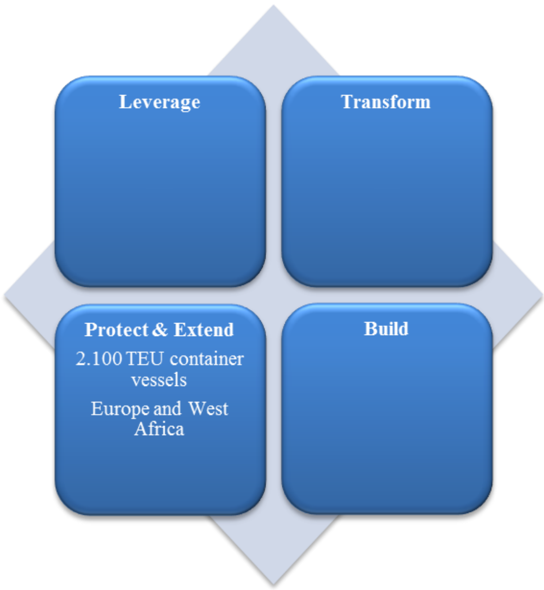


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

Figure 222: Conceptual model: Lin Lines



According to Alphaliner's top 100 and order book (27/07/2011) Lin Lines uses two chartered container vessels for this container liner service. Their nominal TEU capacities are 2.100TEU. Their conceptual model can be seen in Figure 222.

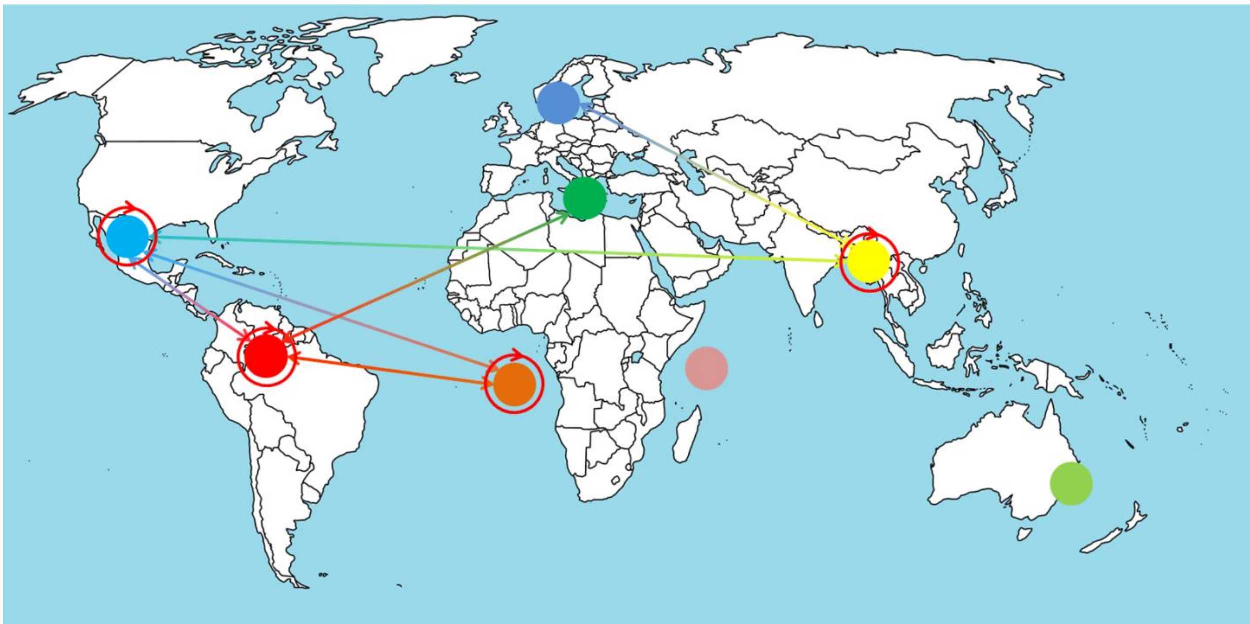
Figure 223: Portfolio model: Lin Lines

Their portfolio model can be seen in Figure 223. Because they only directly serve West Africa, their political situation is slightly stable. Because their vessels are chartered and the container shipping market is commodity oriented, their cash flow is quite stable.

J.4.5 Nordana lines (Dannebrog Group)

According to Dannebrog (18/06/2013) and Alphaliner (27/07/2011), the Dannebrog Group is active in shipping. More in particular multipurpose and RoRo vessels are used by subsidiary Nordana Line. Bulk cargo is transported by Weco Bulk. The tanker market is served by Stena Weco, which is a joint venture between Stena Bulk and Weco. Dannebrog rederi provides fleet management services for dry cargo vessels and tankers. Nordana Project & Chartering provides vessel's operation services. They provide door-to-door container transport services with their logistics department. With their multipurpose liner services, they transport containers in the regions of Asia, Europe, the Mediterranean, North America, South America, and West Africa. An overview of the trades in which their container liner services are active can be seen in Figure 224.

Figure 224: Trades Nordana



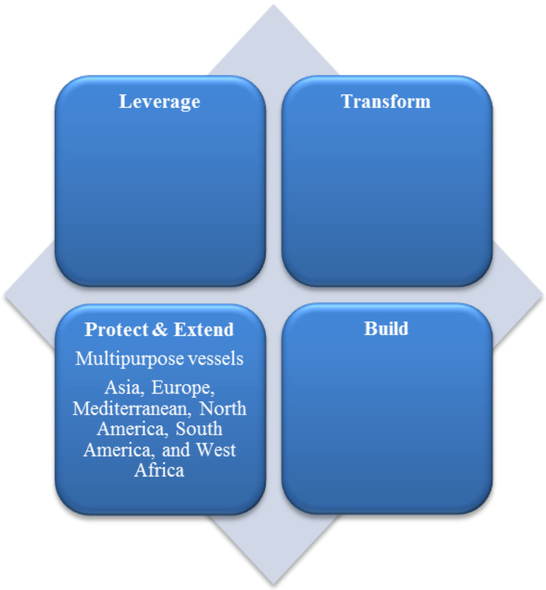
Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

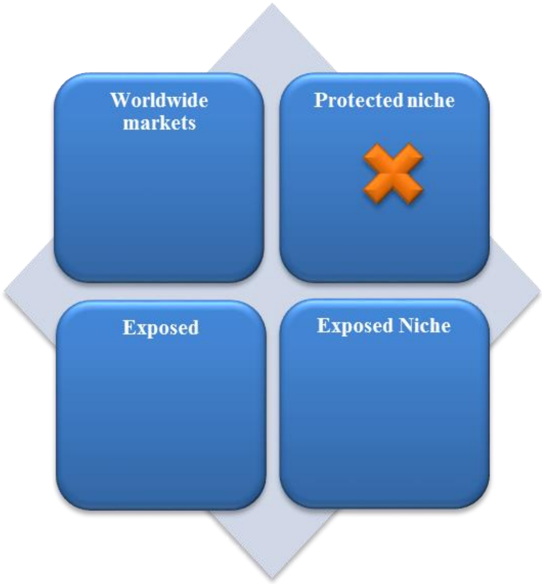
According to Alphaliner's top 100 and order book (27/07/2011) Nordana Line uses five multipurpose vessels (three owned and two chartered) for their multipurpose liner services. Their nominal TEU capacities range from 600TEU to 700TEU. Their conceptual model of Nordana Line can be seen in Figure 225.

Figure 225: Conceptual model: Nordana Line



The portfolio model of the Dannebrog Group can be seen in Figure 226. Because the Dannebrog group is active is several commodity oriented segments of shipping with owned and chartered vessels and active in non-commodity with their fleet management and operations services, their cash flow situation is stable. Because they are active in a lot of regions in the world, they will not be held back in case a country becomes unstable. Therefore, they are politically stable.

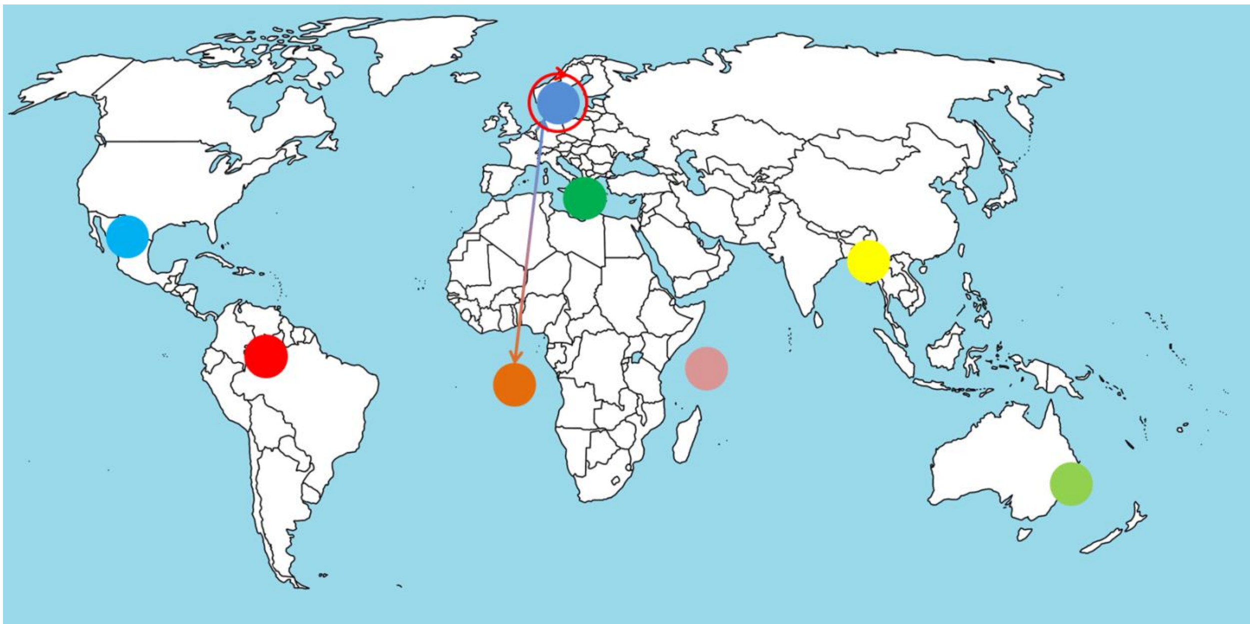
Figure 226: Portfolio model: Dannebrog Group



J.4.6 EuroAfrica

According to EuroAfrica (18/06/2013) and Alphaliner (27/07/2011), EuroAfrica consists of three subsidiaries: West Africa Line, which has multipurpose liner services between Europe and West Africa, UK Line with container liner services between the United Kingdom and Poland, and Ferry Line with RoPax vessels sailing between Poland and Sweden. UK Line subsidiary provides door-to-door container transport services with their logistics department. An overview of trades in which they are active with their containers can be seen in Figure 227.

Figure 227: Trades EuroAfrica

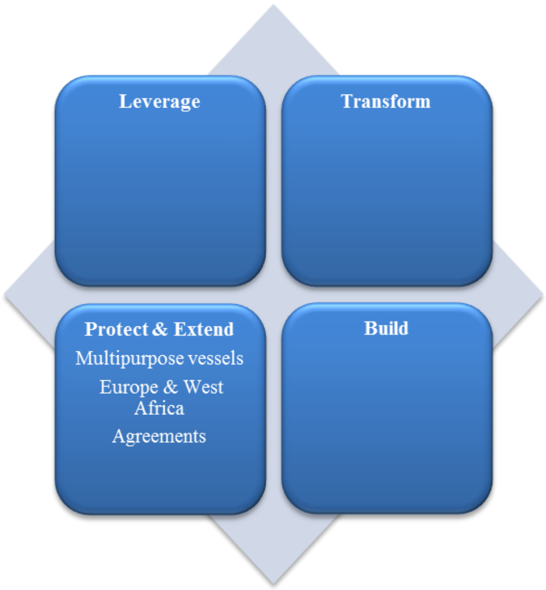


Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

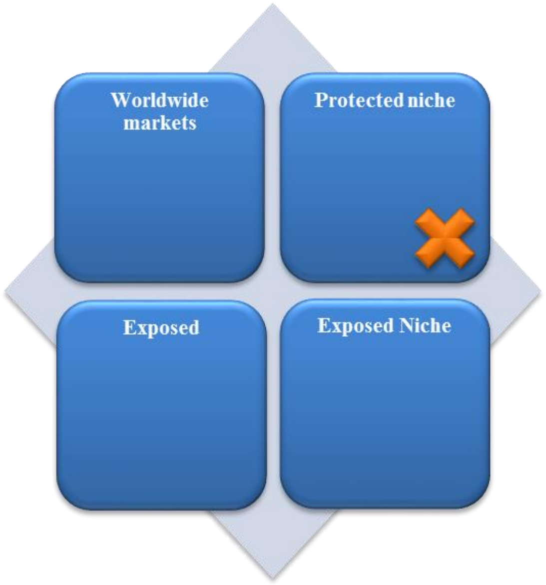
: Trade within the region

Figure 228: Conceptual model: EuroAfrica



According to Alphaliner's top 100 and order book (27/07/2011) EuroAfrica has seven owned multipurpose vessels with container capacities of 550TEU. EuroAfrica has vessel sharing agreements with MacAndrews from the CMA CGM Group. Their conceptual model can be seen in Figure 228 Their Portfolio model can be seen in Figure 229. Because they are active in commodity oriented shipping markets with owned vessels, their cash flow is very stable. The container liner services of EuroAfrica connect Europe to West Africa. Because West Africa is involved, the political situation of EuroAfrica can be seen as slightly stable.

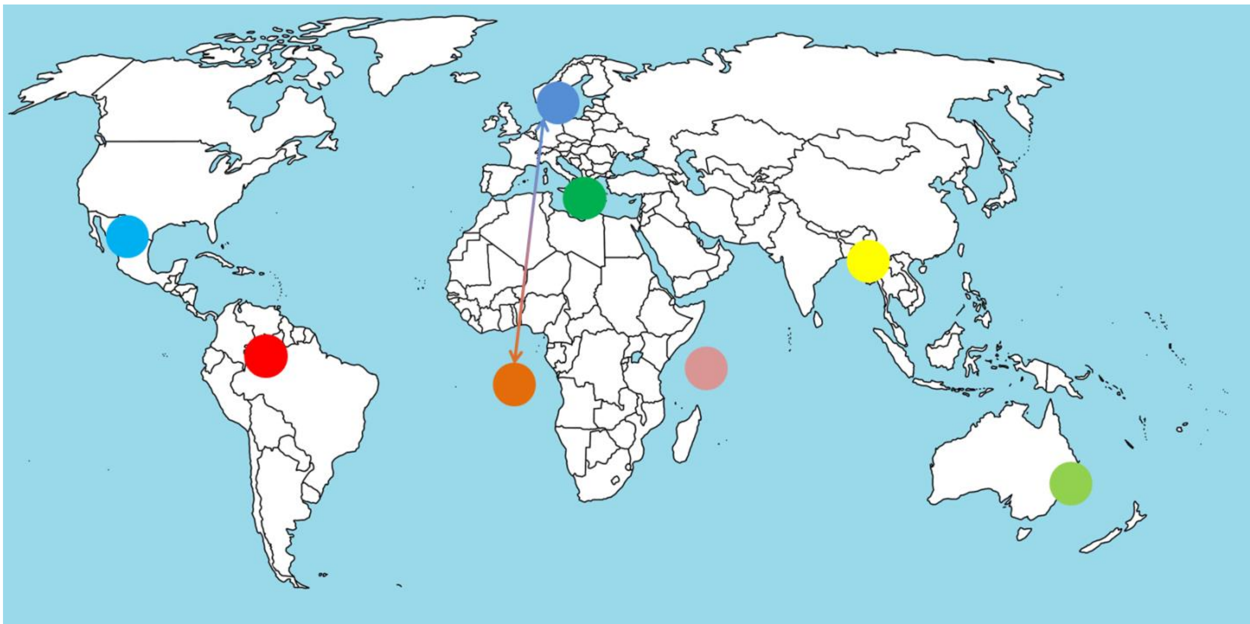
Figure 229: Portfolio model: EuroAfrica



J.4.7 Portline

According to Portline (02/07/2013) and Alphaliner (27/07/2011), Portline is a shipping company, which transports dry bulk and containers. They also have warehouses and are active in logistics. They do provide door-to-door container transport services with their logistics department. Their container shipping segments transports containers between Europa and West Africa as can be seen in Figure 230.

Figure 230: Trades Portline

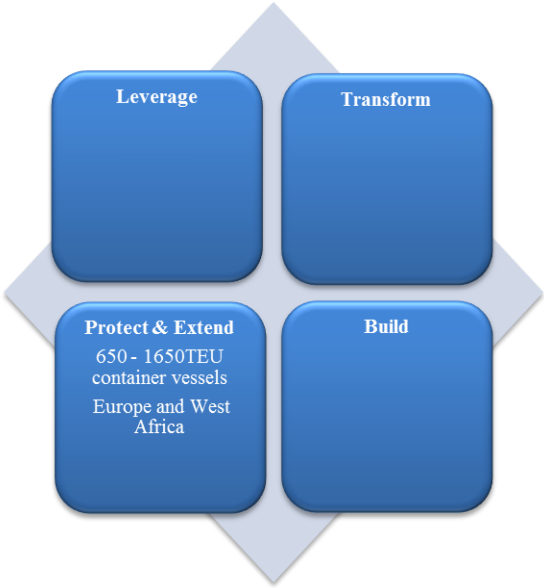


Source: Alphaliner (24/05/2013)

Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

Figure 231: Conceptual model: Portline



According to Alphaliner's top 100 and order book (27/07/2011) Portline uses three container vessels (one owned and two chartered) for these container liner services. Their nominal TEU capacities range from 650TEU to 1.650TEU. Their conceptual model can be seen in Figure 231.

The portfolio model of Portline can be seen in Figure 232. The cash flow is stable as the company is active on only commodity based markets and charters about 66% of their container vessels. This way they benefit from the positive effect of hedging on the cash flow. The political situation is a bit stable as the transport of container and bulk is between Europe and West.

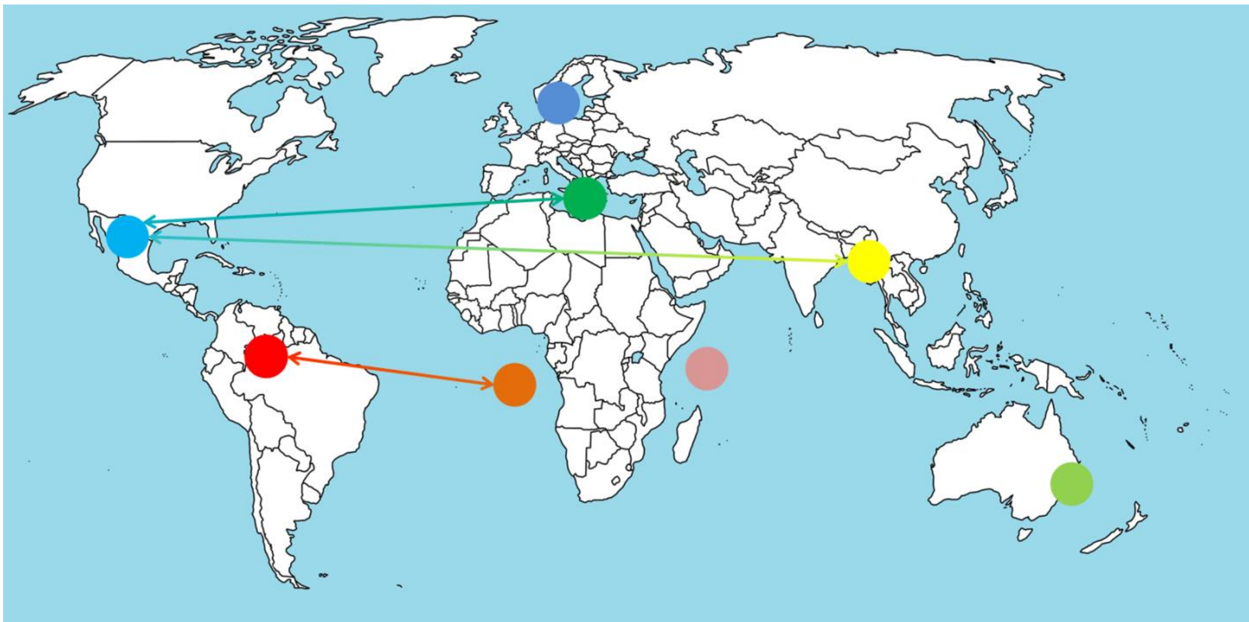
Figure 232: Portfolio model: Portline

J.4.8 Clipper Group

According to Clipper Group (04/06/2013) and Alphaliner (27/07/2011), Clipper Group is active in several shipping segments such as: bulk carriers, multipurpose vessels (Clipper Shipping Line), tankers (Clipper is the largest shareholder in Nordic Shipholding with 30%), RoRo [46] vessels (Seatruck), ferries (Danske Færger, merger between Bornholmstrafikke, Sydfynske, and Nordic Ferry services. Clipper owns 50% of Danske Færger, there is also Mols-Linien in which Clipper has acquired 30% of shares), and cruise vessels. Their primary focus is on bulk.

In the container shipping segment, they are active in Asia, the Mediterranean, North America, South America, and West Africa. The trades in which their multipurpose liner services are active can be seen in Figure 233.

Figure 233: Trades Clipper Shipping Line



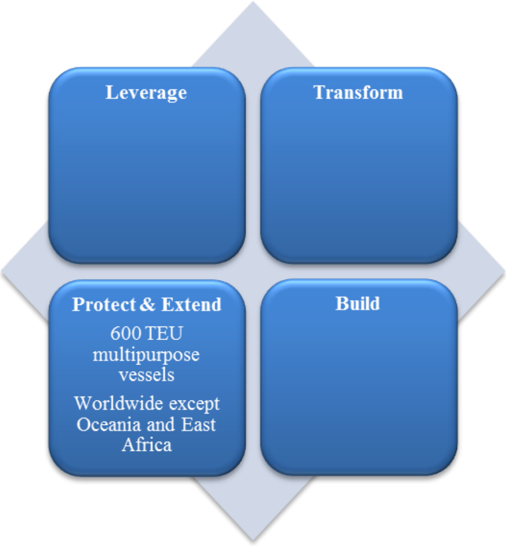
Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

[46] RoRo: Roll-On Roll-Off, transportation of vehicles

Figure 234: Conceptual model: Clipper Shipping Line



According to Alphaliner's top 100 and order book (27/07/2011) Clipper Shipping Line uses seven owned multipurpose vessels for their container transport. Their nominal TEU capacities are 600TEU. Their conceptual model can be seen in Figure 234.

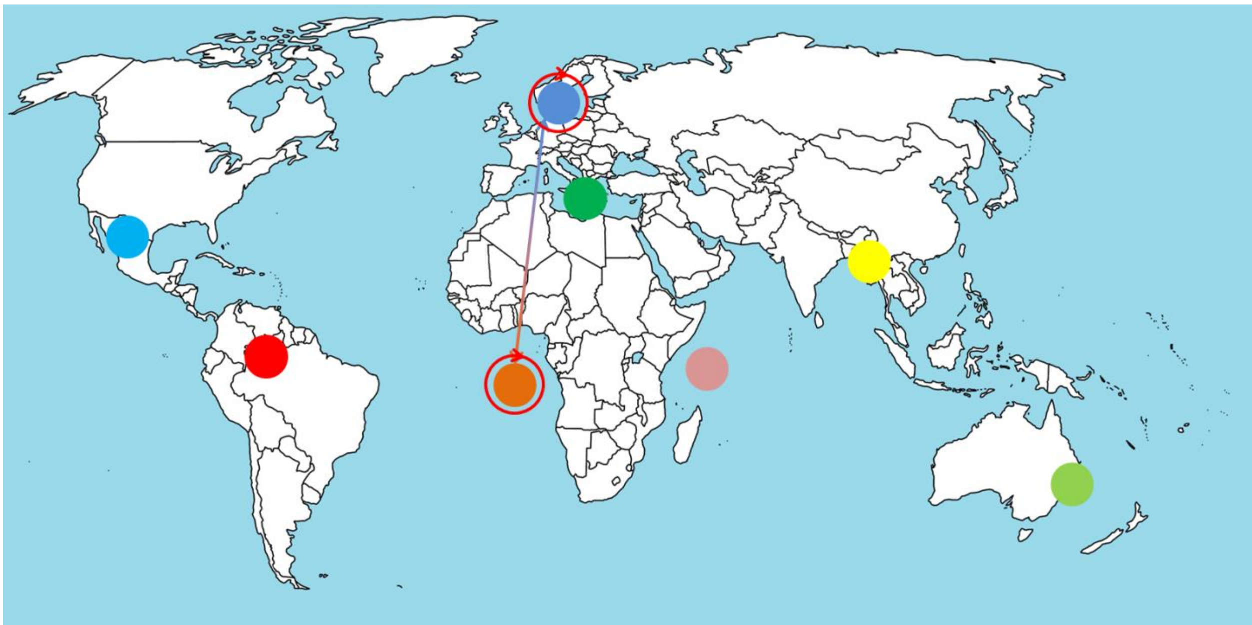
Figure 235 shows the portfolio model of Clipper Shipping Line. Due to their presence worldwide except in Oceania and East Africa, they are politically stable. All of their container vessels are owned and because their only non –commodity market is the cruise market and all their other segments are located in commodity oriented markets, their cash flow is very stable.

Figure 235: Portfolio model: Clipper Group

J.4.9 Traninsular

According to Traninsular (03/07/2013) and Alphaliner (27/07/2011), Transportes Maritimos Insulares (Traninsular) is a shipping company that transports containers, bulk, and RoRo cargo. They provide door-to-door container transport services with their logistics department. They transport containers in the regions of Europe and West Africa as can be seen in Figure 236.

Figure 236: Trades Traninsular

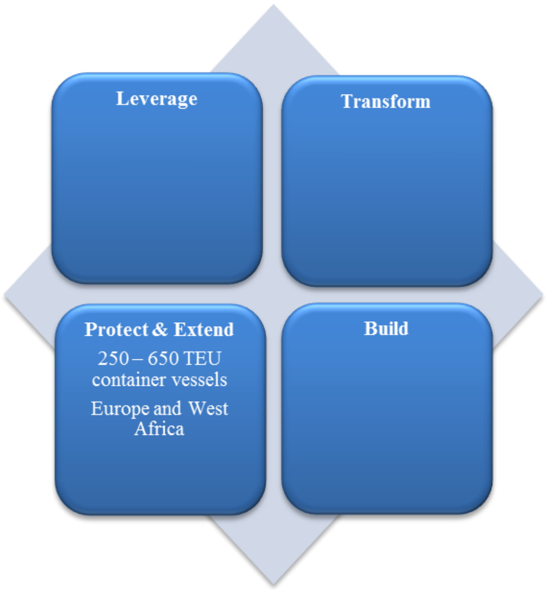


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

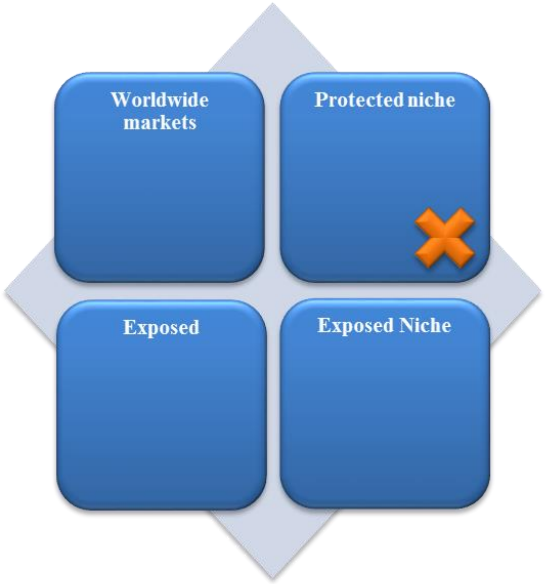
: Trade within the region

Figure 237: Conceptual model: Traninsular



According to Alphaliner's top 100 and order book (27/07/2011) Traninsular uses five owned container vessels for their container liner services. Their nominal TEU capacities range from 250TEU to 650TEU. Their conceptual model can be found in Figure 237

Figure 238: Portfolio model: Traninsular

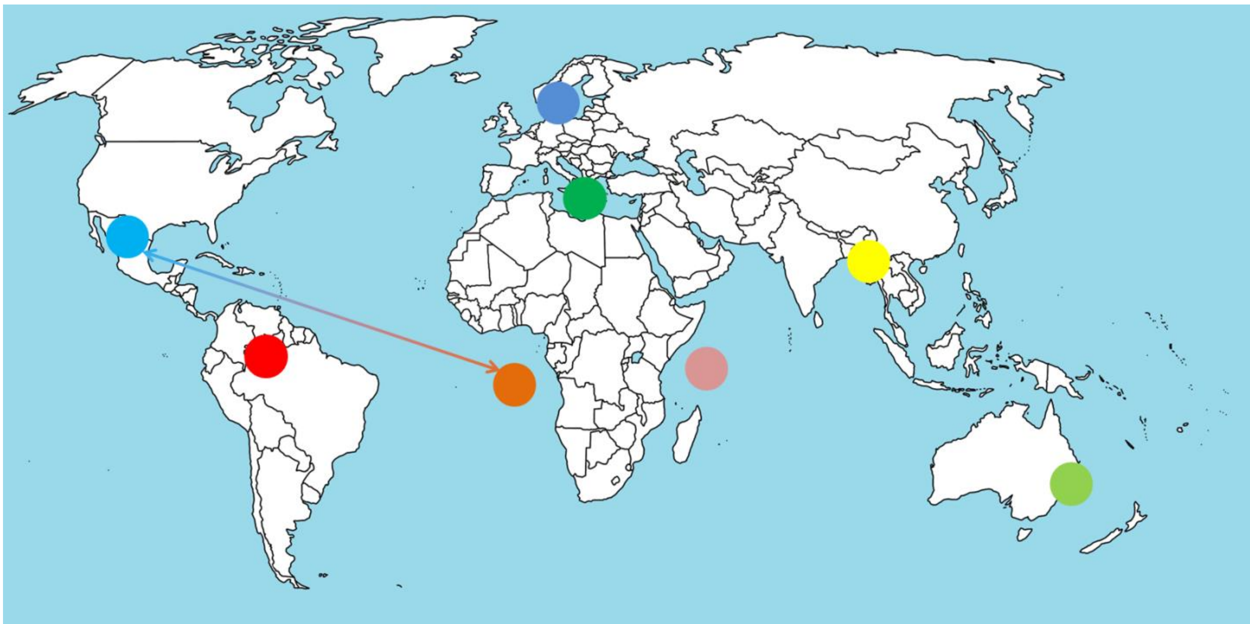


The portfolio model can be seen in Figure 238. It shows a very stable cash flow due to the fact that the company is only active in commodity based markets and all their vessels are owned. Because the company is active in Europe and West Africa, their political situation is quite stable.

J.4.10 CSAL

According to CSAL (04/06/2013) and Alphaliner (27/07/2011), Canada States Africa Line (CSAL) is a shipping company with multipurpose vessels that has liner services between North America and West Africa as can be seen in Figure 239.

Figure 239: Trades CSAL

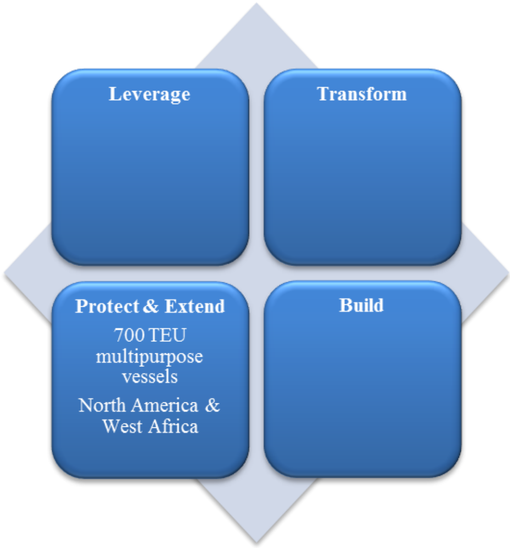


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

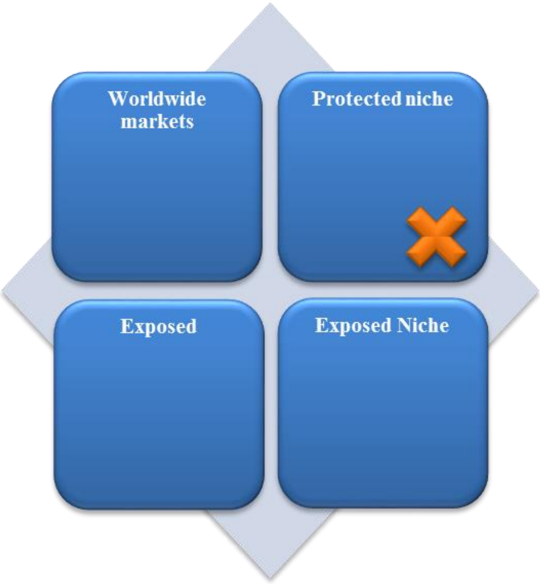
: Trade within the region

Figure 240: Conceptual model: CSAL



According to Alphaliner's top 100 and order book (27/07/2011) CSAL uses three owned multipurpose vessels with container capacities of 700TEU in their multipurpose liner service. Their conceptual model can be seen in Figure 240.

Figure 241: Portfolio model: CSAL

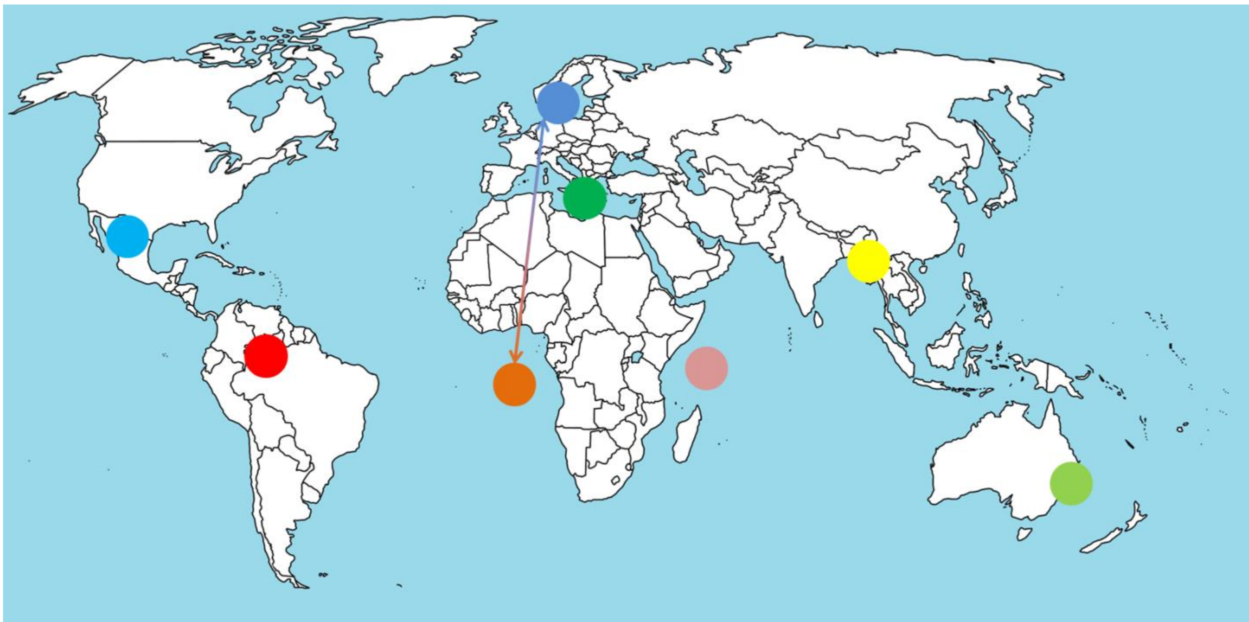


The portfolio model as can be seen in Figure 241 shows that due to the fact that CSAL only has one multipurpose liner service on the trade between North America and West Africa, their political situation is slightly stable. Because they are only active in the commodity oriented shipping market with owned multipurpose vessels, their cash flow is very stable.

J.4.11 Bacoliner

According to Bacoliner (03/06/2013) and Alphaliner (27/07/2011), Bacoliner is a company that transports containers and barges between Europe and West Africa as displayed in Figure 242. Their vessels are very special as they can transport barges and containers at the same time. When the barges are out of the mother ship, containers can be loaded on top of the barges and in this way transported to smaller ports or more inland located ports.

Figure 242: Trades Bacoliner

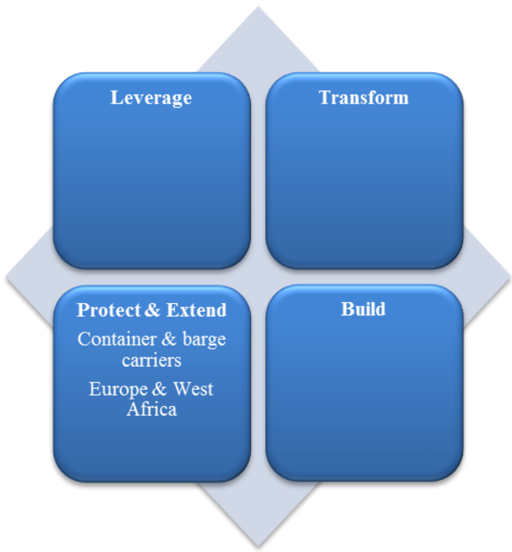


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

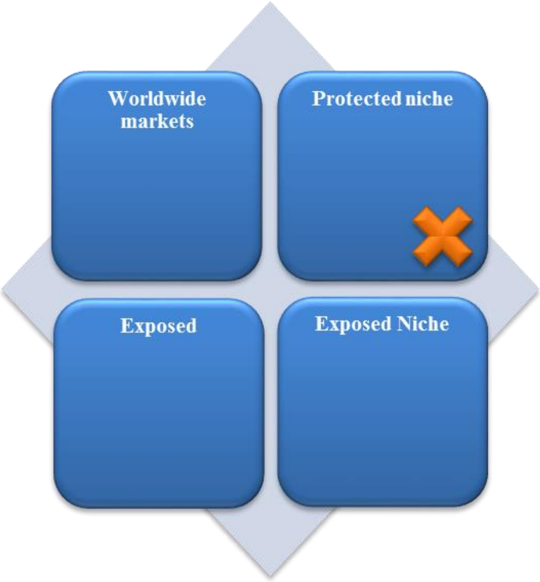
: Trade within the region

Figure 243: Conceptual model: Bacoliner



According to Alphaliner's top 100 and order book (27/07/2011) Bacoliner uses three owned barge & container carriers for these container liner services. Their nominal TEU capacities are 650TEU. Their conceptual model can be seen in Figure 243.

Figure 244: Portfolio model: Bacoliner

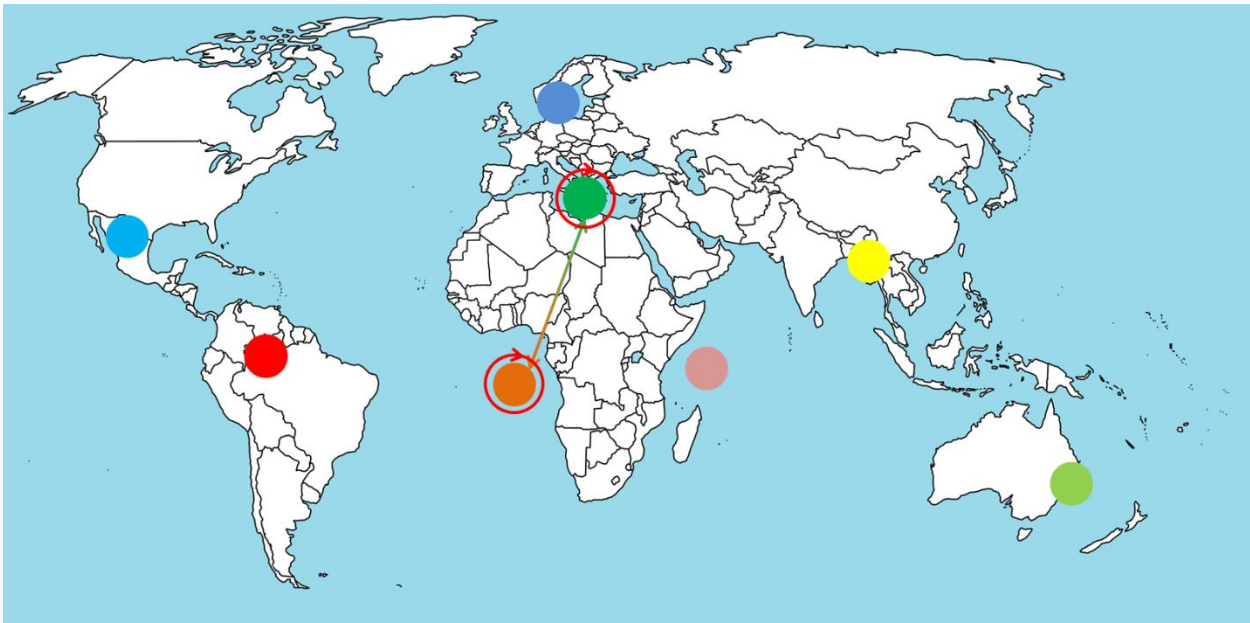


The portfolio model of Bacoliner can be seen in Figure 244. Because the cash flow comes from only three owned vessels and the company is active in a commodity market, the cash flow of Bacoliner is a very stable. Because they are only active between Europe and West Africa, the political situation is slightly stable.

J.4.12 IMTC Group

According to IMTC Group (20/06/2013) and Alphaliner (27/07/2011), International Maritime Transport Corporation Group (IMTC Group) is a company active in several segments of shipping and in travelling. They have Container vessels, RoPax[47], and RoRo vessels. They are ship owners (IMTC), Agent (Comship), and active in logistics by depot and trucking (Casablanca Container Logistics). They provide door-to-door container transport services with their logistics department. Their travel department is run by IMTC Voyages Travel Agency. Their container liner services are active in the regions of The Mediterranean and West Africa. The trades in which these container liner services are active can be seen in Figure 245.

Figure 245: Trades IMTC



Source: Alphaliner (24/05/2013)

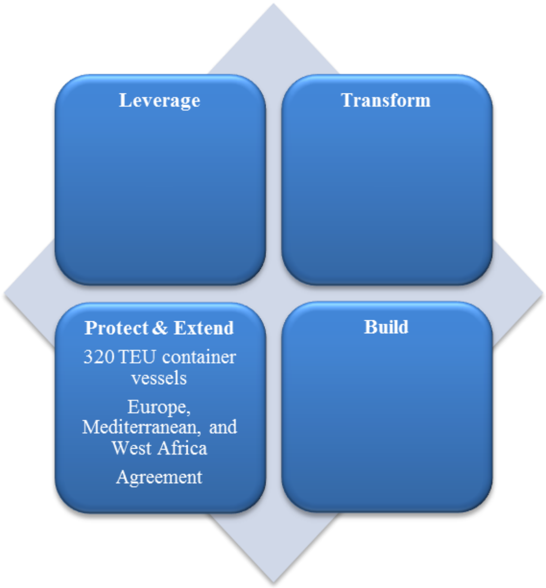
Asia **West Africa** **South America** **East Africa** **North America** **Europe** **Oceania** **The Mediterranean**

: Trade within the region

According to Alphaliner's top 100 and order book (27/07/2011) IMTC uses two owned container vessels for their container liner services. Their nominal TEU capacities are 320TEU. IMTC has a vessel sharing agreement with CoMaNav. Their conceptual model can be seen in Figure 246.

[47] RoPax: this vessel can transport Roll-On Roll-Off cargo and passengers

Figure 246: Conceptual model: IMTC



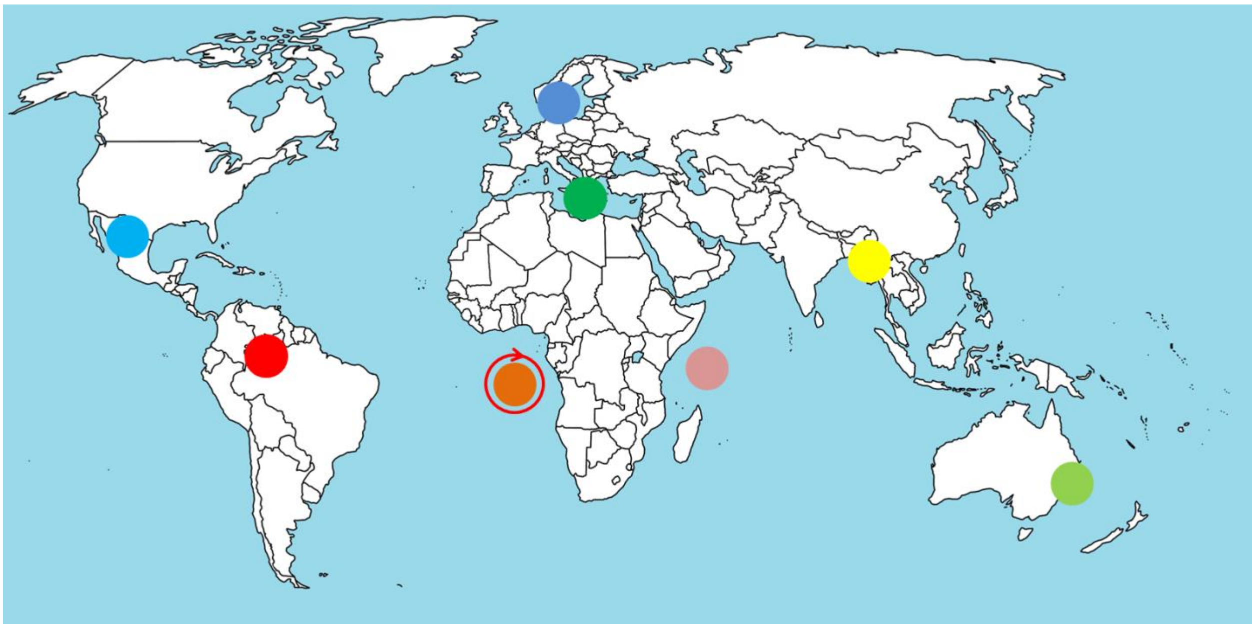
Their Portfolio model can be seen in Figure 247. The shipping container liner services are located in Europe, The Mediterranean, and West Africa. The travel segment focusses on Egypt, Europe, and Morocco. Therefore, the political situation is slightly stable. Because the company is mainly active in non-commodity segments with owned vessels, the cash flow is very stable.

Figure 247: Portfolio model: IMTC Group

J.4.13 Angola South Line

According to Angola South Line (03/06/2013) and Alphaliner (27/07/2011), Angola South Line is active in the inter West African container shipping market as can be seen in Figure 248. They have one liner service. For this liner service, they use multipurpose vessels. Their focus is on break bulk and container transport. They provide door-to-door container transport services with their logistics department

Figure 248: Trades Angola South Line



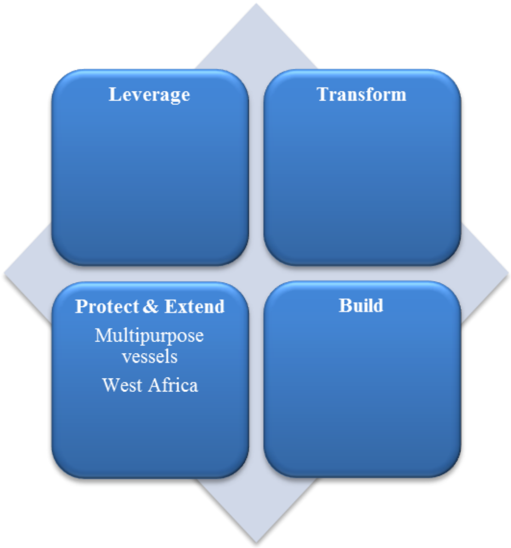
Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

According to Alphaliner's top 100 and order book (27/07/2011) Angola South Line uses two chartered multipurpose vessels for its multipurpose liner service. Their nominal TEU capacities range from 380TEU to 700TEU. Their conceptual model can be seen in Figure 249.

Figure 249: Conceptual model: Angola South Line



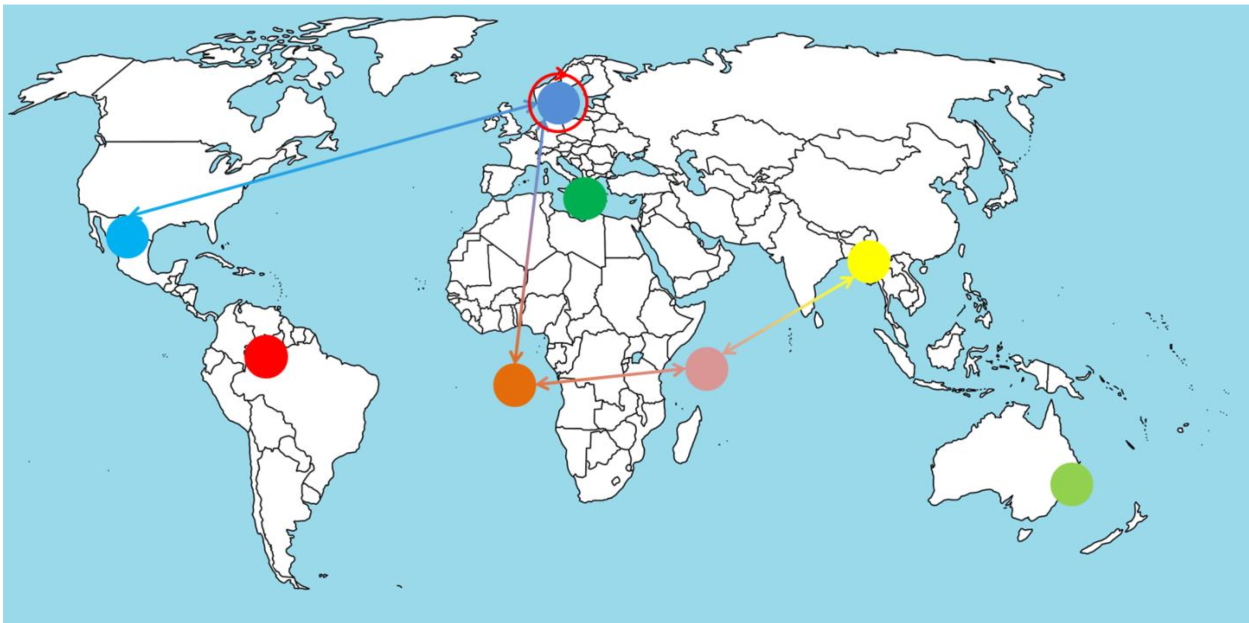
The portfolio model as can be seen in Figure 250 shows a slightly stable political situation due to the fact that only ports in West Africa are called. Countries in West Africa tend to get unstable sometimes. The company may therefore encounter problems in case of a politically unstable West African country. Because all vessels used are time chartered and the company is active in commodity based shipping segments, the cash flow is quite stable.

Figure 250: Portfolio model: Angola South Line

J.4.14 Stinnes Linien

According to Hugo Stinnes (02/02/2013) and Alphaliner (27/07/2011), Stinnes Linien is a shipping company with multipurpose vessels. They are active in the regions of Asia, East Africa, Europe, North America, and West Africa. The trades in which the multipurpose liner services of Stinnes Linien are active can be found in Figure 251.

Figure 251: Trades Stinnes Linien

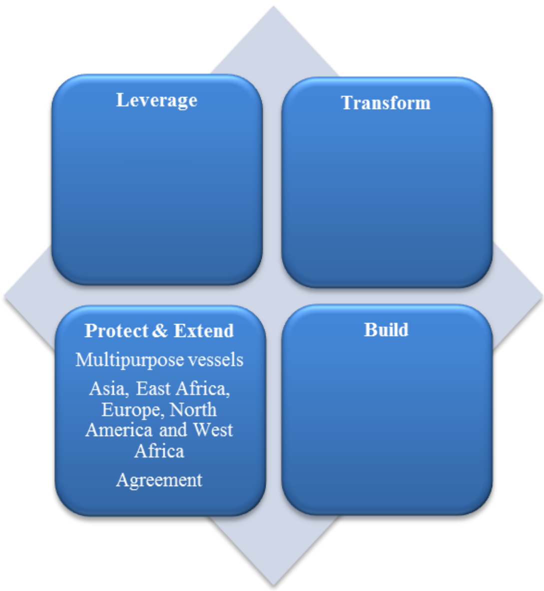


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

Figure 252: Conceptual model: Stinnes Linien



According to Alphaliner's top 100 and order book (27/07/2011) Stinnes Linien has two multipurpose vessels, which are time chartered. Their nominal container capacities are 1.000TEU. Stinnes Linien has a vessel sharing agreement with MSC for the Europe – West Africa – East Africa- Asia trade. MSC uses container vessels for this trade. Their conceptual model can be seen in Figure 252.

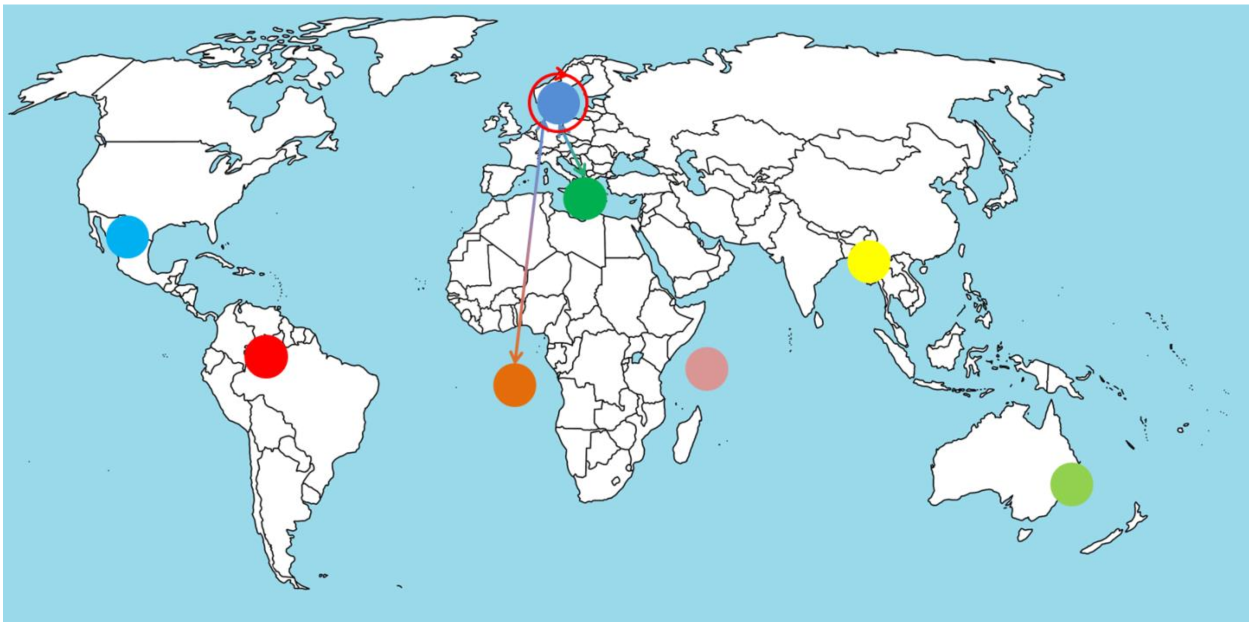
Figure 253: Portfolio model: Stinnes Linien

Their portfolio model can be seen in Figure 253. It shows a quite stable cash flow because the company is only active in commodity based markets and all their vessels are chartered. Because the company is mainly active in Europe, North America and West Africa their political situation is quite stable. However, in case an African country becomes instable they might get problems on their Europe – West Africa multipurpose liner service.

J.4.15 VACS

According to Van Uden Group (04/07/2013) and Alphaliner (27/07/2011), Van Uden Atlas Container Service (VACS) is a shipping company active in the segments of container and RoRo transport. Their liner services, which transport containers, are active in Europe, the Mediterranean, and West Africa. In which trades they are active can be seen in Figure 254.

Figure 254: Trades VACS

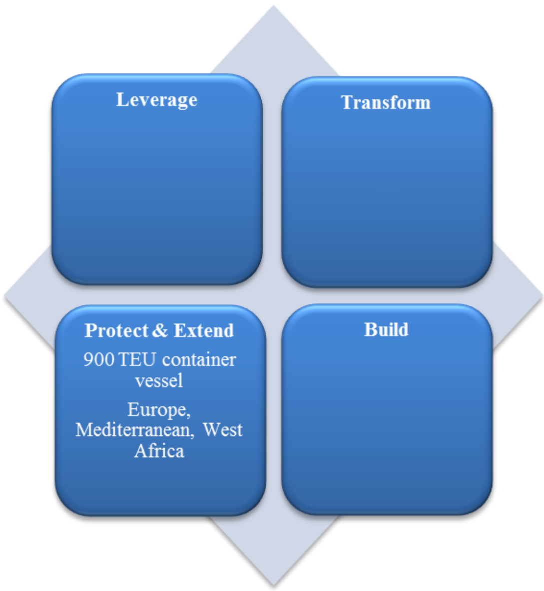


Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

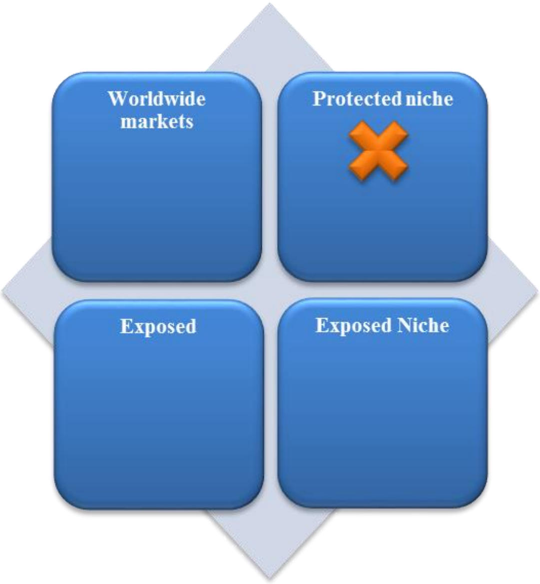
: Trade within the region

Figure 255: Conceptual model: VUCS



According to Alphaliner's top 100 and order book (27/07/2011) VACS uses one chartered container vessel with a nominal container capacity of 900TEU. Their conceptual model can be seen in Figure 255.

Figure 256: Portfolio model: VUCS

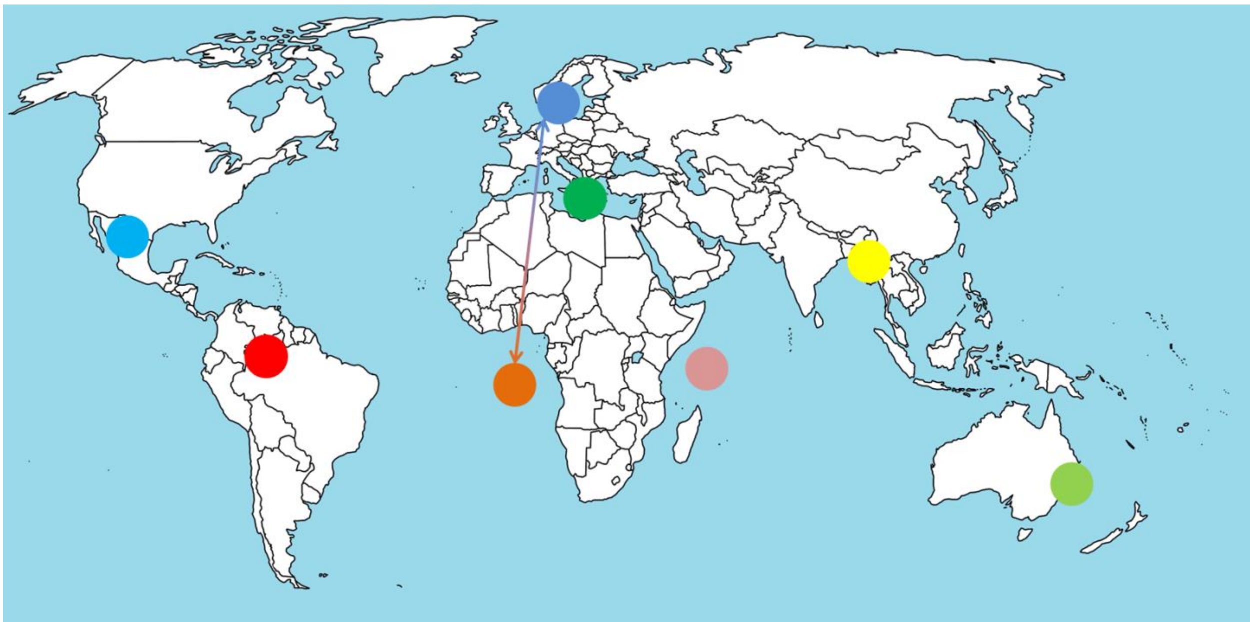


Their portfolio model can be seen in Figure 256. It shows a very stable political situation due to the fact that the container and RoRo liner services combined are active worldwide. Therefore, in case a country becomes unstable it will cause much less inconvenience for the company. Their cash flow is stable as they are only active in commodity oriented markets and because they use a combination of owned and chartered vessels.

J.4.16 SOL

According to SOL (02/02/2013) and Alpahaliner (27/27/2011), Svenska Orient Linien (SOL) is a shipping company active in the RoRo, container and dry bulk segment. The main focus is on RoRo and dry bulk. For their container liner services, they have no owned or chartered container vessels, but they depend on a slot agreement with Safmarine, Maersk Line, MOL, and DAL. They provide door-to-door container transport services with their logistics department. Their container liner service is active between Europe and West Africa as can be seen in Figure 257. Their conceptual model can be seen in Figure 258.

Figure 257: Trades SOL



Source: Alphaliner (24/05/2013)

Asia West Africa South America East Africa North America Europe Oceania The Mediterranean

: Trade within the region

The portfolio model can be seen in Figure 259. It has an stable cash flow as the company is only active in commodity based markets with chartered and owned vessels. Because they are mainly active in the RoRo and dry bulk segment, which is active in Europe and the Mediterranean, their political situation is stable.

Figure 258: Conceptual model: SOL

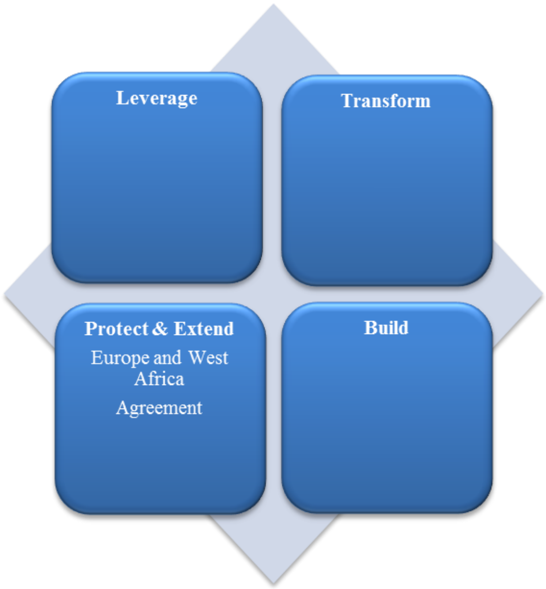
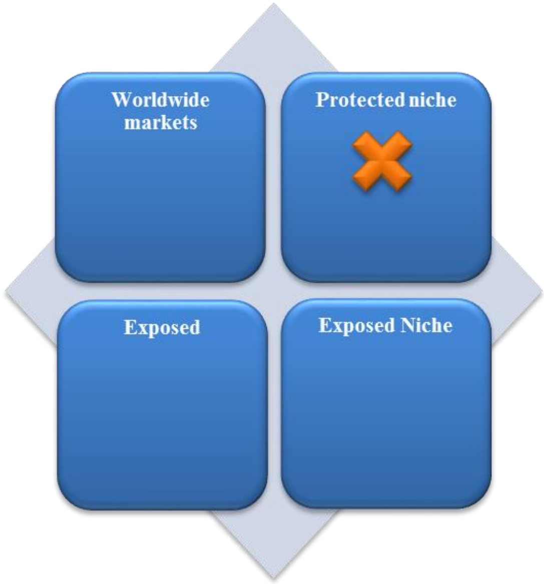


Figure 259: Portfolio model: SOL



Appendix K : Explanation steps container transport chain

Next, an overview follows of a description of each step in terms of activity, costs, and revenue.

Container depot

Activity

NileDutch’s leased or owned, containers are stored at the container depot. In case an additional lease-purchase, long-term leased or short-term leased container is required the container depot will provide this as well.

In case there are no possibilities at the container terminal to clean, repair, or upgrade a container, a truck takes the container to the container depot and it is done there.

Costs

There are handling charges for a container transported in or out a depot.

Costs for lease-purchase, long-term leased or short-term leased containers

Costs for cleaning repairing and upgrading a container

Costs for storage

Transport

Activity

A truck transports the container from the container depot to the shipper or from the consignee to the container depot. The time required for transportation depends on the driving distance.

Costs

Transportation costs

Shipper stuffing

Activity

The shipper can make use of his own containers (shipper’s owned container) or make use of a container that NileDutch provides. When the shipper receives the empty container from the local depot, he will stuff it with his commodities before transporting it to the port of loading. The stuffing behaviour of shippers depends on the port.

Pre-carriage and on-carriage

Activity

Pre-carriage is the transport of the container from the shipper to the port of loading. On-carriage is the transport of the container from the final port of discharge to the consignee. Transportation can be done by trucking, railing, the use of a barge, or a feeder.

Costs

Transportation costs for pre-carriage and on-carriage

Customs container terminal

Activity

Customs clears the container when it enters a country or when it leaves a country. In West Africa, the clearance of a container can take up to one week. This due to paperwork that customs needs to redeem to clear the container.

Costs

Clearance costs

Container terminal

Activity

At the container terminal, the container is put at quay to await the container vessel where it needs to be loaded onto. The time required to load, discharge, or restowe a container on a container vessel depends on the speed of the shore cranes of the port. In case of transshipment, the container is discharge form the container vessel to the quay and loaded onto the second container vessel that will bring the container to its final port of discharge.

Congestion can occur at a container terminal. The congestion time behaviour typically depends per container terminal.

A container vessel can also take bunkers on board at a container terminal.

A container vessel can also be arrested at a container terminal.

In case there are no possibilities at the container terminal to clean, repair, or upgrade a container, a truck brings the container to the container depot and it is done here.

Costs

Stevedoring costs, commissions, transshipment costs, and port costs

Shipping

Activity

A container vessel transports the container from its port of loading to it port of discharge. The duration of this voyage depends on the speed of the vessel and the distance it needs to sail. The sea state (weather, currents, and waves) can however delay the transit time of the container vessel. Exceptionally a container vessel can encounter problems with its machinery or hull for which it needs to divert its course.

In case a feeder container liner service is used, bunkering takes place offshore.

Costs

Vessels time charter

Bunker costs

General vessel expenses

Offshore bunkering

Activity

According to NileDutch's operations department (02/09/2013) when a container vessel is taking bunkers offshore, a bunker barge will come and sail alongside the container vessels for the duration of the bunker operations. The container vessel will not divert its course for this operation but will have a longer transit time, as it needs to slow down its speed.

Costs

Bunker costs

Appendix L : Explanation voyage calculations

L.1 Ocean freight

The charge for transporting a container with a container vessel from port A to B. If the container goes from port A to C via B, the total charge will be the charge used from A to B on the first ship plus the charge used from B to C on the second ship.

L.2 Additional freight

Additional freight is the part of the total net freight added to the net freight. It represents the freight to compensate for market fluctuations and container handlings done by third parties.

The most common additional freight surcharges NileDutch uses can be combinations of the next additional surcharges:

Bunker Adjustment Factor (BAF)

Bunker costs have a sizable share in the operation costs on long voyages, so if the bunker prices increase unexpectedly a BAF will be used to cover these extra costs.

Terminal Handling Charge (THC)

This surcharge is to cover the costs for handling containers on the container terminal. These container handlings are between the quay and the container stacking area and in the container stacking area. An example of a container handling is taking a container from a truck by the use of a reach stacker and put it on a pile in the container stacking area. Another example is taking a container from a pile in the container stacking area by the use of a straddle carrier and put it a quay next to a gantry crane.

International Ship and Port Facility Security (ISPS)

This surcharge is the consequence of the International Maritime Organization's (IMO) ISPS code. This code was the consequence of the 9/11 attacks in the United States. The surcharge covers all the measures taken to warrant the security of vessels and port facilities

Outport additional

The surcharge is to cover the expenses of NileDutch to bring a container from another port to one of NileDutch's main ports. NileDutch appeals for the container liner services of another company to do this.

Congestion surcharge

In case of congestion in a port a congestion surcharge will be initiated to cover the additional costs the container vessel needs to wait before it can come alongside and start its container handling operations.

Heavy weight surcharge

Heavy weight containers (gross tonnage >20ton) take a more extensive share of the deadweight tonnage of a container vessel. The more heavy weight containers there are on board the container vessel the less containers can be transported, as the container vessel will reach his deadweight tonnage (DWT) capacity more quickly. In certain ports, there are draft restrictions, which easily get reached by the container vessel. Therefore, fewer containers can be put on board the container vessel. To compensate for this missed opportunity to transport more containers, a heavy weight surcharge is added to the net freight.

Hazardous surcharge

The types of hazardous goods are divided according to the International Maritime Dangerous Goods (IMDG) code classes. According to the type of IMDG code class, the cargo might not be accepted by a container shipping company due to the company’s policy. If the container is accepted, the position of the container in the container vessel may depend on other hazardous cargo that needs to go on board the container vessel as well or is already present in the container vessel. This because IMO rules state that certain IMDG class containers cannot be near certain other IMDG class containers. Depending on the danger level between those classes, the distance between the containers to create a safe situation the container will be longer or shorter.

Hazardous cargo is surcharged because of the extra work. The extra work involves extra paperwork that needs to be arranged, the approval of the cargo, and the positioning of the container into the container vessel to create a safe situation.

Port additional

The port additional is the surcharge to cover the terminal handling costs that are billed to NileDutch in Angola and in Pointe Noire. The other part of the container handling costs will be billed to the customer.

Piracy surcharge

The piracy surcharge covers the additional costs for insurance of the container vessel when it sails in a piracy area.

Congo River surcharge

Is to cover the costs for the pilotage, the ports costs, dredging costs, delays caused by the Devil’s Cauldron on the Congo River and the possibility to only sail at daytime.

L.3 Voyage costs

The voyage costs are composed of four different costs. The vessel's hire, the bunker costs, the ports costs, and the general vessel expenses. A description of all these costs can be found below:

Vessel hire

NileDutch uses time charters for their vessels hire agreements. The time charter rate per voyages is the time charter rate ($/day) multiplied with the amount of voyage days. Table 161 indicates which costs are for the owner and for the charter for the different kinds of charter contracts that exist in the shipping business. In Table 162 an overview can be found into which costs the capital charges, the daily running costs, the voyage costs and the cargo expenses are subdivided.

Table 161: Distribution of the costs for the owner and the chartered per charter type and for an owned vessel.

Type of charter	Capital charges	Operation costs	Voyage costs	Cargo expenses
Bareboat Charter	Owner	Charterer		
Time Charter	Owner		Charterer	
Voyage charter	Owner			Charterer
Contract of affreightment	Owner			
Owned Operated	Owner			

Source: Pruyn (2010)

Table 162: Overview costs

Capital charges	Operation costs	Voyage costs	Cargo expenses
Loan repayments	Crew costs	Fuel costs	Cargo handling
Loan interest	Maintenance and repair	Port charges	Cargo claims
Taxes	Supplies and Lub. Oils	Canal dues	
Return after taks	Insurance		
(depreciation)	Docking		
(profit)	Administration		

Source: Pruyn (2010)

Bunker costs

The bunker costs are calculated by multiplying the fuel consumption of a voyage with the price paid for the bunkers.

Port costs

Ports costs involve differed types of costs related to the port. They may include pilotage, towage, mooring operation, harbour dues, light dues, clearance, federal police tax, free practique tax, car hire, watchmen expenses, custom expenses, and agency fees.

General vessel expenses

General vessel expenses may involve expenses such as garbage removal, painting, cleaning, vessels inspection, cash to master, courier expenses, fresh water supply, crew medical expenses, crew travel, crew lodging, and ships chandlers.

L.4 Cargo costs

The cargo costs involve all the costs concerning the containers and their handlings. These are stevedoring, commission, container costs, and transshipment,

Stevedoring

Cargo costs involve the stevedoring costs for the loading, discharge, and restowage operations of full and empty container of all sorts of container types. It may also involve removing hatch covers, stuffing, lashing, securing, connecting reefer plugs, and storage.

Commission

Commissions need to be paid to third parties for their services such as booking commission, shipping commission, forwarding agency commission, compensation local haulage, north bound import, and lump sum.

Container costs

The container costs include the costs for owning containers, long-term hire, short-term hire, cleaning, reparation, and replacement.

Transshipment

The transshipment costs involve the stevedoring costs for the loading, discharge, and restowage operations of full and empty containers of all sorts of container types. It may also involve removing hatch covers, stuffing, lashing, securing, connecting reefer plugs, and storage.

L.5 General expenses

The general expenses to cover the overhead costs of the company. These costs include rents, electricity, salaries, depreciation, taxes, insurances, utilities, etc.

Appendix M : Data required for voyage costs calculations

M.1 Port costs

Port costs consist of general port costs, agency fees for the port costs and authority port costs. SNACS historical data (2008 and 2009) provides these costs per port and per container vessel size (418 TEU, 1.100TEU, 1.300TEU, 1.700TEU, and 2.500TEU). Per container vessels size the average costs are calculated per costs type and for the total port costs. Table 163 showss these results per container vessels size. Next a regression analysis with the method of least squared for a linear function is excecuted. Figure 260 the results of the linear function. The standard error has a value of 736,5 and the T test value is 2,31. This function looks as next:

$$y = 2,379 \cdot x + 15.547 \quad (70)$$

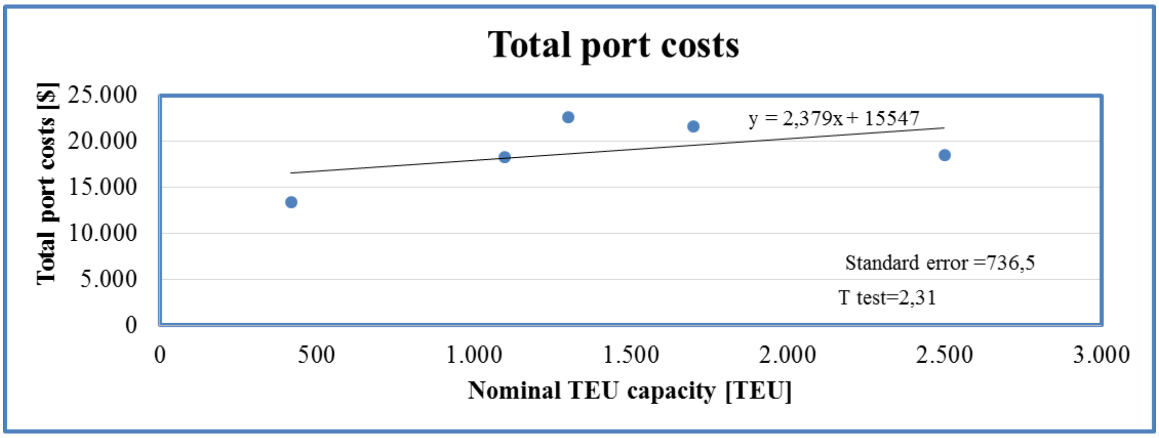
- x : Nominal TEU capacity of the container vessel
- y : Total port costs

Table 163: General port costs per container vessel size

Port cost type / Size container vessel	418 TEU	1.100 TEU	1.300 TEU	1.700 TEU	2.500 TEU
General port costs	$10.895	$13.342	$17.584	$16.621	$12.730
Agency fee port costs	$1.649	$1.719	$1.701	$1.624	$1.564
Athorities port costs	$831	$3.255	$3.313	$3.378	$4.221
Total port costs	**$13.375**	**$18.317**	**$22.598**	**$21.623**	**$18.515**

Source: SNACS historical data (2008 and 2009)

Figure 260: Linear regression function for the total port costs



M.2 General vessel expenses

The general vessel expenses per round trip are based on the estimated values NileDutch uses in its calculations. For container vessels up to a nominal TEU capacity of 2.900TEU, $30.250 is used for the general vessel expenses per round trip. Container vessels with a nominal TEU capacity of 3.000TEU and above have a general vessel expense of $ 60.500 per round trip.

M.3 Stevedoring costs

The stevedoring costs are provided by the Stevedoring contracts (2010-2012). The stevedoring costs were provided per 20’ container and 40’ container. In some port taxed also needs to be payed. The contracts also make a distinction between full and empty containers. Some port also provided the costs in other currencies than in dollars. Therefore Oanda (09-11-2013) exchange rates are used to convert the currencies to dollars. Table 164 shows these exchange rates. Table 165 to Table 170 show the stevedoring costs per full and empty TEU per port and for loading discharging and transshipment.

Table 164: Exchange rates

Currency	Exchange rate relationship to USD
EUR	1,32565
BRL	0,43844
RMB	0,16299
ZAR	0,09706
SGD	0,78799
THB	0,03108
SEK	0,11506

Oanda (09-11-2013)

M.3.1 Loading

Table 165: Stevedoring port costs for loading empty TEUs per port

Region	Country	Port	Costs per TEU final
Asia	China	Changzhou	$146,04
Asia	China	Ningbo	$95,05
Asia	China	Qingdao	$77,36
Asia	China	Shanghai	$90,08
Asia	China	Shekou	$147,99
Asia	China	Xingang-Tianjin	$71,60
Asia	Malaysia	Port Kelang	$58,33
Asia	Singapore	Singapore	$69,41
Asia	South Korea	Inchon	$96,64
Europe	Belgium	Antwerp	$108,70
Europe	France	Le Havre	$128,11
Europe	Netherlands	Amsterdam	$83,52
Europe	Portugal	Leixoes	$112,10
Europe	Portugal	Lisbon	$128,40
South America	Argentina	Buenos Aires	$50,00
South America	Brazil	Paranagua	$95,14
South America	Brazil	Rio de Janeiro	$117,72
South America	Brazil	Santos	$95,00
South America	Brazil	São Francisco do Sul	$92,75
West Africa	Angola	Cabinda	$436,77
West Africa	Angola	Lobito	$399,81
West Africa	Angola	Luanda	$424,40
West Africa	Angola	Namibe	$436,77
West Africa	Angola	Soyo	$436,77
West Africa	Benin	Cotonou	$88,38
West Africa	Cameroon	Douala	$104,93
West Africa	Congo	Pointe Noire	$195,90
West Africa	DR of the Congo	Boma	$103,34
West Africa	DR of the Congo	Matadi	$150,79
West Africa	Gabon	Libreville	$103,80
West Africa	Ghana	Tema	$95,83
West Africa	Ivory Coast	Abidjan	$42,83
West Africa	Liberia	Monrovia	$100,00
West Africa	Nigeria	Lagos	$41,50
West Africa	Sierra Leone	Free town	$75,79
West Africa	South Africa	Cape Town	$104,79
West Africa	South Africa	Durban	$104,73
West Africa	Togo	Lomé	$87,05
Asia	Asia	Asia	$94,72
Asia	Asia	Xiamen	$94,72
Europe	Europe	Europe	$112,17
South America	South America	South America	$90,12
West Africa	West Africa	West Africa	$186,01

Source: Stevedoring contracts (2010-2012)

Table 166: Stevedoring port costs for loading full TEUs per port

Region	Country	Port	Costs per TEU final
Asia	China	Changzhou	$182,55
Asia	China	Ningbo	$121,37
Asia	China	Qingdao	$111,87
Asia	China	Shanghai	$129,03
Asia	China	Shekou	$182,55
Asia	China	Xingang-Tianjin	$115,43
Asia	Malaysia	Port Kelang	$95,07
Asia	Singapore	Singapore	$164,17
Asia	South Korea	Inchon	$123,04
Europe	Belgium	Antwerp	$120,63
Europe	France	Le Havre	$178,96
Europe	Netherlands	Amsterdam	$140,85
Europe	Portugal	Leixoes	$164,50
Europe	Portugal	Lisbon	$182,90
South America	Argentina	Buenos Aires	$85,00
South America	Brazil	Itajai	$140,00
South America	Brazil	Paranagua	$238,95
South America	Brazil	Rio de Janeiro	$189,00
South America	Brazil	Santos	$205,00
South America	Brazil	São Francisco do Sul	$259,49
West Africa	Angola	Cabinda	$192,28
West Africa	Angola	Lobito	$192,28
West Africa	Angola	Luanda	$140,00
West Africa	Angola	Namibe	$192,28
West Africa	Benin	Cotonou	$165,71
West Africa	Cameroon	Douala	$160,28
West Africa	Congo	Pointe Noire	$487,34
West Africa	DR of the Congo	Boma	$200,50
West Africa	DR of the Congo	Matadi	$251,54
West Africa	Gabon	Libreville	$170,08
West Africa	Ghana	Tema	$125,42
West Africa	Ivory Coast	Abidjan	$86,88
West Africa	Liberia	Monrovia	$216,40
West Africa	Nigeria	Lagos	$102,20
West Africa	Sierra Leone	Free town	$191,20
West Africa	South Africa	Durban	$11,06
West Africa	South Africa	Saldanha Bay	$43,77
West Africa	Togo	Lomé	$170,13
Asia	Asia	Asia	$136,12
Asia	Asia	Xiamen	$136,12
Europe	Europe	Europe	$157,57
South America	South America	South America	$186,24
West Africa	West Africa	West Africa	$172,19
West Africa	West Africa	Cape Town	$172,19
West Africa	West Africa	Soyo	$172,19

Source: Stevedoring contracts (2010-2012)

M.3.2 Discharging

Table 167: Stevedoring port costs for discharging empty TEUs per port

Region	Country	Port	Costs per TEU final
Asia	China	Changzhou	$67,86
Asia	China	Ningbo	$101,13
Asia	China	Qingdao	$77,36
Asia	China	Shanghai	$91,90
Asia	China	Shekou	$147,99
Asia	China	Xingang-Tianjin	$77,33
Asia	Malaysia	Port Kelang	$58,33
Asia	Singapore	Singapore	$69,41
Asia	South Korea	Inchon	$96,64
Europe	Belgium	Antwerp	$92,53
Europe	France	Le Havre	$178,96
Europe	Netherlands	Amsterdam	$83,52
Europe	Portugal	Leixoes	$112,10
Europe	Portugal	Lisbon	$128,40
South America	Argentina	Buenos Aires	$50,00
South America	Brazil	Paranagua	$95,14
South America	Brazil	Rio de Janeiro	$117,72
South America	Brazil	Santos	$95,00
South America	Brazil	São Francisco do Sul	$92,75
West Africa	Angola	Cabinda	$102,37
West Africa	Benin	Cotonou	$88,38
West Africa	Cameroon	Douala	$114,13
West Africa	Congo	Pointe Noire	$203,02
West Africa	DR of the Congo	Boma	$104,43
West Africa	DR of the Congo	Matadi	$150,79
West Africa	Gabon	Libreville	$46,40
West Africa	Ivory Coast	Abidjan	$42,83
West Africa	Ivory Coast	San Pedro	$42,83
West Africa	Liberia	Monrovia	$100,00
West Africa	Nigeria	Lagos	$38,50
West Africa	Sierra Leone	Free town	$78,53
West Africa	South Africa	Cape Town	$104,79
West Africa	South Africa	Durban	$104,73
West Africa	South Africa	Saldanha Bay	$11,06
Asia	Asia	Asia	$87,55
Asia	Asia	Xiamen	$87,55
Europe	Europe	Europe	$119,10
South America	South America	South America	$90,12
West Africa	West Africa	West Africa	$88,85
West Africa	West Africa	Luanda	$88,85
West Africa	West Africa	Lobito	$88,85
West Africa	West Africa	Lomé	$88,85
West Africa	West Africa	Namibe	$88,85
West Africa	West Africa	Soyo	$88,85
West Africa	West Africa	Tema	$88,85

Source: Stevedoring contracts (2010-2012)

Table 168: Stevedoring port costs for discharging full TEUs per port

Country	Country2	Port	Costs per TEU final
Asia	China	Changzhou	$59,50
Asia	China	Ningbo	$57,10
Asia	China	Qingdao	$291,05
Asia	China	Shanghai	$75,95
Asia	China	Xingang-Tianjin	$158,96
Asia	Malaysia	Port Kelang	$57,87
Asia	Singapore	Singapore	$102,15
Asia	South korea	Inchon	$123,04
Europe	Belgium	Antwerp	$83,36
Europe	France	Rouen	$148,50
Europe	Netherlands	Amsterdam	$140,85
Europe	Portugal	Leixoes	$7,95
Europe	Portugal	Lisbon	$139,22
South Africa	Brazil	Itajai	$237,60
South Africa	Brazil	Rio de Janeiro	$175,00
West Africa	Angola	Cabinda	$192,28
West Africa	Angola	Lobito	$192,28
West Africa	Angola	Luanda	$95,00
West Africa	Angola	Namibe	$192,28
West Africa	Angola	Soyo	$192,28
West Africa	Cameroon	Douala	$66,69
West Africa	Congo	Pointe Noire	$168,04
West Africa	DR of the Congo	Boma	$195,50
West Africa	DR of the Congo	Matadi	$201,50
West Africa	Gabon	Libreville	$148,03
West Africa	Ghana	Tema	$109,25
West Africa	Ivory Coast	Abidjan	$86,88
West Africa	Ivory Coast	San Pedro	$86,88
West Africa	Liberia	Monrovia	$216,40
West Africa	Nigeria	Lagos	$160,00
West Africa	Sierra Leone	Free town	$208,67
Asia	Asia	Asia	$115,70
Asia	Asia	Xiamen	$115,70
Asia	Asia	Shekou	$115,70
Europe	Europe	Europe	$103,98
Europe	Europe	Le Havre	$103,98
South America	South America	South America	$206,30
South America	South America	Buenos Aires	$206,30
South America	South America	São Francisco do Sul	$206,30
South America	South America	Santos	$206,30
West Africa	West Africa	West Africa	$157,00
West Africa	West Africa	Durban	$157,00
West Africa	West Africa	Cape Town	$157,00
West Africa	West Africa	Lomé	$157,00
West Africa	West Africa	Cotonou	$157,00

Source: Stevedoring contracts (2010-2012)

M.3.3 Transshipment

Table 169: Stevedoring port costs for transshipment empty TEUs per port

Country	Country2	Port	Costs per TEU final
Asia	China	Ningbo	$48,35
Asia	China	Shanghai	$62,04
Asia	China	Shekou	$175,27
Asia	China	Xingang-Tianjin	$121,86
Europe	Portugal	Lisbon	$128,40
West Africa	Angola	Cabinda	$102,37
West Africa	Angola	Lobito	$102,37
West Africa	Angola	Luanda	$90,00
West Africa	Angola	Namibe	$102,37
West Africa	Angola	Soyo	$102,37
West Africa	Cameroon	Douala	$104,93
West Africa	Congo	Pointe Noire	$203,02
West Africa	DR of the Congo	Boma	$123,36
West Africa	DR of the Congo	Matadi	$50,04
West Africa	Gabon	Libreville	$103,80
West Africa	Liberia	Monrovia	$100,00
West Africa	Sierra Leone	Free town	$78,53
Asia	Asia	Asia	$101,88
Asia	Asia	Port Kelang	$101,88
Asia	Asia	Singapore	$101,88
Asia	Asia	Qingdao	$101,88
Asia	Asia	Xiamen	$101,88
Europe	Europe	Europe	$128,40
Europe	Europe	Antwerp	$128,40
Europe	Europe	Le Havre	$128,40
Europe	Europe	Leixoes	$128,40
South America	South America	South America	$105,83
South America	South America	Buenos Aires	$105,83
South America	South America	São Francisco do Sul	$105,83
South America	South America	Santos	$105,83
South America	South America	Rio de Janeiro	$105,83
West Africa	West Africa	West Africa	$105,26
West Africa	West Africa	Durban	$128,40
West Africa	West Africa	Cape Town	$128,40
West Africa	West Africa	Abidjan	$105,26
West Africa	West Africa	Lomé	$105,26
West Africa	West Africa	Cotonou	$105,26
West Africa	West Africa	Lagos	$105,26
West Africa	West Africa	Tema	$105,26

Source: Stevedoring contracts (2010-2012)

Table 170: Stevedoring port costs for transshipment full TEUs per port

Country	Country2	Port	Costs per TEU final
Asia	China	Changzhou	$59,50
Asia	China	Ningbo	$57,10
Asia	China	Qingdao	$291,05
Asia	China	Shanghai	$75,95
Asia	China	Xingang-Tianjin	$158,96
Asia	Malaysia	Port Kelang	$57,87
Asia	Singapore	Singapore	$102,15
Asia	South korea	Inchon	$123,04
Europe	Belgium	Antwerp	$83,36
Europe	France	Rouen	$148,50
Europe	Netherlands	Amsterdam	$140,85
Europe	Portugal	Leixoes	$7,95
Europe	Portugal	Lisbon	$139,22
South Africa	Brazil	Itajai	$237,60
South Africa	Brazil	Rio de Janeiro	$175,00
West Africa	Angola	Cabinda	$192,28
West Africa	Angola	Lobito	$192,28
West Africa	Angola	Luanda	$95,00
West Africa	Angola	Namibe	$192,28
West Africa	Angola	Soyo	$192,28
West Africa	Cameroon	Douala	$66,69
West Africa	Congo	Pointe Noire	$168,04
West Africa	DR of the Congo	Boma	$195,50
West Africa	DR of the Congo	Matadi	$201,50
West Africa	Gabon	Libreville	$148,03
West Africa	Ghana	Tema	$109,25
West Africa	Ivory Coast	Abidjan	$86,88
West Africa	Ivory Coast	San Pedro	$86,88
West Africa	Liberia	Monrovia	$216,40
West Africa	Nigeria	Lagos	$160,00
West Africa	Sierra Leone	Free town	$208,67
Asia	Asia	Asia	$115,70
Asia	Asia	Xiamen	$115,70
Asia	Asia	Shekou	$115,70
Europe	Europe	Europe	$103,98
Europe	Europe	Le Havre	$103,98
South America	South America	South America	$206,30
South America	South America	Buenos Aires	$206,30
South America	South America	São Francisco do Sul	$206,30
South America	South America	Santos	$206,30
West Africa	West Africa	West Africa	$157,00
West Africa	West Africa	Durban	$157,00
West Africa	West Africa	Cape Town	$157,00
West Africa	West Africa	Lomé	$157,00
West Africa	West Africa	Cotonou	$157,00

Source: Stevedoring contracts (2010-2012)

M.3.4 Lump sum

Table 171: Lump sum port costs per call

Port	Description	Amount
Namibe	Stevedoring	$1.500
Lobito	Stevedoring	$3.500
Luanda	Stevedoring	$7.500
Luanda	Commission vessels from South America	$6.000
Luanda	Commission vessels from Europe	$20.000
Luanda	Commission vessels from West Africa	$6.000
Luanda	Commission vessels from Europe	$6.000

Source: SNACS historical data (2008 and 2009)

M.4 Container costs

The container costs consist of the costs for owned containers, costs for long-term hire, short-term hire, cleaning, reparation, and replacement.

Containers that are shipper's owned are excluded from these container costs because the shipper pays for the costs himself. Per trade and trade lane, the distribution of not shipper's owned and shipper's owned containers are determined. This distribution and the amount of data sets on which these data are based can be found in Table 172.

Table 172: Shipper's owned and not shipper's owned container distribution over the trades and trade lanes.

	Not shipper's owned		Shipper's owned	
Trade + Trade Lane	Percentage	Quantity	Percentage	Quantity
Asia - West Africa, East Bound	99,17%	5.154	0,83%	43
Asia - West Africa, West Bound	96,83%	46.639	3,17%	1.525
Europe - West Africa, North Bound	95,50%	2.443	4,50%	115
Europe - West Africa, South Bound	96,45%	42.142	3,55%	1.550
South America - West Africa, East Bound	98,07%	11.002	1,93%	216
Inter West Africa	96,18%	39.364	3,82%	1.565

Source: NileDutch's Container Management Control database, data from 01/01/2007 to 31/12/2011

M.4.1 Average costs owned container

The costs for an owned container are provided by finance and accountancy department. These costs are on average €0,86 per day per TEU based values of the containers purchased in 2012 and 2013.

M.4.2 Average weighted long-term and short-term container lease price per TEU per day

Long-term container lease means leasing a container for one year or more. The calculations of the average long-term lease price for one TEU per day are based on the NileDutch's long-term on hire lease contracts as per 01/08/2012 and NileDutch's Container Stats 01/08/2012. The calculations are only done by the use of two types of contracts, the master lease contracts and the lease purchase contracts. The difference between the two is that in a master lease contract the amount of containers can be delivered according to the need and in the lease purchase contracts the amount of leased containers is already indicated in the contract. To obtain an indication of the amount of containers that are leased per container type with a master lease contract the amount of containers are used from NileDutch's Container Stats List (01/08/2012), which represents the total NileDutch container fleet. In the list the amount of containers per container, type and contract are specified. Contracts with incomplete data are excluded from the calculations of the average weighted long-term container lease price per TEU.

The calculation is done by multiplying the amount of containers per container type by their corresponding container lease price per day. These amounts per container type are counted up and this total is divided by the total amount of TEU. The outcome is an average weighted long-term container lease price per TEU per day is $1.23.

Short-term container lease means leasing containers for less than one year. The calculations of the average weighted short-term container lease price per TEU are based on NileDutch's short-term lease contracts as per 04/06/2012 and NileDutch's container stats 04/06/2012. To obtain an indication of the amount of containers that are leased per container type with these short-term contracts, the total amount of containers per company are used from the NileDutch container stats list (04/06/2012) which represents the total NileDutch container fleet. These amounts represent containers that are long-term and short-term leased. The reason why also the long-term leased container are included in the calculation is to obtain an average weighted short-term container lease price which includes the distribution of all leased container over the container types.

The calculation is done by multiplying the amount of containers per container type by their corresponding container lease price. These amounts are counted up per container type and this total is divided by the total amount of TEUs. The outcome is an average weighted short-term container lease price per TEU per day of $1.11. The overview of the used data and the outcome of the calculation can be found later on in the text.

When comparing the average weighted long-term container lease price per TEU ($1.23) to the average weighted short-term container lease price per TEU ($1.11) one would expect the short-term price to be higher than the long-term price. The calculation shows differently. According to NileDutch's container department, this is explained by the fact that a lot of their long-term container lease contracts involve new containers. The long-term lease of new containers is more expensive than older containers.

M.4.3 Container handling charge per TEU

The average container handling charges per TEU for the in and out handlings when a container is leased or brought back, vary per container supplier. For a container owned by NileDutch these rates also apply, as the containers are stocked at the same companies where they lease the containers.

The average container handling charge is based on the hire contracts (01/08/2012) and NileDutch's container fleet obtained from NileDutch Container Stats, 01/08/2012. The average value to handle in a TEU is $55 and for handling out a TEU is $58.

M.4.4 Average depot costs per TEU per day

The depot costs for the storage of a full or empty container vary per depot place. To calculate the average depot costs per region NileDutch's contracts with depots (19/07/2013) are consulted.

As some contracts use other currencies than the USD or Euro these tariffs are converted to USD or Euro by the use of exchange rates obtained from Oanda (09/11/2013):

EUR - USD	1,32565	SGD - USD	0,78799
USD - EUR	0,75427	THB - USD	0,03108
BRL - USD	0,43844	SEK - EUR	0,11506

Next per region, the average tariffs are calculated per region. In case a locations uses one or two tariff periods and another location within this region used three tariff periods the three tariff periods will be used and the average value of the rates, which apply to this tariff period, is calculated. The results of this calculation can be found in Table 173.

Table 173: Depot tariffs per region for the storage of TEUs

Region	Tariff 1 ($ or € /TEU/day)	Tariff 1 ($ or € /TEU/day)	Tariff 1 ($ or € /TEU/day)
Asia	0 - 3 days	3 -30 days	>30 days
	$0,00	$0,34	$0,50
Europe	0 - 14 days	15 -31 days	>31 days
	€ 0,00	€ 0,83	€ 1,88
South America	0 - 90 days	>90 days	
	$0,00	$0,11	/
West Africa	0 - 15 days	16 - 30 days	> 30 days
	$1,17	$2,93	$6,76
	€ 0,88	€ 2,21	€ 4,76

Source: NileDutch's depot contracts (19/07/2013)

M.4.5 Average costs for cleaning containers

When a container is returned back to NileDutch, it takes one day to clean a container before it re-enters the container fleet. The average cleaning costs for a TEU are $24,95. NileDutch's cleaning standards involves sweeping, washing, steaming, and chemical cleaning of the container. If a customer wants the container to be extra cleaned on top of NileDutch's standards, he can chose to have the container foodstuff, malt, or top malt cleaned.

Foodstuff cleaned means that the container does not contain any smells from the previous cargo that was in the container. It is however accepted to have rust on the floor and walls. When a container is malt cleaned this means that odours are eliminated and the floor is free of rust. The last type of cleaning, the top malt cleaning involves a container without odours and rust free on the inside.

This additional cleaning on top of the NileDutch standard cleaning costs the customer extra money. These costs will however not be included in the computer model as there is no information available about how many containers are upgraded to these states of cleanness. The costs for these additional cleaning is also very small so the impact on the costs calculation of the containers in the computer model is so small they are negligible.

M.4.6 Damaged containers

During transportation and container handling, a container can be damaged or get total loss. A function will be assigned in the computer model to the transported containers to indicate the damaged and total loss containers. No data has been collected by NileDutch regarding this subject. However, the Container Control Department provided some information. According to their experience, about 75% of the containers are damaged after a round trip. These containers re-enter the fleet after three and a half days on average. These three and a half days represent two and a half days of repairing and one day of cleaning. About 65 containers a year get total loss. These containers leave the container fleet permanently. The distribution of container loss of these 65 containers per year in percentages over the different regions is as follows: 10% in South America, 5 % in South Africa, 10% in East Asia, 0% in China, 70% in West Africa, and 5% in Europe. The loss of a container will happen randomly during the year. When this happens, it will be distributed in proportion to percentages of occurrence in each region and over the ports of that region.

M.4.7 Average replacement value rented container

In case a container gets total loss or gets lost NileDutch needs to pay a replacements value to the rental company in case the container is rented. The on hire contracts (01/08/2012) for container lease explain how the replacement value of a container is determined. The original value of a new container is named casualty value. A contract states the percentage of the casualty value that needs to be paid minimally. However, the replacement value can be higher. The first year the containers replacement value is equal to the casualty value. Each year the container ages the replacement value goes down by the depreciation rate. As it is a linear deprecation, each year de depreciated casualty value will be the same. Based on the average age of each container type in the rented container fleet from NileDutch's Container management Control database (15/11/2012) and the on hire container contract (01/08/2012) the average replacement value used in the computer model is calculated. The results per container type can be found in Table 174.

Table 174: Average replacement values rented containers per container type

Container type	Average replacement value
20DC	$1.790
40DC	$1.904
40HC	$3.564
20RF	$11.632
40RF	$13.400
40HR	$15.065
20OT	$1.975
40OT	$3.182
20FR	$2.565
40FR	$3.869

Source: NileDutch's on hire contracts, 01/08/2012, Container

M.5 Commission on cargo costs

Table 175: Commission percentages per trade on Net freight

Trade	Percentage
Asia - West Africa	3,50%
Europe - West Africa	4,00%
South America - West Africa	4,00%
Inter Africa	5,10%

Source: NileDutch's calculations department (2012)

M.6 General expenses

In the voyage calculations general expenses need to be calculated. Per voyage the share of general expenses from the total general expenses of NileDutch. Namely 14 million dollar. Is equal to the share of transported TEUs in that voyage from the total annual transported TEUs So if during a voyage 5% of the yearly transported TEUs are transported. The general expenses for that voyage are 5% of 14 million dollars. So $ 700.000.

Appendix N : Data required for the calculation of time of a container vessel’s voyage

To calculate the turnaround time of a container vessel’s voyage the time of the transits between each port in the vessel’s turnaround schedule, the average congestion time per port, the time required for loading and discharging container needs, and the bunker time required for offshore bunkering needs to be summated. To calculate the transit times between the ports in the turnaround schedules one needs to distinguish three different sailing conditions. The sea passage time, which is the period when the container vessels sails at service speed, form the beginning of sea passage until the end of sea passage, the average transition time to go from service speed to manoeuvring speed from. This takes place between the end of sea passage until the beginning of manoeuvring, and the average manoeuvring time which is from the beginning of manoeuvring until the container vessels is berthed. In the computer model, the vessel’s service speed is kept variable. It will be manually adjusted until all the container vessels in their container liner service have a weekly sailing.

N.1 Sea passage time

To calculate the time period when the container vessels sail at service speed, the distances between the ports in the turnaround schedule is required.

The distances between the ports in the turnaround schedule are obtained by the program Netpas Distance 3.2. Per scenario, the distances are as follows:

Scenario 1 & 2

Table 176: Distance between the ports of the FEWA container liner service

Port	Distance (miles)
Xingang - Tianjin	
Qingdao	441
Shanghai	375
Ningbo	139
Shekou	901
Singapore	1.420
Durban	4.894
Cape Town	8.100
Pointe Noire	1.818
Luanda	260
Lobito	246
Namibe	210
Cape Town	1.212
Durban	810
Singapore	4.894
Xingang - Tianjin	2.760

Table 177: Distance between the ports of the SWAX container liner service

Port	Distance (miles)
Shanghai	
Ningbo	139
Shekou	901
Singapore	1.426
Durban	4.894
Lomé	3.374
Tema	92
Lagos	216
Cotonou	67
Durban	3.362
Singapore	4.894
Shanghai	2.199

Table 178: Distance between the ports of the WEWA container liner service

Port	Distance (miles)
Antwerp	
Le Havre	240
Leixoes	722
Lisbon	176
Tema	2.900
Pointe Noire	946
Luanda	260
Lobito	246
Namibe	210
Antwerp	5.101

Table 179: Distance between the ports of the ECSA container liner service

Port	Distance (miles)
Buenos Aires	
São Francisco do Sul	846
Santos	191
Rio de Janeiro	216
Pointe Noire	3.369
Luanda	260
Buenos Aires	4.213

Table 180: Distance between the ports of the WAF1 container liner service

Port	Distance (miles)
Pointe Noire	
Libreville	419
Douala	234
Pointe Noire	622

Source: Netpas Distance (02/09/2013)

Table 181: Distance between the ports of the WAF2 container liner service

Port	Distance (miles)
Pointe Noire	
Cabinda	55
Boma	91
matadi	30
Soyo	74
Pointe Noire	92

Scenario 3

Table 182: Distance between the ports of the FEWA container liner service

Port	Distance (miles)
Xingang - Tianjin	
Qingdao	441
Shanghai	375
Ningbo	139
Xiamen	607
Shekou	327
Singapore	1.420
Durban	4.894
Cape Town	8.100
Pointe Noire	1.818
Luanda	260
Lobito	246
Namibe	210
Cape Town	1.212
Durban	810
Singapore	4.894
Xingang - Tianjin	2.760

Table 183: Distance between the ports of the SWAX container liner service

Port	Distance (miles)
Shanghai	
Ningbo	139
Shekou	901
Singapore	1.426
Durban	4.894
Lomé	3.374
Tema	92
Lagos	216
Cotonou	67
Durban	3.362
Singapore	4.894
Shanghai	2.199

Table 184: Distance between the ports of the WEWA container liner service

Port	Distance (miles)
Antwerp	
Le Havre	240
Leixoes	722
Lisbon	176
Abidjan	2.659
Tema	267
Pointe Noire	946
Luanda	260
Lobito	246
Namibe	210
Antwerp	5.101

Table 185: Distance between the ports of the ECSA container liner service

Port	Distance (miles)
Buenos Aires	
São Francisco do Sul	846
Santos	191
Rio de Janeiro	216
Pointe Noire	3.369
Luanda	260
Buenos Aires	4.213

Table 186: Distance between the ports of the WAF1 container liner service

Port	Distance (miles)
Pointe Noire	
Libreville	419
Douala	234
Pointe Noire	622

Table 187: Distance between the ports of the WAF2 container liner service

Port	Distance (miles)
Pointe Noire	
Cabinda	55
Boma	91
matadi	30
Soyo	74
Pointe Noire	92

Scenario 4

Table 188: Distance between the ports of the SWAX container liner service

Port	Distance (miles)
Shanghai	
Shekou	889
Port kelang	1.621
lagos	7.985
Tema	216
Luanda	1.170
Shanghai	9.284

Table 189: Distance between the ports of the WEWA container liner service

Port	Distance (miles)
Antwerp	
Le Havre	240
Leixoes	722
Lisbon	176
Tema	2.900
Pointe Noire	946
Luanda	260
Lobito	246
Namibe	210
Antwerp	5.101

Table 190: Distance between the ports of the ECSA container liner service

Port	Distance (miles)
Buenos Aires	
São Francisco do Sul	846
Santos	191
Rio de Janeiro	216
Pointe Noire	3.369
Luanda	260
Buenos Aires	4.213

Table 191: Distance between the ports of the WAF1 container liner service

Port	Distance (miles)
Lagos	
Cotonou	67
Tema	157
Lomé	92
Lagos	137

Table 192: Distance between the ports of the WAF2 container liner service

Port	Distance (miles)
Lagos	
Douala	433
Libreville	234
Pointe Noire	419
Lagos	847

Table 193: Distance between the ports of the WAF3 container liner service

Port	Distance (miles)
Luanda	
Soyo	196
Matadi	74
Boma	30
Cabinda	91
Luanda	220

Table 194: Distance between the ports of the WAF4 container liner service

Port	Distance (miles)
Luanda	
Lobito	246
Namibe	210
Cape Town	1.212
Durban	810
Luanda	2.395

N.2 The average transition time to go from service speed to manoeuvring speed

The average transition time to go from service speed to manoeuvring speed is according to NileDutch's Operations department (02/09/2013) 1 hour.

N.3 The average manoeuvring time and speed

The manoeuvring time is the time from end of sea passage until the vessels has come alongside the quay in case there is no congestion in the port. During this period container vessel sail on average 6 knots. Per port, the overview of the manoeuvring time can be seen in Table 195. These manoeuvring times per port and average manoeuvring speed are based on the experience of NileDutch's operations department (02/09/2013).

Table 195: Manoeuvring time per port

Region	Port	Manoeuvering time (hours)	Region	Port	Manoeuvering time (hours)
Asia	Ningbo	1	West Africa	Abidjan	1
	Port kelang	1		Boma	1,5
	Qingdao	2		Cabinda	0,25
	Shanghai	1		Cape Town	1
	Shekou	3		Cotonou	1
	Singapore	1,5		Douala	1
	Xiamen	2		Durban	0,5
	Xingang - Tianjin	1,5		Lagos	2,5
Europe	Antwerp	9		Libreville	2,5
	Le Havre	1,5		Lobito	1
	Leixoes	1		Lomé	1
	Lisbon	2,25		Luanda	1
South America	Buenos Aires	12		Matadi	8
	Rio de Janeiro	1,5		Namibe	1
	Santos	2		Pointe Noire	0,75
	São Fransisco do Sul	2		Soyo	0,5
				Tema	0,25

Source: NileDutch's operations department (02/09/2013)

The port of Boma, Matadi, and Soyo are located upstream on the Conge River. For the Congo River special time frames exists to sail the river. Before sunset and after sundown no vessels can sail upstream on this river.

N.4 Average congestion time

The average congestion time needs to be taken into account in the computer model as congestion may occur in a port and can cause delays in the sailing schedules. This is done by the use of NileDutch's Shipnet Agency Liner System database (01/01/2007 to 31/12/2011). These database gives the time of arrival and the time of berthing per port, per date, and per hour. So per port call in this period the amount of time required between the arrival and the berthing can be calculated. This time also includes the sailing time to get from the arrival place to the berthing place. It is difficult to determine the average congestion time per port as weather conditions, currents, tides, locks, bilges, waiting time for the pilot, daily navigation, busy traffic, manoeuvrability at the berthing place, type of vessel, etc. have an influence on this. Therefore average congestion time per port is the result between the average time between the time of arrival and the time of berthing per port and the minimum time between the time of arrival and the time of berthing per port. The datasets are also checked for unreliable data. With the experience of Hedwig Fransen from NileDutch's operations department data sets, which take longer than approximately two months, are considered incorrect and are therefore not used in the congestion behaviour calculations. Ports with no data sets or data sets less than 100 are considered as unreliable and are replaced by the average congestion time of the region of that port. The results of the average congestion time per port can be seen in Table 196.

Table 196: Average congestion time per port

Region	Place name	Average congestion time (days)	Data sets
Asia	Ningbo[a]	0,89	564
	Port Kelang[a]	0,89	564
	Qingdao[a]	0,89	564
	Shanghai	1,36	123
	Shekou	0,76	132
	Singapore	0,47	165
	Xiamen[a]	0,89	564
	Xingang-Tianjin[a]	0,89	564
Europe	Antwerp	1,03	148
	Le Havre[b]	0,82	975
	Leixoes	0,67	149
	Lisbon	0,69	504
South America	Buenos Aires[c]	1,37	177
	Rio de Janeiro[c]	1,37	177
	Santos[c]	1,37	177
	São Francisco do Sul[c]	1,37	177
West Africa	Abidjan[d]	3,42	2.161
	Boma[d]	3,42	2.161
	Cabinda[d]	3,42	2.161
	Cape Town	0,57	103
	Cotonou[d]	3,42	2.161
	Douala[d]	3,42	2.161
	Durban	1,74	213
	Lagos[d]	3,42	2.161
	Libreville[d]	3,42	2.161
	Lobito	2,21	142
	Lomé[d]	3,42	2.161
	Luanda	7,17	320
	Matadi	3,23	164
	Namibe[d]	3,42	2.161
	Pointe Noire	4,01	590
	Soyo[d]	3,42	2.161
	Tema[d]	3,42	2.161
Asia[e]		**0,89**	**564**
Europe[e]		**0,82**	**975**
South America[e]		**1,37**	**177**
West Africa[e]		**3,42**	**2.161**
Entire market[e]		**2,31**	**3.877**

NileDutch's Shipnet Agency Liner System database (01/01/2007 to 31/12/2011).

a: Congestion data are replaced by Asia data

b: Congestion data are replaces by Europe data

c: Congestion data are replaced by South America data

d: Congestion data are replaced by West Africa data

e: Congestion data based on all port in the database

N.5 Container moves per port and type of gear

The average container moves per port in moves per hour are based on NileDutch's Container Moves database (30/01/2009 to 08/07/2012). Because NileDutch switched to solely container transport in May 2010, the data prior to this date is unreliable as also vehicles were loaded and discharged. Before this date the indicated times also include loading and discharging moves of vehicles next to container moves. Unfortunately, the time required to load and discharge the containers cannot be isolated from the vehicles so only the data ranging from 01/05/2010 until 08/07/2012 is used. The data are sorted per port. Incomplete or incorrect data sets are excludes from the calculations. It is also not possible to look at the differences in time for loading, discharging or restowing as a total amount of time for all these container handling operations is given in a commercial time. More into detail it is not possible to look what the difference in time is for 20 feet containers and 40 feet containers or what the influence is on the location of the container in the ship is on the time. After sorting and filtering the total amount of containers and the total commercial time the calculation of the amount of container moves per port is made possible. This is done by dividing the total amount of containers by the total commercial time. The calculations of several ports are based on data sets that are less than 100 and therefore considered unreliable. Therefore, the list is double-checked by the operational department of NileDutch. They made some adjustment based on their experience. A summary of these figures can be found in Table 197. The operation department is also asked about the type of gears that is used per port to load, discharge, and restow containers. These gears or combinations of gears can also be found in Table 197. Additional calculations are made per region and for the entire market. This to estimate the container moves for the ports of Port Kelang and Xiamen. For the port of Abidjan the advice of the operational department is asked. The container terminal of Abidjan has six gantry cranes and three mobile cranes available. In comparison with other West African ports these gears are more modern and should operate faster in comparison with the gears in other West African port. NileDutch's operation department there for estimates the container moves per hour to be eighteen.

In Europe, container moves do not take place on Sunday's. There needs to be waited until Monday morning 7am to start or continue the container moves. In Buenos Aires, no container moves take place during the weekend. There needs to be waited until Monday morning 7am to start or continue the container moves. In all the other ports used in the computer model container moves can takes place at any time during the day.

Table 197: Results calculation average container moves per hour per port

Region	Port	Amount of datasets	Total commercial hours	Total containers	Average move/hour	Adjustments operations	Average move/hour final	Type of gear
Asia	Ningbo	67	427,82	21.606	50,50		50,50	Gantry cranes
	Qingdao	52	486,98	23.027	47,29		47,29	Gantry cranes
	Shanghai	78	669,88	35.641	53,21		53,21	Gantry cranes
	Shekou	84	797,50	34.721	43,54		43,54	Gantry cranes
	Singapore	109	1.397,88	50.927	36,43		36,43	Gantry cranes
	Xingang-Tianjin	54	482,93	25.294	52,38		52,38	Gantry cranes
Europe	Amsterdam	7	143,33	3.501	24,43		24,43	Gantry cranes
	Antwerp	77	2.751,28	64.370	23,40		23,40	Gantry cranes
	Le Havre	40	356,52	11.474	32,18		32,18	Gantry cranes
	Leixoes	77	1.117,45	35.443	31,72		31,72	Gantry cranes
	Lisbon	85	2.287,60	37.626	16,45		16,45	Gantry cranes
	Rouen	12	237,37	4.682	19,72		19,72	Gantry cranes
South America	Buenos Aires	26	468,70	10.607	22,63		22,63	Gantry cranes
	Paranagua	5	142,70	1.251	8,77		8,77	Ship cranes
	Rio de Janeiro	26	140,12	2.435	17,38		17,38	Gantry cranes
	Rio Grande	3	21,08	709	33,63		33,63	Gantry cranes
	Santos	29	723,02	13.299	18,39		18,39	Ship cranes
	São Francisco do Sul	28	296,03	8.704	29,40		29,40	Gantry cranes
West Africa	Bata	/	/	/	/	5,00	5,00	Ship cranes
	Boma	34	933,58	3.805	4,08		4,08	Ship cranes
	Cabinda	50	6.627,27	14.020	2,12		2,12	Ship cranes
	Cape Town	63	1.166,70	13.321	11,42		11,42	Gantry cranes
	Cotonou	5	65,75	982	14,94		14,94	Ship cranes + mobile cranes
	Douala	38	674,37	12.276	18,20		18,20	Ship cranes or gantry cranes
	Durban	122	4.738,90	36.398	7,68		7,68	Ship cranes + mobile cranes or gantry cranes
	Lagos	16	1.736,18	22.136	12,75		12,75	Ship cranes + mobile cranes
	Libreville	33	732,35	9.560	13,05		13,05	Ship cranes
	Lobito	75	5.155,35	34.007	6,60		6,60	Ship cranes
	Lomé	22	309,83	8.659	27,95		27,95	Ship cranes + mobile cranes
	Luanda	195	21.815,48	210.210	9,64	30,00	30,00	Ship cranes + mobile cranes
	Malabo	/	/	/	/	5,00	5,00	Ship cranes
	Matadi	121	5.476,90	46.962	8,57		8,57	Ship cranes
	Namibe	49	1.936,20	12.442	6,43		6,43	Ship cranes
	Pointe Noire	349	14.092,20	173.897	12,34	25,00	25,00	Ship cranes + mobile cranes
	Soyo	29	659,67	2.416	3,66		3,66	Ship cranes
	Tema	50	954,92	18.318	19,18		19,18	Ship cranes + gantry cranes or ship cranes + mobile cranes
Asia		**444**	**4.262,99**	**191.216**	**44,85**		**44,85**	**Gantry cranes**
Port Kelang		**444**	**4.262,99**	**191.216**	**44,85**		**44,85**	**Gantry cranes / regional average**
Xiamen		**444**	**4.262,99**	**191.216**	**44,85**		**44,85**	**Gantry cranes / regional average**
Europe		**298**	**6.893,55**	**157.096**	**22,79**		**22,79**	**Gantry cranes**
South America		**117**	**1.791,65**	**37.005**	**20,65**		**20,65**	**Gantry cranes or ship cranes**
West Africa		**1.251**	**67.075,65**	**619.409**	**9,23**		**9,23**	**Ship cranes + mobile cranes or gantry cranes**
Abidjan							**18,00**	**6 gantry cranes and 3 mobile cranes / advice operational department**
Entire market		**2.110**	**80.023,84**	**1.004.726**	**12,56**		**12,56**	

Source: NileDutch's Container Moves database, data: from 30/01/2009 to 08/07/2012

N.6 Offshore bunker operations: bunker time & distance sailed

According to NileDutch's operations department (02/09/2013) when a container vessel is taking bunkers offshore, a bunker barge will come and sail alongside the container vessels for the duration of the bunker operations. The container vessel will not divert its course for this but will have a longer transit time, as the bunker time will be added.

During the bunker operation, it will first take about an hour to make preparations before the bunkering can begin. When the bunkering is done it also takes about an hour before finalizing the entire bunker operation. During the duration of the bunker operations, both the container vessels and the bunker barge sail slowly at about 0.5 knots. This to avoid too much roll movement of the vessels. Offshore bunker operations only take place between 6am and 7pm.

According to NileDutch's operation department the speed to bunker a container vessel is 350 tons/hour. When knowing the amount of bunkers required, the bunker time can be determined:

$$T_B = \frac{m_B}{\dot{V}_B} \qquad (71)$$

- T_B : Bunker time $[h]$
- m_B : Mass of bunkers $[tons]$
- $\dot{V}_B$: Volume flow bunkers $\left[\frac{tons}{h}\right]$

When knowing the vessel's speed during bunker operations and the time required to do so, the distance sailed during bunker operations can be calculated as follows:

$$d_B = v_{s_B} \cdot T_B \qquad (72)$$

- d_B : Distance sailed during bunker operations $[mile]$
- v_{s_B} : Vessel speed during bunker operations $[knots]$
- T_B : Bunker time $[h]$

Appendix O : Data required for the time calculation of the total time a TEU is at the disposal of the shipper

The average time required to stuff a container varies per port and per customer. To determine the average stuffing time per port calculations are carried out and are based on NileDutch's Container Management Control database (01/01/2007 to 31/12/2011). Only the registered gate out empty (GOE), gate in full (GIF), and NileDutch owned containers are selected. The difference between the GOE and GIF time of a container gives the time required to pick up, stuff, and bring back a container. Because shipper's owned containers do not have a registered gate out empty time, the determination of the stuffing behaviour of the customers is done by NileDutch's container fleet. Next these containers are sorted per date and per container number so the calculation to determine the time to pick up, stuff, and bring back a container was made possible and incomplete data could be filtered out. Ports with no data sets or data sets less than 100 are considered unreliable and are replaced by the average stuffing time of all ports in that region or the average stuffing time from all port in the database, so the entire market.

The average time required to pick up, strip, and bring back a container to the quay varies per port and per customer. Data from 01/01/2007 to 31/12/2011 from NileDutch's Container Management Control database are used to obtain the average stripping time. Only the registered discharged full (DIF), gate in empty (GIE), and NileDutch owned containers are selected. Containers for which it takes longer than four years are therefore excluded from the calculations. Because shipper's owned containers do not have a registered gate out empty time, the determination of the average stripping time is done based on NileDutch's container fleet movements only. The data are grouped per container number and ranked per date. This way the successive container movements per container were obtained. Only valid data sets were used. One data set consists of a container, which has successively the DIF, GOF, and GIE container movements. When one or more of these movements are missing in a data set, the dataset is not used in the calculations to determine the average stripping time. Ports with no data sets or data sets less than 100 are considered unreliable and are replaced by the average stripping time of all ports in that region or the average stripping time from all port in the database, so the entire market.

An overview of the average stuffing and stripping times per port can be seen in Table 198. The table also indicates the amount of data sets on which the calculations are based and if the data for a port is replaced by data of the region or entire market in case the datasets of the port were missing of less than 100.

When knowing the average stuffing time per port, the average stripping time per port and the costs for long-term and short-term lease of a TEU, the costs per leased container can be calculated during their stuffing and stripping period. The results of this calculation per port can also be found in Table 198.

Table 198: Average stuffing and stripping times per port and costs per day for long-term and short-term container lease

Region	Port	Amount of datasets stuffing	Average stuffing time (days)	Costs long term leased TEU ($)	Costs short term leased TEU ($)	Amount of datasets stripping	Average stripping time (days)	Costs long term leased TEU ($)	Costs short term leased TEU ($)
Asia	Ningbo[b]	5.414	1,89	$2,32	$2,10	5.101	13,34	$16,41	$14,81
	Port Kelang	1.759	3,59	$4,42	$3,98	653	8,31	$10,22	$9,23
	Qingdao	5.530	6,17	$7,59	$6,85	158	12,09	$14,87	$13,42
	Shanghai	6.259	5,36	$6,60	$5,95	871	10,58	$13,01	$11,74
	Shekou[b]	2.903	1,89	$2,33	$2,10	5.101	13,34	$16,41	$14,81
	Singapore	837	7,01	$8,62	$7,78	317	14,19	$17,45	$15,75
	Xiamen[b]	346	1,89	$2,32	$2,10	5.101	13,34	$16,41	$14,81
	Xingang - Tianjin	5.238	6,55	$8,06	$7,27	1.096	17,89	$22,00	$19,86
Europe	Antwerp	12.966	7,36	$9,06	$8,17	375	16,47	$20,26	$18,28
	Le Havre	1.837	10,68	$13,14	$11,86	177	17,49	$21,51	$19,41
	Leixoes[c]	8.566	1,84	$2,27	$2,05	1.765	12,46	$15,32	$13,83
	Lisbon[c]	8.786	2,88	$3,55	$3,20	1.765	12,46	$15,32	$13,83
South America	Buenos Aires[d]	4.317	6,32	$7,77	$7,01	87.512	26,00	$31,98	$28,86
	Rio de Janeiro[d]	185	10,71	$13,18	$11,89	87.512	26,00	$31,98	$28,86
	Santos[d]	3.272	16,26	$20,00	$18,05	87.512	26,00	$31,98	$28,86
	São Fransisco do Sul[d]	2.684	6,87	$8,45	$7,63	87.512	26,00	$31,98	$28,86
West Africa	Abidjan[a/e]	13.782	8,06	$9,91	$8,95	80.644	27,09	$33,33	$30,07
	Boma[a]	13.782	8,06	$9,91	$8,95	972	77,58	$95,42	$86,11
	Cabinda[a]	13.782	8,06	$9,91	$8,95	2.988	24,53	$30,18	$27,23
	Cape Town	2.401	2,46	$3,02	$2,73	645	3,70	$4,55	$4,10
	Cotonou[a]	13.782	8,06	$9,91	$8,95	423	33,88	$41,68	$37,61
	Douala	1.325	23,57	$28,99	$26,16	1.474	29,42	$36,19	$32,66
	Durban	6.178	6,23	$7,66	$6,91	4.360	6,40	$7,87	$7,10
	Lagos	526	3,52	$4,33	$3,91	5.051	28,41	$34,94	$31,53
	Libreville[a]	13.782	8,06	$9,91	$8,95	1.720	32,51	$39,99	$36,09
	Lobito[a]	13.782	8,06	$9,91	$8,95	4.702	22,27	$27,39	$24,72
	Lomé	277	3,59	$4,41	$3,98	2.603	44,96	$55,29	$49,90
	Luanda[a]	13.782	8,06	$9,91	$8,95	38.709	23,97	$29,48	$26,61
	Matadi[a/e]	13.782	8,06	$9,91	$8,95	10.208	40,17	$49,41	$44,59
	Namibe[a]	13.782	8,06	$9,91	$8,95	919	27,25	$33,52	$30,25
	Pointe Noire	384	12,34	$15,18	$13,70	3.421	32,22	$39,63	$35,76
	Soyo[a/e]	13.782	8,06	$9,91	$8,95	80.644	27,09	$33,33	$30,07
	Tema	2.603	10,12	$12,45	$11,23	2.394	21,95	$27,00	$24,36
Asia[f]		**41.333**	**4,20**	**$5,16**	**$4,66**	**5.101**	**13,34**	**$16,41**	**$14,81**
Europe[f]		**35.034**	**4,80**	**$5,91**	**$5,33**	**1.765**	**12,46**	**$15,32**	**$13,83**
South America[f]		**10.466**	**9,64**	**$11,86**	**$10,71**	**2**	**16,00**	**$19,68**	**$17,76**
West Africa[f]		**13.782**	**8,06**	**$9,91**	**$8,95**	**80.644**	**27,09**	**$33,33**	**$30,07**
Entire market[f]		**100.615**	**5,50**	**$6,77**	**$6,11**	**87.512**	**26,00**	**$31,98**	**$28,86**

Source: NileDutch's Container Management Control database, (01/01/2007 to 31/12/2011)

a: Stuffing data are replaced by West Africa data

b: Stripping data are replaces by Asia data

c: Stripping data are replaced by Europe data

d: Stripping data are replaced by South America data

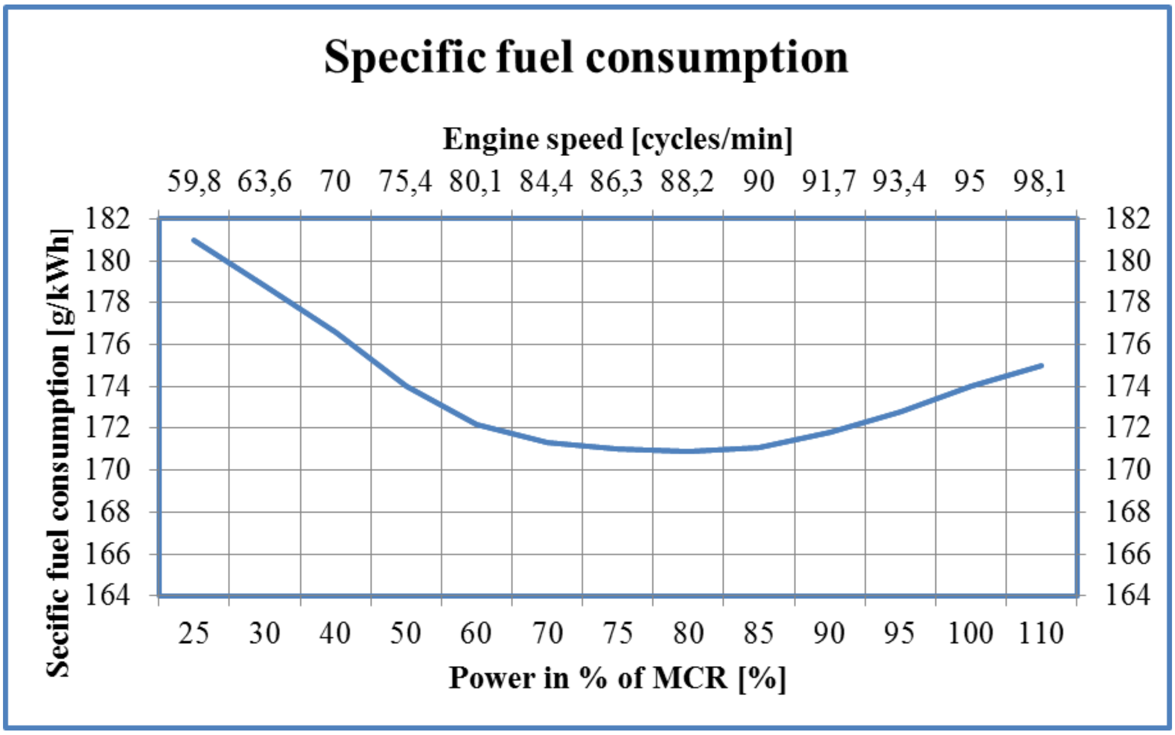
e: Stripping data are replaced by West Africa data

f: Stripping data based on all port in the database

Appendix P : Specific fuel consumption

The specific fuel consumption (sfc) is a variable, which changes together with the engine speed. The sfc is a measure how efficiently an engine is using the fuel supplied to produce work. Figure 261 Shows this behaviour.

Figure 261: Specific Fuel Consumption



Source: Wärtsilä netGTD, selected engine: Wärtsilä 7RTA68-D Tier II, MCR Power: 21.910 kW,

MCR Speed: 95 rpm, Fresh water cooled / single-stage SAC / separate HT - 1 x ABB TPL85B15 / 1xSAC237

To explain the shape of the specific fuel consumption graph the process that takes place into the cylinder of a turbocharged diesel engine should be explained. The chemical process that takes place during the combustion process and an example of the required oxygen to combust one kg of marine diesel oil (MDO) is given in Klein Woud and Stapersma (2003:206):

In the combustion of one kg of MDO the next assumptions are made:

Composition of, 85% *Carbon* (C), 13% *Hydrogen* (H), 1% *Sulfur* (S), and 1% of other components.

Complete combustion

The quantity of *Dioxide* (O_2) in air varies but is fixed at 0.23kg for one kg of air.

The process equations of C, H, and S looks as follows:

$$C + O_2 \Rightarrow CO_2 \qquad (73)$$

$$2H_2 + O_2 \Rightarrow 2H_2O \qquad (74)$$

$$S + O_2 \Rightarrow SO_2$$ 75

The relative atomic masses A_r of C, H, O, and S are as follows according to the International Union of Pure and Applied Chemistry (IUPAC)(2012):

$$A_r(C) = 12,00 = 12\frac{kg}{mol}$$

$$A_r(H) = 1.007 = 1\frac{kg}{mol}$$

$$A_r(O) = 15.99 = 16\frac{kg}{mol}$$

$$A_r(S) = 32.05 = 32\frac{kg}{mol}$$

The molecular mass (M) of C, H_2, O, O_2, and S molecules are calculated as follows:

$$M(Z) = \sum(A(X)) \cdot A_r(X)$$ 76

$M(X)$:	Molecular mass of molecule Z
$\sum(A(X))$:	Sum of the atoms of element X in a molecule
$A_r(X)$:	Relative atomic mass of element X

$$M(C) = 1 \cdot 12 = 12\frac{kg}{mol}$$

$$M(H_2) = 2 \cdot 1 = 2\frac{kg}{mol}$$

$$M(O) = 1 \cdot 16 = 16\frac{kg}{mol}$$

$$M(O_2) = 2 \cdot 16 = 32\frac{kg}{mol}$$

$$M(S) = 1 \cdot 31 = 32\frac{kg}{mol}$$

The mass of O_2 required to get complete combustion with one kg of MDO can be calculated as follows:

$$m(O_2) = \%(C) \cdot \frac{M(O_2)}{M(C)} + \%(H) \cdot \frac{M(O)}{M(H_2)} + \%(S) \cdot \frac{M(O_2)}{M(S)}$$ 77

m: Mass $[kg]$

$M(X)$: Molecular mass of element X $\left[\frac{kg}{mol}\right]$

$\%(X)$: Percentage of element X in the total amount $[-]$

$$m(O_2) = 0.85 \cdot \frac{32}{12} + 0.13 \cdot \frac{16}{2} + 0.01 \cdot \frac{32}{32}$$
$$m(O_2) = 3.32kg$$

The amount of air required to get complete combustions with one kg of MDO (the stoichiometric air-fuel ratio: σ) can be calculated as follows:

$$\sigma = \frac{m(O_2)}{0.23} = \frac{3.32}{0.23} \cong 14.5 \frac{kg\ air}{kg\ \text{MDO}}$$ 78

Therefore, there is 14.5 times more air required than MDO to get complete combustion. This makes the turbocharger very important in the combustions process as it increases the amount of oxygen in the combustion chamber. A single stage turbocharger is described by Klein Woud and Stapersma (2003:134). It consists of a compressor, an intercooler, a turbine, and a shaft as shown in Figure 262. The compressor is connected to the turbine by a shaft as shown in

Figure 263. The turbine is driven by the exhaust gasses of the engine. When the turbine wheel starts to turn, the shaft will make the compressor wheel turn and ambient air will be compressed. This way the ambient air is compressed to a higher density and higher pressure. Next, the compressed air goes to the intercooler where it will reach a higher density because it is cooled down.

Figure 262: Single stage turbocharger

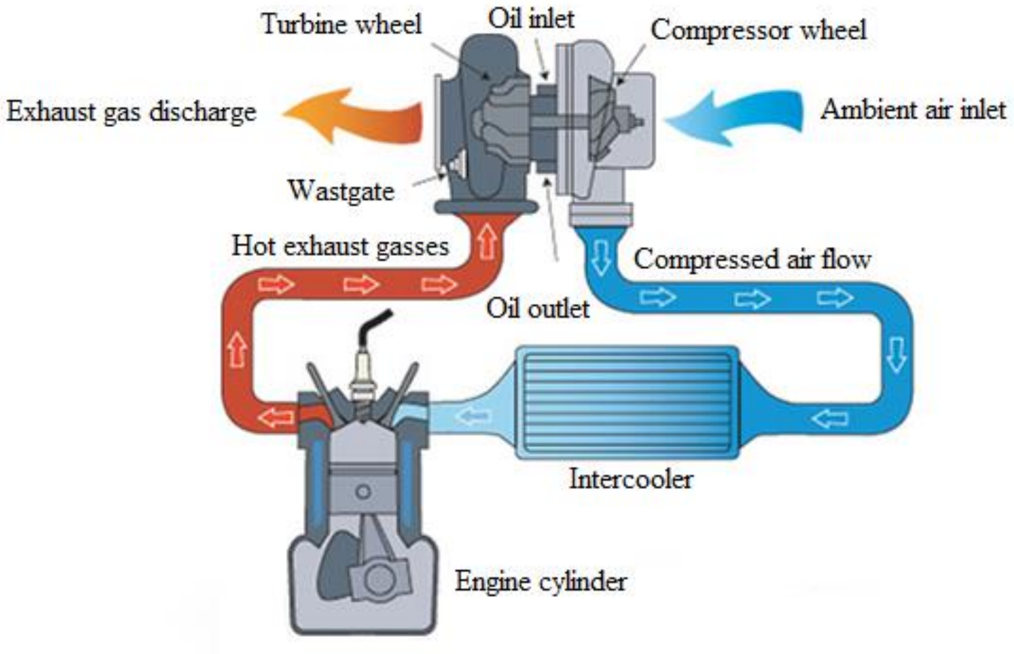
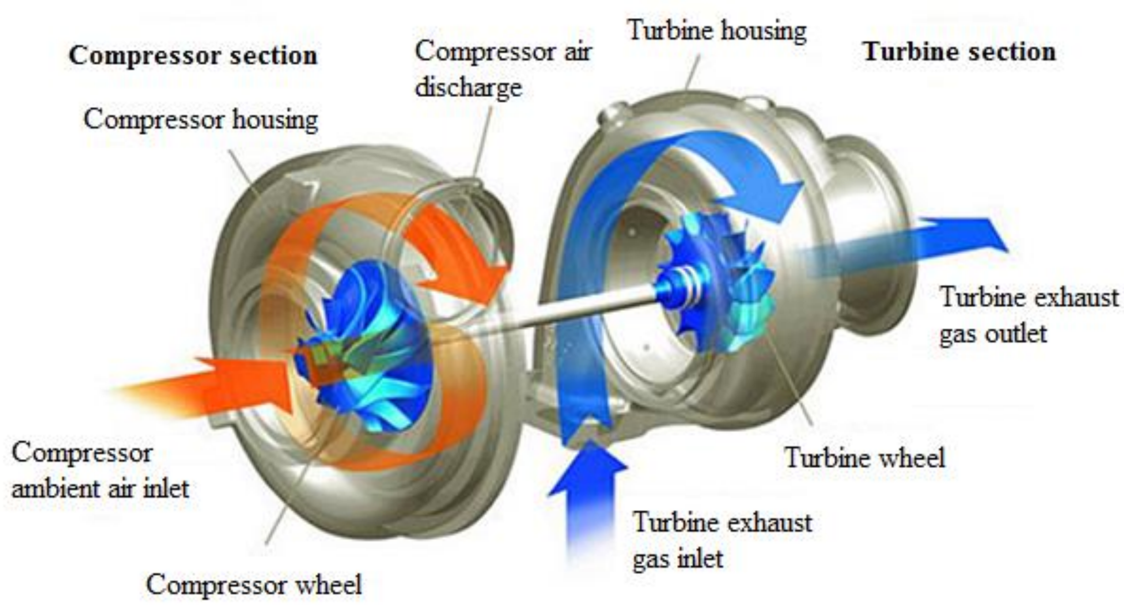
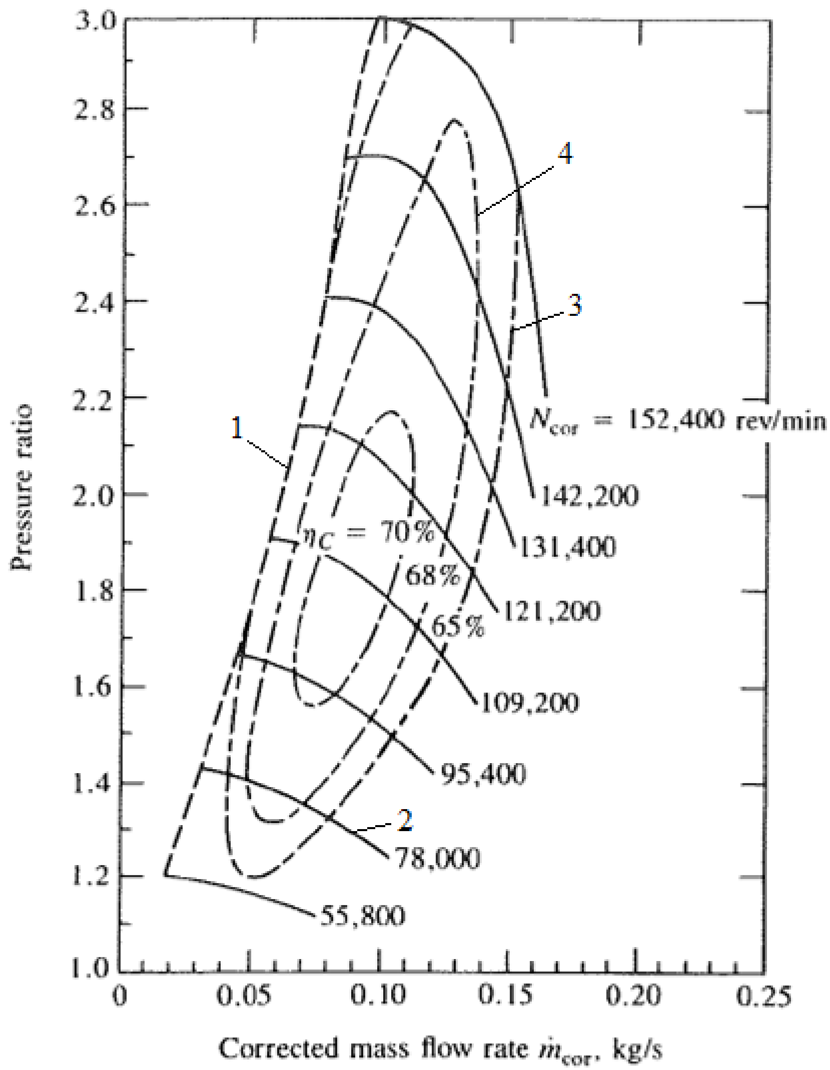


Figure 263: The compressor and turbine of a turbocharger



The next step in understanding the shape of the specific fuel consumption is to look at the compressor performance map as can be seen in Figure 264. The compressor performance map is described in Heywood (1988:261-262). At the left side of the surge line the flow in the boundary layers of the compressor are reversed. Moving further away from the surged line to the left the complete flow is reversed and causes a drop in the pressure. This relieves the adverse pressure gradient and by consequence, the flow re-establishes itself. However, the process keeps on repeating itself. At the choke line in the compressor operating map the velocity of the mass flow rate ($\dot{m}$) reaches the speed of sound in the compressor housing. When the sonic speed is achieved, the compressor has reached its limit. Extra mass flow can now only be reached by increasing the speed of the turbocharger, so you move up higher in the compressor operating map. The higher the polytrophic compressor efficiency (η_c) the higher the density of air in the cylinders, the more complete the combustion so the lower the sfc value.

Figure 264: Centrifugal compressor performance map.



Source: Heywood. (1988). International Combustion Engine Fundamentals

1 Surge line

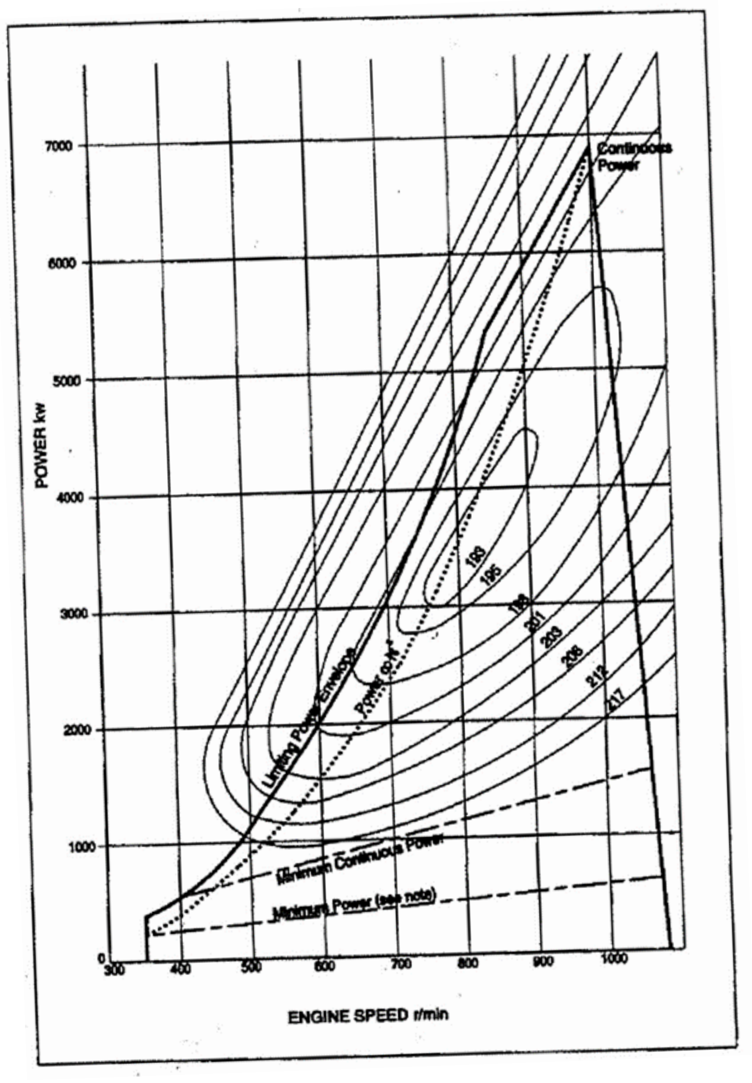
3 Choke line

2 Line of constant turbocharger speed

4 Efficiency curve

The compressor in the turbocharger is tuned for the engine. The compressor will be in the highest efficiency curve or will be near the highest efficiency curve at the engine speed, which is used most often during the operational profile. Because higher η_c values result in lower sfc values, the curves of sfc can be plotted in the operating envelope curve of an engine. See Figure 265 found in Frouws et al (2000:166). In the figure the sfc curve intersects the limiting power envelope line more often at lower engine speeds than in the higher regions of the engines speed. This explains why the slope of the sfc curve in figure 1 is steeper on the left side than on the right side.

Figure 265: Power/speed characteristics of a highly turbocharged diesel engine showing limit curve and lines of constant specific fuel consumption.



Source: Frouws et al (2000:166)

Appendix Q : Average full and empty TEU weights per trade and trade lane

Q.1 Full TEU weights

The average full TEU weights per TEU for each trade and trade lane combination are obtained of the NileDutch Container Management Control database (01/01/2007 to 31/12/2011). The database contains the weight of each booking. The database consists of 618.913 TEUs represented in 150.064 bookings. These TEUs are transported on the next trades and trade lanes: Asia - West Africa, East bound, Asia - West Africa, West bound, East Africa - Asia, East bound, Europe - West Africa, North bound, Europe - West Africa, South bound, Inter Asia, Inter Europe, Inter West Africa, the Mediterranean - West Africa, South bound, North America - West Africa, South bound, South America - West Africa, East bound, and South America - West Africa, West bound. As the computer model only needs data about the Asia - West Africa, East bound, Asia - West Africa, West bound, Europe - West Africa, North bound, Europe - West Africa, South bound, Inter West Africa, South America - West Africa, East bound, and South America - West Africa, West bound. The data are filtered for these trades. After filtering 615.5581 TEU are left for 149.665 bookings. So 3.332 TEU for 399 bookings are excluded. Next bookings with registered container weights of 0kg are excluded from the calculations. After excluding these datasets 614.754 TEU are left which are represented in 149.339 bookings, so 827 TEU represented in 326 bookings is extra excluded from calculations. Because these container weights cannot exceed the maximum gross weights and/or be lower than the tare weights per container type, these boundaries need to be connected to the data and abnormalities need to be filtered out of the database. 30 different container types are distinguished in the remaining database. However NileDutch's container department could not provide these boundaries per container type. CMA CGM (01/08/2012) does provide these boundaries for fourteen container types. These values can be found in Table 199.

Table 199: Max. Gross weight, Tare weight and max. Net weight per container type

		Weight (kg)		
Container type	Abbreviation	Max. gross weight	Tare weight	Max. net weight
20 ft dry cargo	20DC	30.480	2.230	28.250
40 ft dry cargo	40DC	30.480	3.740	26.740
40 ft high cube	40HC	30.480	3.900	26.580
45 ft high cube	45HC	30.480	4.700	25.780
20 ft reefer	20RF	30.480	3.010	27.470
40 ft high cube reefer	40HR	34.000	4.700	29.300
20 ft open top	20OT	30.480	2.200	28.280
40 ft open top	40OT	30.480	3.880	26.600
20 ft flat rack folding ends	20FF	34.000	2.750	31.250
40 ft flat rack folding ends	40FF	50.000	5.100	44.900
20 ft flat rack fixed ends	20FR	34.000	2.750	31.250
40 ft flat rack fixed ends	40FR	50.000	5.100	44.900
20ft platform	20PF	24.000	1.890	22.110
40ft platform	40PF	45.000	4.400	40.600

Source: CMA CGM (01/08/12)

These fourteen container types do however represent the gross majority of the containers in the database namely 587.888 TEU represented in 146.801 bookings. So 26.866 TEU represented in 2.538 bookings are further excluded from calculations. After connecting these boundaries to their respective container types and filtering for abnormalities 567.381 TEU represented in 143.098 bookings are left on which the average weight per TEU per trade and trade lane will be based. Filtering for abnormalities excluded an additional 20.507 TEU represented in 3.703 bookings. So 51.532 TEU represented in 6.966 bookings are in total excluded from calculations. With these database the average weight per TEU for full containers on each trade and trade lane could be calculated. The results can be seen in Table 200.

Table 200: Average full TEU weights per trade and trade lane

	2007		2008		2009		2010		2011		2007 - 2011	
Trade + trade lane	Avg. Weight (t/TEU)	# TEU	Avg. Weight (t/TEU)	# TEU	Avg. Weight (t/TEU)	# TEU	Avg. Weight (t/TEU)	# TEU	Avg. Weight (t/TEU)	# TEU	Avg. Weight (t/TEU)	# TEU
Asia - West Africa, East bound	6,9	1.557	14,2	813	26,0	3.081	18,7	6.779	18,3	5.433	18,6	17.663
Asia - West Africa, West bound	13,6	18.289	13,4	30.784	14,7	40.046	14,9	58.391	15,2	58.371	14,6	205.881
Europe - West Africa, North bound	17,9	4.128	17,2	4.000	17,2	4.597	17,0	4.796	17,0	2.779	17,3	20.300
Europe - West Africa, South bound	15,7	35.516	15,1	42.557	15,2	45.407	15,2	36.462	15,6	51.395	15,4	211.337
South America - West Africa, East bound	19,1	6.088	18,6	8.822	19,4	7.054	18,6	10.299	18,5	14.761	18,8	47.024
South America - West Africa, West bound	28,4	14	5,9	11	/	/	23,9	35	7,7	3	21,0	63
Inter West Africa	14,4	14.286	14,2	16.021	14,2	10.360	14,2	11.971	16,4	12.475	14,6	65.113
Entire West African Market	15,2	79.878	14,8	103.008	15,6	110.545	15,5	128.733	15,9	145.217	15,5	567.381

Source: NileDutch Container Management Control database(19/01/2012), 01/01/2007 to 31/12/2011

When looking at the evolution of these full TEU weights per year it becomes clear that these average values per trade fluctuate quite a lot. To avoid that the data for 2011 do not represent the average full TEU values sufficiently, the average value per trade between 2007 and 2011 will be used in the computer model. These average values per trade and trade lane can be found in the last column of Table 200. It can also be seen that the average weights per TEU are quite high. When looking at the commodities with an average weight above the trade and trade lanes average weight and with TEU quantities of 500 and higher, a list could be composed with the commodities which make the average weights per TEU so high. Per trade and trade lane these commodities can be found in Table 201 to Table 206. Due to the confidiality reasons the type of comodities are put in next cathegories: Food, beverages, metals, oil; building materials, chemicals and various. South America – West Africa, West bound has no data which survived the filters. This because only 63 TEU has been transported. 36 TEU from this 63 TEU are containers which transported food. The average values of these containers with food are 28,92t/TEU, which explains where the high average weight per TEU comes from.

Table 201: Heavy commodities: Asia – West Africa, East bound

Asia - West Africa, East bound	Total Weight (t)	# TEU	Avg. weight (t/TEU)
Food	47.606	1.692	28,14
Metals	99.279	4.544	21,85
Various	20.857	956	21,82

Source: NileDutch Container Management Control database(19/01/2012), 01/01/2007 to 31/12/2011

Table 202: Heavy commodities: Asia – West Africa, West bound

Asia - West Africa, West bound	Total Weight (t)	# TEU	Avg. weight (t/TEU)
Beverages	96.553	3.771	25,60
Building materials	333.654	17.659	18,89
Chemicals	136.626	7.069	19,33
Food	216.890	9.381	23,12
Metals	59.364	3.432	17,30
Oil	277.771	11.125	24,97

Source: NileDutch Container Management Control database(19/01/2012), 01/01/2007 to 31/12/2011

Table 203: Heavy commodities: Europe – West Africa, North bound

Europe - West Africa, North bound	Total Weight (t)	# TEU	Avg. weight (t/TEU)
Food	233.155	12.435	18,75

Source: NileDutch Container Management Control database(19/01/2012), 01/01/2007 to 31/12/2011

Table 204: Heavy commodities: Europe – West Africa, South bound

Europe - West Africa, South bound	Total Weight (t)	# TEU	Avg. weight (t/TEU)
Beverages	1.300.821	62.185	16,08
Building materials	15.550	670	15,99
Chemicals	38.686	2.055	15,91
Food	628.069	32.795	15,51
Oil	71.379	3.248	21,98

Source: NileDutch Container Management Control database(19/01/2012), 01/01/2007 to 31/12/2011

Table 205: Heavy commodities: South America – West Africa, East bound

South America - West Africa, East bound	Total Weight (t)	# TEU	Avg. weight (t/TEU)
Building materials	31.463	1.152	27,31
Food	379.258	14.846	25,55

Source: NileDutch Container Management Control database(19/01/2012), 01/01/2007 to 31/12/2011

Table 206: Heavy commodities: Inter West Africa

Inter West Africa	Total Weight (t)	# TEU	Avg. weight (t/TEU)
Beverages	168.099	7.835	21,45
Building materials	112.401	6.336	17,74
Chemicals	39.634	2.097	18,90
Food	125.334	5.552	22,57
Metals	9.761	514	18,99
Various	108.359	6.636	16,33

Source: NileDutch Container Management Control database(19/01/2012), 01/01/2007 to 31/12/2011

Q.2 Empty TEU weights

By the use of NileDutch's Container Management Control database, (01/01/2007 to 31/12/2011) only the registered loaded empty (LOE) and discharged (DIE) containers are considered. The database contains the weight of each container. The database consists of 105.498 empty TEUs. These TEUs are transported on next trades and trade lanes: Asia - West Africa, East bound, Asia - West Africa, West bound, Europe - West Africa, North bound, Europe - West Africa, South bound, Inter Asia, Inter Europe, Inter South America, Inter West Africa, South America - West Africa, East bound, and South America - West Africa, West bound. As the computer model only needs data about the Asia - West Africa, East bound, Asia - West Africa, West bound, Europe - West Africa, North bound, Europe - West Africa, South bound, South America - West Africa, East bound, South America - West Africa, West bound, and Inter West Africa, the data are filtered for these trades. After filtering 91.002 TEU are left. So 14.496 TEUs are excluded. Table 207 shows the average empty TEU weights per trade and trade lane.

Table 207: Average empty TEU weights per trade and trade lane

Trade + trade lane	Tons/empty TEU	Data sets
Asia - West Africa	2,9	33.931
Asia - West Africa	3,4	163
Europe - West Africa	2,8	35.546
Europe - West Africa	3,4	2
South America - West Africa	4,5	1
South America - West Africa	3,1	11
Inter West Africa	2,8	21.348

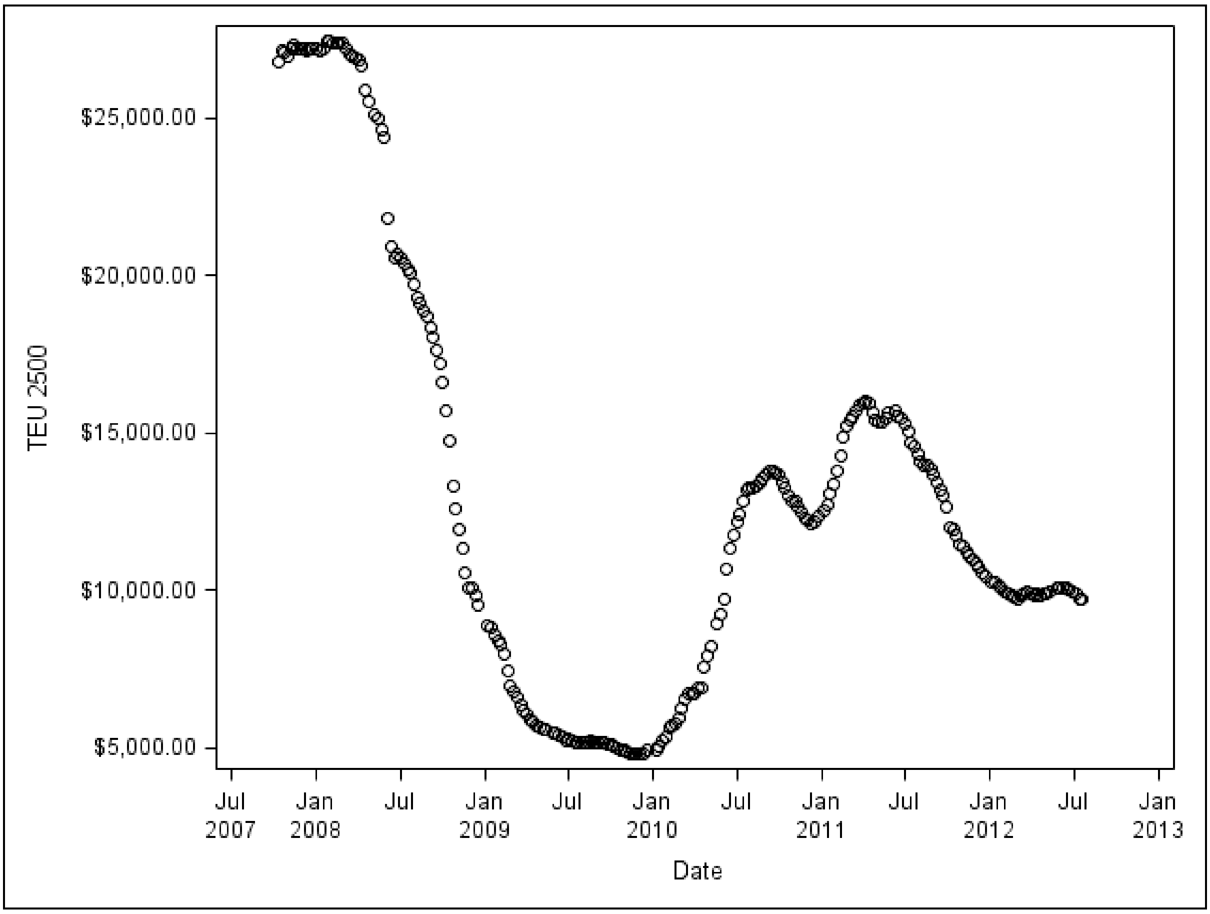
Source: NileDutch Container Management Control database (19/01/2012), 01/01/2007 to 31/12/2011

Appendix R : Econometric ARIMA models and Monte Carlo simulation with a Weibull probability density distribution

R.1 ARIMA (p, d, q)

Fitting econometric ARIMA models is done by the use of the SAS 9.2, which bases its methods on the Box-Jenkins models. The outcome of the program and how the Box-Jenkins method works is described in the process paragraphs and is explained by the help of the Time charter prices for a 2.500TEU container vessel example. This time series can be seen in Figure 266. Finally, the results from the SAS 9.2 program are summarised.

Figure 266: Average charter price evolution 2.500TEU container vessel



Source: Die Vereinigung Hamburger Schiffsmakler und Schiffsagenten e.V. (23/07/2012), data from 11/10/2007 to 19/07/2012 and own calculations on the predictions and forecast until 2015

The Univariate AutoRegressive Integrated Moving Averages ($ARIMA(p,d,q)$) models, also known by the name Box-Jenkins models, are used to forecast equally spaced univariate time series data. The model predicts one value based on a linear combination of the historical data and errors. In case of missing values in the time series, SAS institute Inc. (2010:260) states that the conditional least squares algorithm fills in missing values by forecasting ahead from the non-missing past values as far as required with the use of the structure of the missing values. The newly created values are updated at each iteration along with parameter estimates. Chatfield (1996) recommends a minimum of 50 data sets in the time series.

Hyndman and Athanasopoulos (2012) describe the econometric ARIMA model as follows:

$$ARIMA(p,d,q) \quad (79)$$

- p : Order of polynomial ϕ (integer)
- d : differentiating parameter (Order of differentiating) (integer)
- q : Order op polynomial θ (integer)

$$\phi(B)\cdot(1-B)^d\cdot X_t = c+\theta(B)\cdot\varepsilon_t \quad (80)$$

- ϕ : Autoregressive operator
- B : Backward operator
- d : Differentiating parameter, d=1, 2, 3, … (integer)
- X_t : Actual value, t =0, 1, 2,…, T (integer)
- c : Constant term
- θ : Moving averages operator
- ε_t : series of errors, t =0, 1, 2,…, T (integer)

The autoregressive operator is defined as:

$$\phi(B)=1+\sum_{i=1}^{p}-\phi_i\cdot B^i = 1-\phi_1\cdot B^1-\phi_2\cdot B^2-...-\phi_p\cdot B^p \quad (81)$$

The definition of the backward operator (B):

$$B^n\cdot X_t = X_{t-n} \quad (82)$$

The constant term is defined as:

$$c=\mu\cdot(1-\phi_1-\phi_2-...-\phi_p) \quad (83)$$

The mean is the estimation of the time series:

$$E\left[X_t\right]=\mu \quad (84)$$

The moving average operator is defined as:

$$\theta(B)=1+\sum_{i=1}^{q}\theta_i\cdot B^i = 1+\theta_1\cdot B^1+\theta_2\cdot B^2+...+\theta_q\cdot B^q \quad (85)$$

The series of errors (ε_t) is assumed to be independent, normally distributed, a mean of zero, and a constant variance.

Box and Jenkins (1976) describes three stages to obtain a forecast. These stages can be viewed in Figure 267. The first stage is identification. In this stage, the time series is tested for stationary, differentiated if necessary and possible econometric ARIMA models are obtained.

The estimation & diagnostic checking part estimates the parameters to see if certain parameters are unnecessary, it checks if the proposed econometric ARIMA model is a good fit for the time series, and it provides criteria to compare different econometric ARIMA models to each other. When a model is found to be inadequate, the estimation and diagnostic stage needs to be repeated until a model is found that satisfies all criteria. The third part about the forecast produces future values and added confidence interval to these forecasts.

Figure 267: Econometric ARIMA modelling stages

R.1.1 Identifying

Before the identifying starts, time series expressed in currencies need to be adjusted for inflation. Deflation is done by dividing a monetary time series by a price index. The world inflation of the consumer prices provided by the Organisation for Economic Co-operation and Development (OECD) (28/03/2014) are in this case used as price index. The index itself is obtained by dividing the world inflation consumer prices of each year by the base year. So in this case the base year is 2007. The world inflation consumer prices of 2007 up to 2012 are divided by the world inflation consumer price of 2007.

Identifying an econometric ARIMA model starts with checking for stationarity. When a time series is not stationary, the time series has a unit root and the conditional least squares (CLS) distribution is not normally distributed. The time series will need to be made stationary. The process of making a time series stationary will also determine the differentiating parameter d .

Stationarity is the case if the mean (μ), the variance (σ^2) and by consequence the covariance ($Cov\left[X_t \cdot X_{t-k}\right]$) are constants for all t .

The mean, also called arithmetic mean, is the average value of the data which can be calculated as follows:

$$\mu = \frac{\sum_{i=1}^{N} x_i}{N} \qquad 86$$

- μ : Mean of ARIMA data [/]
- x_i : Data I from ARIMA [/]
- N : Amount of data from ARIMA [/]

The variance gives an indication of the spread from the data around the mean and from each other. It can be calculated as follows:

$$\sigma^2 = \frac{\sum_{i=1}^{N} x_i - \mu}{N-1} \qquad 87$$

- σ : Standard deviation [/]
- x_i : Data I from ARIMA [/]
- μ : Mean of ARIMA data [/]
- N : Amount of data from ARIMA [/]

The covariance is a measure of the strength of the correlation between two datasets. It is calculated as follows:

$$Cov\left[X_t, X_{t-k}\right] = \sum_{t=1}^{N} \frac{(x_t - \overline{x}_t)\cdot(x_{t-k} - \overline{x}_{t-k})}{N} \quad 88$$

- $Cov\left[X_t, X_{t-k}\right]$: Covariance for X_t and X_{t-k} [/]
- N : Amount of data [/]
- k : lag number [/]
- x_t : Data i from X_t [/]
- x_{t-k} : Data i from X_{t-k} (Econometric ARIMA model) [/]
- $\overline{x}_t$: Mean of data X_t [/]
- $\overline{x}_{t-k}$: Mean of data X_{t-k} or μ (Econometric ARIMA model) [/]

The Augmented Dickey-Fuller (ADF) test can be used to check if the time series is stationary. This test is developed by Dickey (1976) and Dickey and Fuller (1979).

The Dickey-Fuller test can be explained by the $ARIMA(1,0,0)$ model, also named the random walk model.

$$X_t = \phi_1 \cdot X_{t-1} + \mu + \varepsilon_t \quad 89$$

If $|\phi_1| \geq 1$ than X_t is non-stationary with a time dependant variance going to infinity, if $|\phi_1| < 1$ than X_t is stationary. So the null hypothesis of a unit root and thus stationarity can be evaluated if $|\phi_1| < 1$. The regression is obtained by subtracting X_{t-1} from both sides of the $ARIMA(1,0,0)$ equations, which results in:

$$\Delta X_t = (\phi_1 - 1)\cdot X_{t-1} + \mu + \varepsilon_t \quad 90$$

In case of $AR(d)$ the equation will be extended with lags of ΔX_t . This results in the Augmented Dickey-Fuller (ADF) test.

To know if the null hypothesis needs to be rejected or not SAS 9.2 uses confidence bounds (α). These are typically 95% and 99% in statistics. In case a probability is 5% or larger, the null hypothesis is not rejected. In case the probability is between 5% and 1% the null hypothesis is not rejected but the probability results are in a grey zone. In case the probability is less than 1% the null hypothesis is rejected. The Dickey-Fuller test also takes three different situation into account. The first one is when the mean of the time series is zero, the second situation is when the mean of the time series is not zero and there is also no trend in the time series noticeable, and thirdly when the mean of the time series is not zero and there is a trend noticeable in the time series. The value of the mean is calculated by SAS 9.2 and by observing the plot of the time series, a trend can be noticed. When it is determined to which situation the time series belongs, the correct part in the output values of the Dickey-Fuller test can be consulted for interpretation. The amount of lags that are used for observation are SAS 9.2 default lags: 0, 1, and 2. Mean of Working Series 12.021,94

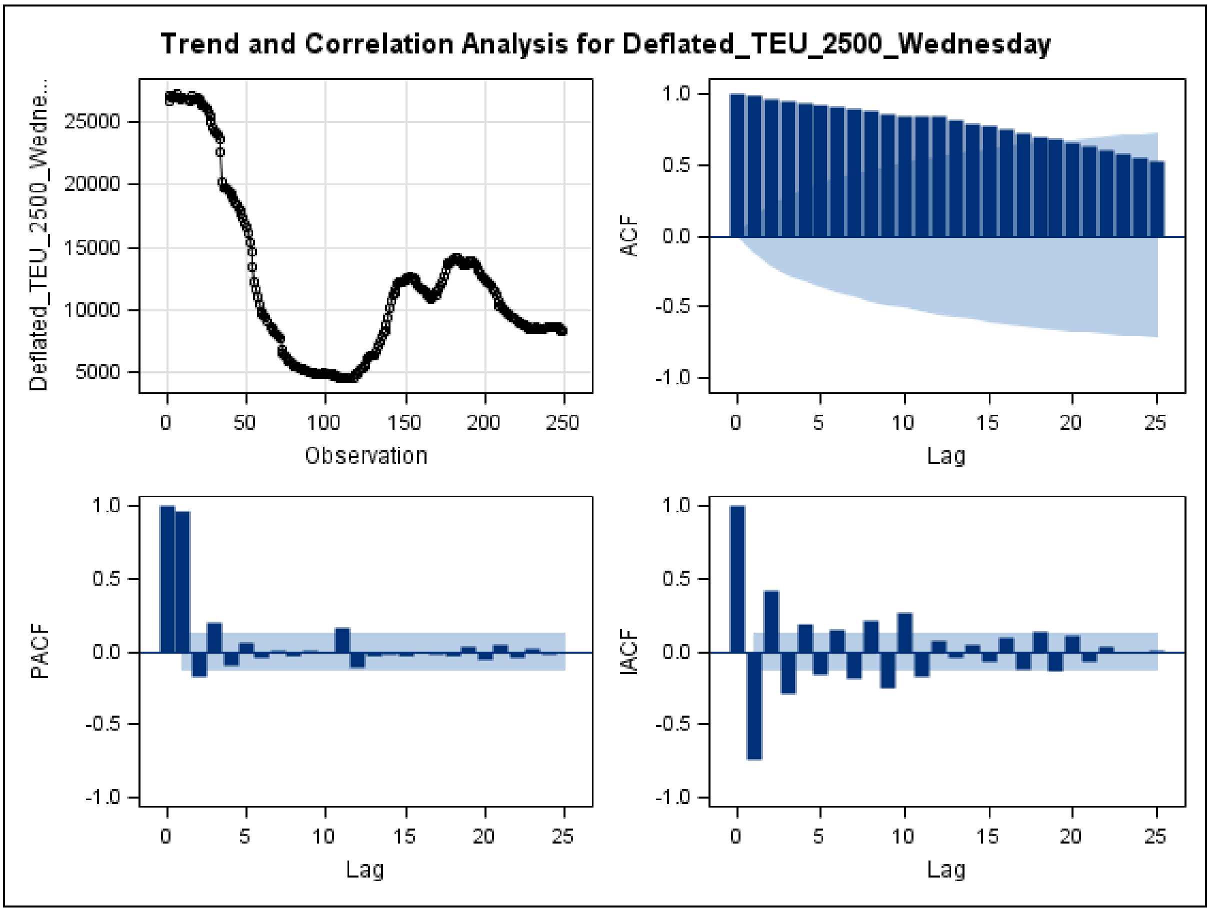
Standard Deviation	6.641,992
Number of Observations	249
Embedded missing values in working series	7

Figure 268 shows the plot of the time series, the ACF, PACF, and IACF. It is noticeable that there is an upward trend in this time series. The descriptive statistics as can be seen below, also indicate that the time series has a non-zero mean. Therefore, for this example the trend section of the Dickey-Fuller test needs to be consulted.

Descriptive statistics

Mean of Working Series	12.021,94
Standard Deviation	6.641,992
Number of Observations	249
Embedded missing values in working series	7

Figure 268: Trend and correlation analysis for bunker prices example



Source: SAS 9.2 (25/03/2014)

The output values of SAS 9.2 for the Dickey-Fuller test can be seen in Table 208. Especially the columns of Pr>Rho, Pr>Tau, and Pr>T are important to determine whether the time series has unit roots. These columns represent the probabilities, which are used to reject or not reject the null hypothesis of a unit root. In this example it is a clear that the null hypothesis is not rejected and the time series thus has a unit root. Observing the ACF may also give information about the stationarity of a time series. When these bars decay really slowly this might be an indication of non-stationarity. When the bars decay exponentially this might indicate a stationary time series. This method is however not conclusive and the Dickey-Fuller test is a better check to test for stationarity.

Table 208: Dickey-Fuller test for example bunker prices

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-1,7200	0,3648	-5,30	<0,0001		
	1	-2,2067	0,3069	-2,85	0,0045		
	2	-2,2514	0,3021	-2,69	0,0073		
Single Mean	0	-2,5103	0,7153	-3,74	0,0043	14,98	0,0010
	1	-4,0640	0,5295	-2,64	0,0876	5,08	0,0363
	2	-4,0863	0,5269	-2,44	0,1309	4,44	0,0615
Trend	0	-1,4852	0,9807	-1,94	0,6294	10,80	0,0010
	1	-3,2036	0,9272	-1,90	0,6518	3,94	0,3899
	2	-3,2844	0,9234	-1,83	0,689	3,34	0,5103

Source: SAS 9.2 (25/03/2014)

After differentiating the time series, the output value of the Dickey fuller test can be seen in Table 209. Now it is very clear that the null hypothesis of a unit root present in the time series is rejected and so we have obtained a stationary time series.

Table 209: Dickey-Fuller test after differentiating once for the charter price example

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-62,2925	<0,0001	-6,04	<0,0001		
	1	-50,6373	<0,0001	-5,01	<0,0001		
	2	-35,3144	<0,0001	-4,05	<0,0001		
Single Mean	0	-66,9343	0,0014	-6,31	<0,0001	19,96	0,0010
	1	-55,8667	0,0014	-5,30	<0,0001	14,08	0,0010
	2	-40,1668	0,0014	-4,35	0,0005	9,53	0,0010
Trend	0	-72,9486	0,0006	-6,68	<0,0001	22,33	0,0010
	1	-62,6993	0,0006	-5,63	<0,0001	15,85	0,0010
	2	-47,0059	0,0006	-4,71	0,0009	11,12	0,0010

Source: SAS 9.2 (25/03/2014)

Therefore, in case the time series appears to be non-stationary, estimating the d value will start with a value for d of 1. If this does not give a stationary process, a value of two for d will be examined and so on until the dickey-Fuller test indicates a stationary process. Another way of obtaining a stationary time series is to take the log transformation of the original time series, use the augmented Dickey-Fuller test to check for stationarity. When the times series does not seem to be stationary the d value can be estimated starting with a value of 1.

The differentiating process can be expressed as follows:

$$(1-B)^{-1+d} \cdot Y_t = (1-B)^d \cdot X_t \qquad \text{(general form)}$$ 91

$$Y_t = (1-B)^1 \cdot X_t \qquad (d = 1)$$

$$Z_t = (1-B)^1 \cdot Y_t = (1-B)^2 \cdot X_t \qquad (d = 2)$$

...

Next in the identifying phase the p and q parameters in the econometric ARIMA models needs to be determined. The autocorrelation function (ACF), the partial autocorrelation function (PACF), and the inverse autocorrelation function (IACF) are normally used. According to SAS Institute Inc. (2010:303):"Fitting econometric ARIMA models is as much an art as it is a science." Therefore SAS 9.2 provides three diagnostics options to help determine the p and q values of the econometric ARIMA model. The three diagnostic options are named: Smallest Canonical Correlation Method (SCAN), Extended Sample Autocorrelation Function method (ESACF), and the Minimum Information Criterion Method (MINIC). Tsay and Tiao (1985) developed the SCAN technique, which was altered by Choi (1992) with a better description for the algorithm. Box et al. (1994) improved the algorithm even more. The ESACF method proposed by Tsay and Tiao (1984). Choi (1992) provided a useful description for the algorithm. Hannan and Rissannen (1982) proposed the MINIC method. Box et al. (1994) and Choi (1992) provided useful descriptions for the algorithm. More information about how the SCAN, ESACF, and MINIC methods work can be found in respectively SAS Institute Inc. (2010:348) and SAS Institute Inc. (2010:245). Independently of a time series being stationary or not both the SCAN and ESACF can be used to determine $p+d$ and q. MINIC can define the order of a stationary and invertible ARIMA process.

When applying the SCAN, ESACF, and MINIC to the example, SAS 9.2 outcome for the parameters $p+d$ and q for possible econometric ARIMA models can be found in Table 210.

Table 210: SCAN ESACF, and MINIC after differentiating

SCAN		ESACF		MINIC	
p+d	q	p+d	q	p+d	q
1	2	2	2	2	0
		4	2		
		5	2		

Source: SAS 9.2 (25/03/2014)

R.1.2 Estimation & diagnostic checking

To check if an econometric ARIMA model is a good fit, the values of the autocorrelation function (ACF), the partial autocorrelation function (PACF), and the inverse autocorrelation function (IACF) need to be checked as well as the SAS 9.2 output of conditional least squares estimation, the correlation of parameter estimates, the autocorrelation check for residuals (white noise), and the residual normality diagnostics are used. Continuing with the example, we now have obtained a stationary time series and the trend and correlation analysis output from SAS9.2 as can be seen in Figure 269. Next, the ARIMA (1, 1, 2) model will be estimated and diagnosed.

Figure 269: Trend and Correlation analysis of an econometric ARIMA model.

SCAN		ESACF		MINIC	
p+d	q	p+d	q	p+d	q
1	2	2	2	2	0
		4	2		
		5	2		

Source: SAS 9.2 (25/03/2014)

Autocorrelation function (ACF)

The general form of the autocorrelation function (ACF) is:

$$\rho_k = \frac{Cov\left[X_t, X_{t-k}\right]}{Var\left[X_t\right]} \qquad 92$$

- ρ_k: Autocorrelation at lag k

The ACF graph gives information about the possible MA order of the model. When the graph has a peak at lag x when the time series is stationary this lag x might indicate an order x MA parameter. When having obtained the final econometric ARIMA model the ACF graph can confirm the right order of the MA parameter by having a peak at lag zero and no significant peak at further lags.

Partial autocorrelation function (PACF)

The general form of the partial autocorrelation function (PACF) is:

$$\alpha_k = Corr(X_t, X_{t-k} \mid X_{t-1}, X_{t-2}, ..., X_{t-k+1})$$
$$\alpha_k = \frac{Cov\left[X_t, X_{t-k} \mid X_1, X_2, ..., X_{t-k+1}\right]}{\sqrt{Var\left[X_t \mid X_1, X_2 ..., X_{t-k+1}\right] \cdot Var\left[X_{t-h} \mid X_1, X_2 ..., X_{t-k+1}\right]}} \qquad 93$$

The first partial autocorrelation (α_1) equals the first autocorrelation (ρ_1):

$$\alpha_1 = Corr(X_t, X_{t-1}) = \frac{Cov\left[X_t \cdot X_{t-1}\right]}{Var\left[X_t\right]} = \rho_1 \qquad 94$$

The second and third

$$\alpha_2 = Corr(X_t, X_{t-2} | X_{t-1}) = \frac{Cov\left[X_t, X_2 | X_1\right]}{\sqrt{Var\left[X_t | X_1\right] \cdot Var\left[X_2 | X_1\right]}} \quad 95$$

$$\alpha_3 = Corr(X_t, X_{t-3} | X_{t-1}) = \frac{Cov\left[X_t, X_3 | X_1, X_2\right]}{\sqrt{Var\left[X_t | X_1, X_2\right] \cdot Var\left[X_3 | X_1, X_2\right]}} \quad 96$$

...

The PACF graph gives information about the possible AR order of the model. When the graph has a peak at lag x when the time series is stationary this lag x might indicate an order x AR parameter. When having obtained the final econometric ARIMA model the PACF graph can confirm the right order of the PA parameter by having a peak at lag zero and no significant peak at further lags.

Inverse autocorrelation function (IACF)

Consider a stationary time series (X_t) with spectral density s. It is supposed that 1/s is integratable on [0, 1].

$\forall k \in [0,1,2,...]$

$$\dot{\gamma}(k) = \int_0^1 e^{2\pi ikf} \frac{1}{s(f)} df \quad 97$$

$$\gamma : Cov\left[X_t, X_{t-k}\right] \quad 98$$

$$\dot{\rho}(k) = \frac{\dot{\gamma}(k)}{\dot{\gamma}(0)} \quad 99$$

- $\dot{\rho}_k$: Inverse autocorrelation at lag k

This is the same as the model:

$$\phi(B) \cdot X_t = \theta(B) \cdot \varepsilon_t \quad 100$$

If $\theta(B)$ is invertible, meaning that the polynomial has no roots equal or less than one the equation becomes:

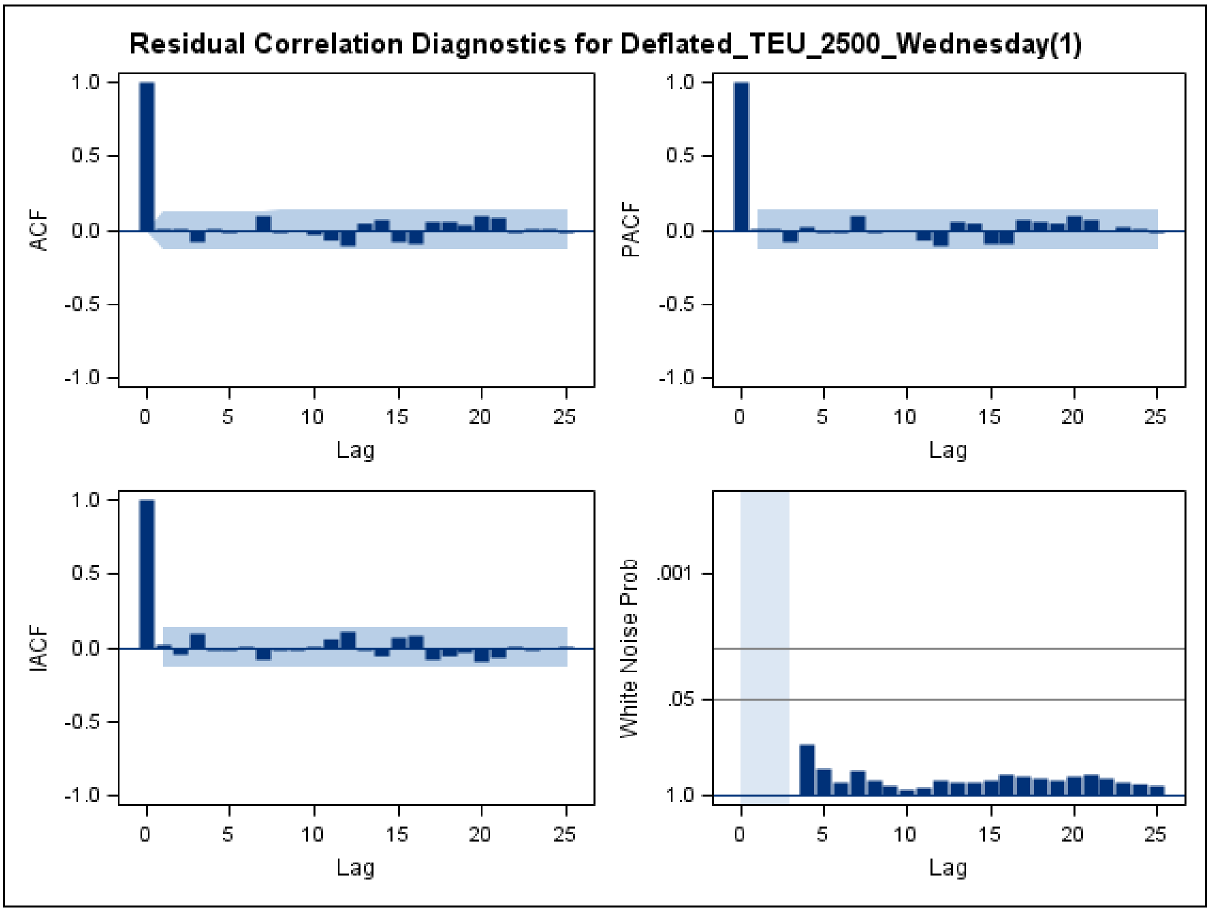
$$\theta(B) \cdot Z_t = \phi(B) \cdot \varepsilon_t \quad 101$$

The inverse autocorrelation function (IACF) determines if the time series is over differentiated or not. In case the graph descents more or less linearly, the time series is over differentiated.

When it descends exponentially, the time series is not over differentiated. In case the estimated model is a good fit, the IACF graph will show a peak at lag zero.

Therefore, a good fitted model should show a peak at lag zero of the ACF, the PACF, and IACF values such as shown in Figure 270.

Figure 270: Residual correlation diagnostics for an ARIMA (1, 1, 2) model



Source: SAS 9.2 (25/03/2014)

Autocorrelation check residuals (white noise)

The autocorrelation check for residuals indicates if the residuals are white noise or not and so if the econometric ARIMA model is a good fit for the data or not. For the null hypothesis this is the case if none of the residuals (autocorrelations) are significantly different from zero and therefore, they are white noise. Yet again the confidence bounds of more than 1% and preferable more than 5% are applied to reject the null hypothesis. Table 211 shows an example of SAS 9.2 output for the autocorrelation check for residuals. It displays the Chi-Square (χ^2) value, the amount of degrees of freedom (DF), the probability of uncorrelated residuals, and the autocorrelations. Table 211 shows that the residuals are white noise, as the null hypothesis is not rejected. Figure 270 also indicates the white noise probabilities per lag. The two horizontal lines in the graph represent the 5% and 1 % confidence bounds. In this case the bars a well below the 5% probability interval, so in this case the residuals are white noise.

Table 211: Autocorrelation check for residuals for the charter prices example of an ARIMA (1, 1, 2) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	1,69	3	0,6386	0,013	0,014	-0,079	0,017	-0,014	-0,006
12	7,27	9	0,6093	0,095	-0,014	0,000	-0,025	-0,062	-0,109
18	13,43	15	0,5694	0,052	0,068	-0,074	-0,094	0,063	0,061
24	17,19	21	0,6994	0,043	0,104	0,081	-0,018	0,003	0,014
30	21,49	27	0,7629	-0,012	-0,042	0,020	0,062	-0,067	0,103
36	29,16	33	0,6589	-0,047	0,015	-0,173	0,035	0,031	-0,058
42	37,95	39	0,5177	0,212	0,010	-0,014	-0,017	0,020	-0,003
48	38,82	45	0,7301	-0,038	0,023	-0,001	0,000	-0,018	0,051

Source: SAS 9.2 (25/03/2014)

The Chi-Square (χ^2) value can be calculated as follows:

$$\chi^2 = n \cdot (n+2) \cdot \sum_{j=1}^{m} \frac{r_j^2}{n-j} \qquad (102)$$

$$r_k = \frac{\sum_{t=1}^{n-k} \varepsilon_t \cdot \varepsilon_{t+k}}{\sum_{t=1}^{n} \varepsilon_t^2} \qquad (103)$$

- χ^2 : Chi-square [/]
- n : number of residuals [/]
- m : type of series (m=24 for monthly, m= 8 for quarterly, etc.) [/]
- ε_t : residual series, t =0, 1, 2,…, T (integer) [/]

Conditional least squares estimation

Conditional least squares estimation gives information about the parameters in the econometric ARIMA model. They indicate if the parameter is required or not.

The conditional least squares estimation displays the estimated value, the standard error, the ratio of estimate to standard error (t value), the probability that a parameter is unnecessary in the econometric ARIMA model, and at which lag the parameter appears in the model. The t-value and probability are the most important values in this output table. In general, t values lower than -2 or larger than 2 are desired together with probabilities below 5% and especially below 1% rejects the null hypothesis of the parameter not being necessary for the econometric ARIMA model. Interpreting Table 212 indicates that all parameters in the ARIMA (1, 1, 2) model are necessary.

Table 212: Conditional least squared estimation for the charter prices example of an ARIMA (1, 1, 2) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-6,05567	80,6409	-0,08	0,9402	0
MA1.1	0,34444	0,07475	5	<0,0001	1
MA1.2	0,23947	0,07198	3	0,001	2
AR1.1	0,93901	0,03354	28	<0,0001	1

Source: SAS 9.2 (25/03/2014)

The standard error reflects the variability of means and is calculated as follows:

$$SE = \frac{\sigma}{\sqrt{n}} \qquad 104$$

- SE : Standard error [/]
- σ : Standard deviation [/]
- n : amount of samples [/]

The ratio of estimate to standard error (t value) indicates if two sets of data are significantly different from each other. It can be calculated as follows:

$$t = \frac{\bar{x}_t - \mu}{SE}$$

- t : t value [/]
- $\bar{x}_t$: Mean of data X [/]
- μ : Mean of ARIMA data [/]
- SE : Standard error [/]

Correlation of parameter estimates

The SAS 9.2 output table of correlation of parameter estimates also indicates if a parameter is unnecessary. Values higher than 0,75 are assumed to have a strong correlation. Estimates of a pair of identical parameters are typically 1, but if a pair of non-identical parameters has an estimate larger than 0,75, one of the parameter can be considered to be dropped from the model. Table 213 shows that no parameters show significant high chances of being correlated.

Table 213: Correlations of parameter estimates for the charter prices example of an ARIMA (1, 1, 2) model

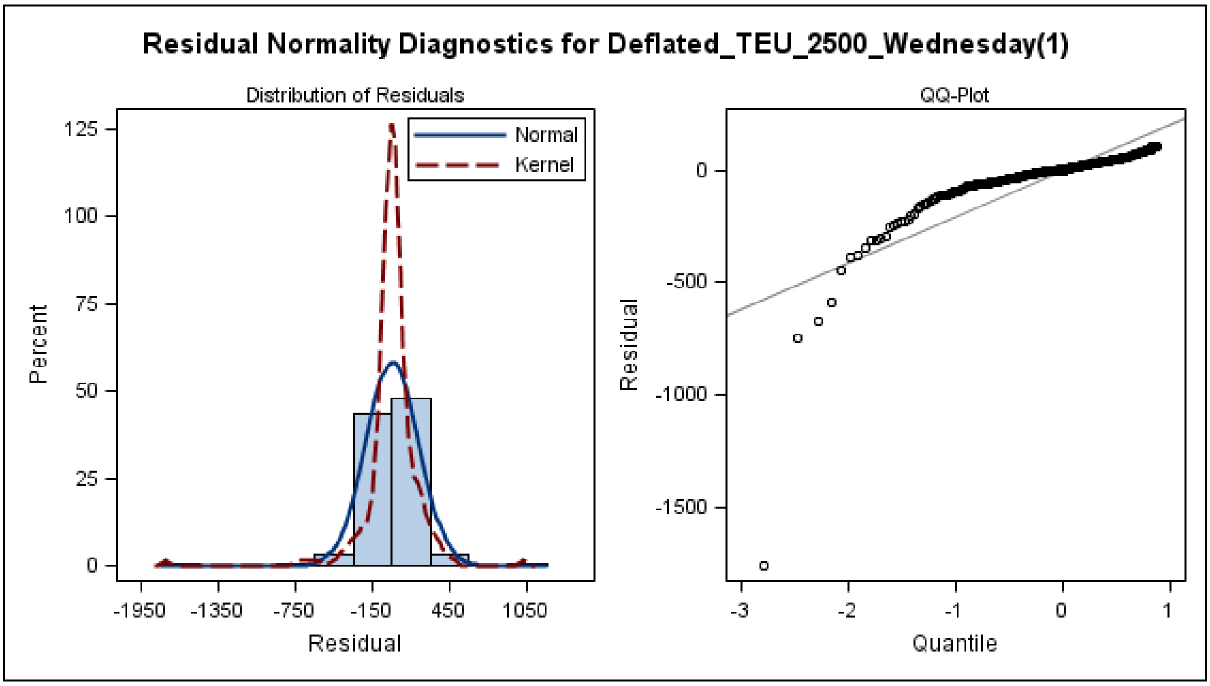
Parameter	MU	MA1.1	MA1.2	AR1.1
MU	1,000	0,091	0,082	0,259
MA1.1	0,091	1,000	-0,116	0,514
MA1.2	0,082	-0,116	1,000	0,450
AR1.1	0,259	0,514	0,450	1,000

Source: SAS 9.2 (25/03/2014)

Residual normality diagnostics

The residual normality diagnostic indicates how much the residuals from an econometric ARIMA model deviate from normality. Figure 271 shows the output of the SAS 9.2 system. The left graph is the histogram showing the distribution of the residuals and the Kernel and normal probability density distribution of the residuals. The Kernel smooths the periodogram by using a weighted moving average of nearby points. If the Kernel line has the typical bell shape like the standard normal distribution and it does not deviate too much from the line of standard normal distribution, it can be said that the econometric ARIMA model does not deviate too much from normality. The right graph represents the QQ plot, which is the distribution of the residuals over the quantiles of the standard normal distribution. In case the distribution is not normal, a curvature in the residuals can be seen or there are more residuals present at the upper and lower ends of the line representing the standard normal distribution. Figure 271 shows a Kernel line, which is not nicely bell-shaped and a small deviation form normality. The QQ plot confirms this small deviation from normality, as there are residuals on the outer ends and a small curvature.

Figure 271: Residual normality diagnostics for the charter prices example of an ARIMA (1, 1, 3) model



Source: SAS 9.2 (25/03/2014)

SAS 9.2 also gives the mean, autoregressive factors and moving average factors as an output.

Model selection in case of multiple models

When there is more than one model that could fit the time series several additional criteria can be used to determine the best fitted econometric ARIMA model. Firstly, the model with the lowest standard errors in general has a preference. Secondly, the models are preferred with the lowest value of the Schwarz Bayesian Information Criterion (SBIC) and the Akaike

Information Criterion (AIC). The model with the least parameters also has a preference. These criteria can be found in the fit statistics overview of the SAS 9.2 output as can be seen below:

Fit statistics

Constant Estimate	-0,36932
Variance Estimate	43.061,3
Std Error Estimate	207,5122
AIC	3.178,406
SBC	3.192,244
Number of Residuals	235

* AIC and SBC do not include log determinant.

The SBIC and AIC are calculated as follows:

Schwarz Bayesian Information Criterion (SBIC)

$$SBIC = -2 \cdot \ln(L) + \ln(n) \cdot k \qquad (105)$$

- L : Likelihood function
- n : Number of residuals that can be computed for the time series
- k : Lag or time span between observation

$$L = f(\phi, \theta) - \ln(\sigma_\varepsilon) - \frac{\sum_{t=2}^{T} \varepsilon_t^2}{2 \cdot \sigma_\varepsilon^2} \qquad (106)$$

The term $f(\phi, \theta)$ is negligible when T is large enough ($T > 80$).

Akaike Information Criterion (AIC)

$$AIC = -2 \cdot \ln(L) + 2 \cdot k \qquad (107)$$

- L : Likelihood function
- k : Lag or time span between observation

R.1.3 Forecast

The forecasting equation is as follows:

$$X_{T+h|T} = \hat{X}_{T+h} + \varepsilon_{T+h} \quad (108)$$

- $X_{T+h|T}$: forecast h periods ahead of T, h=0, 1, 2,… (integer)
- $\hat{X}_{T+h}$: prediction h periods ahead of T, h=0, 1, 2,… (integer)
- ε_{T+h} : prediction error of prediction h periods ahead of T, h=0, 1, 2,… (integer)

The prediction $\hat{X}_{T+h}$ can be obtained by writing the ARIMA equation so that X_t is on the left side and all other terms are on the right side. Next replacing t by $T+h$ in the equation. Last replacing past observation by their value, future observations by their forecasts, future errors by zero, and past errors by their corresponding residuals.

Applying this to our charter prices example with an ARIMA (1, 1, 2) model results in:

$$\begin{aligned}&(1 - 0,93901 \cdot B) \cdot (1 - B) \cdot X_t \\ &= -0,36932 + (1 - 0,34444 \cdot B - 0,23947 \cdot B^2) \cdot \varepsilon_t\end{aligned} \quad (109)$$

Next, the equation can be written as follows:

$$\begin{aligned}&(1 - 1,93901 \cdot B + 0,93901 \cdot B^2) \cdot X_t \\ &= -0,36932 + (1 - 0,34444 \cdot B - 0,23947 \cdot B^2) \cdot \varepsilon_t\end{aligned} \quad (110)$$

The backshift operator can be replaced by $B^n \cdot X_t = X_{t-n}$ and $B^n \cdot \varepsilon_t = \varepsilon_{t-n}$:

$$\begin{aligned}&X_t - 1,93901 \cdot X_{t-1} + 0,93901 \cdot X_{t-2} \\ &= -0,36932 + \varepsilon_t - 0,34444 \cdot \varepsilon_{t-1} - 0,23947 \cdot \varepsilon_{t-2}\end{aligned} \quad (111)$$

Writing this equation to X_t results in:

$$X_t = 1,93901 \cdot X_{t-1} - 0,93901 \cdot X_{t-2} - 0,36932 + \varepsilon_t - 0,34444 \cdot \varepsilon_{t-1} - 0,23947 \cdot \varepsilon_{t-2} \quad (112)$$

t will be replaced by $T+h$ to obtain the prediction equation. This results in:

$$\begin{aligned}\hat{X}_{T+h} &= 1,93901 \cdot X_{T+h-1} - 0,93901 \cdot X_{T+h-2} - 0,36932 \\ &\quad + \varepsilon_{T+h} - 0,34444 \cdot \varepsilon_{T+h-1} - 0,23947 \cdot \varepsilon_{T+h-2}\end{aligned} \quad (113)$$

The first three predictions are calculated as follows:

$$\begin{aligned}\hat{X}_{T+1} &= 1,93901 \cdot X_T - 0,93901 \cdot X_{T-1} - 0,36932 \\ &\quad - 0,34444 \cdot \varepsilon_T - 0,23947 \cdot \varepsilon_{T-1}\end{aligned} \quad (114)$$

$$\hat{X}_{T+2} = 1,93901 \cdot X_{T+1} - 0,93901 \cdot X_T - 0,36932 \\ - 0,23947 \cdot \varepsilon_T \qquad 115$$

$$\hat{X}_{T+3} = 1,93901 \cdot X_{T+2} - 0,93901 \cdot X_{T+1} - 0,36932 \qquad 116$$

The fourth prediction and the ones after that are obtained by:

$$\hat{X}_{T+h} = 1,93901 \cdot X_{T+h-1} - 0,93901 \cdot X_{T+h-2} - 0,36932 \qquad 117$$

The forecasted values of a monetary time series are the deflated values. Inflation needs to be taken into account.

R.2 Monte Carlo simulation with a Weibull probability density distribution

Normally the prediction errors are assumed uncorrelated and normally distributed. This assumption however implies that the probabilities of the real future values are evenly spread underneath and above the predicted values. It does not take influences in the future into account that may increase or decrease the prediction interval. To obtain a prediction interval different from the normal distribution, a Monte Carlo simulation can be used which follows a probability density distribution. A Monte Carlo simulation generates random values according to a preselected probability density distribution.

Possible probability density distributions may be:

- Beta
- Binominal
- Exponential
- Gamma
- Lognormal
- Normal (Gaussian)
- Poisson
- Rayleigh
- Triangular
- Uniform
- Weibull

Because of its versatility, the Weibull probability density distribution will be used. The formula form of the distribution and its cumulative distribution are respectively given by:

$$f(x) = \frac{\beta}{\eta} \cdot \left(\frac{x-\gamma}{\eta} \right)^{\beta-1} \cdot e^{-\left(\frac{x-\gamma}{\eta}\right)^{\beta}} \quad 118$$

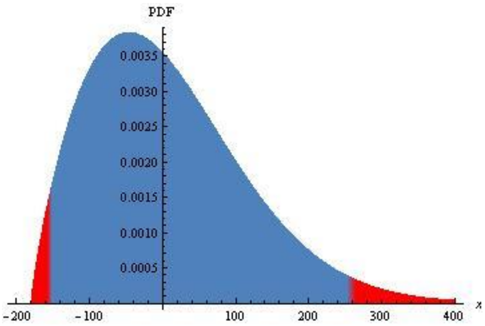
$$F(x) = 1 - e^{-\left(\frac{x-\gamma}{\eta}\right)^{\beta}} \quad 119$$

- $f(x)$: Probability density function
- $F(x)$: Cumulative distribution function
- β : Scale parameter
- γ : Shape parameter
- η :Location parameter

The selection of the Weibull probability density distribution is done by search and try to approximate the earlier set lower and upper prediction intervals. These calculations are done by the use of the Wolfram Mathematica 9 program and Microsoft Office Excel 2010.

When continuing with the example of the 2.500TEU container vessels charter prices For whom the upper and lower prediction interval are selected to be 5.000 $/day and 10.936 $/day. After search and try a Weibull probability density function was found. Its parameters are: shape parameter: 1,8, scale parameter: 210, and location parameter: -180. Figure 272 shows its probability density function and Figure 273 shows its cumulative probability density function.

Figure 272: Weibull probability density fuction (1.8, 210, -180)

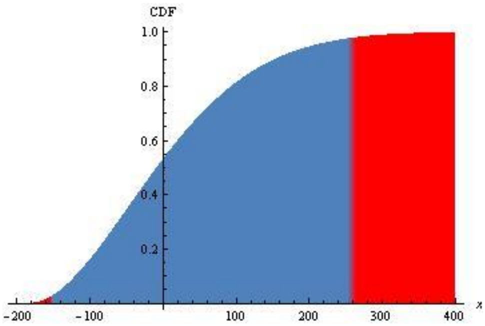


Color code

:inside the 95% confidence interval

: outside the 95% confidence interval

Figure 273: Weibull cummulative probability density function (1.8, 210, -180)



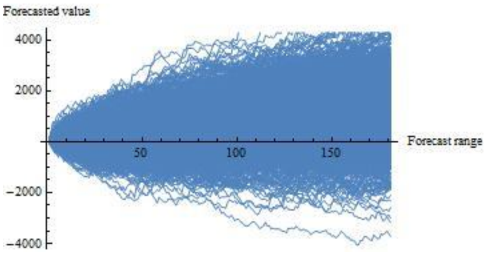
Color code

:inside the 95% confidence interval

: outside the 95% confidence interval

The selected Weibull probability density distributions is next used to obtain possible paths for the predictions 180 periods ahead by generating random input values. For reasons of reliability, this is done 1.000 times and so 1.000 possible paths are generated. Figure 274 shows these paths.

Figure 274: 1.000 generated paths using Weibull probability density fuction (1.8, 210, -180)



The obtained results are next analysed to obtain the 95% confidence interval. Per period the upper and lower bounds of the 95% confidence interval is obtained by calculating the value in the newly obtained cumulative distribution per period. The 95% confidence interval of the Weibull probability density distributions lies between the 2.5% and 97.5% of the cumulative distribution, so when $F(x)$ equals 0,025 and 0,975. These results per period give the confidence interval per prediction and all together, they form the confidence interval lines.

The finite amount of paths causes some amount of errors. These errors are named the Monte Carlo standard error, which measures the accuracy of the resulting estimate. More possible paths give fewer amounts of errors. This Monte Carlo standard error is defined as:

$$MCSE = \sqrt{\frac{\hat{p} \cdot \left(1 - \hat{p}\right)}{M}} \qquad 120$$

- $\hat{p}$: Probability of a future event
- M : Amount of paths

Probability of a future event is obtained by:

$$\hat{p} = \frac{\#\ \text{times event occurs in M draws}}{M} \qquad 121$$

R.3 Results econometric ARIMA models and Monte Carlo simulation with a Weibull probability density distribution

R.3.1 Summary results econometric ARIMA models

Next, the characteristics per time series, the augmented Dickey-Fuller test results, the amount of suggested econometric ARIMA models and the final econometric ARIMA model are summarized per time series in Table 214. For all time series there is an econometric ARIMA model found except for the Europe – West African time series. There did not seems to be an econometric ARIMA model that succeeded all the test and criteria for the average freight rates of the Europe- West Africa, North bound times series. More information about how lack of results is dealt with can be found in paragraph R.3.13 of this appendix. Notice that for the Inter West African freight rate time series two econometric ARIMA models are found; one without differentiating the time series and one when the time series is differentiated once. Because the differentiated time series does not show over differentiating and the augmented Dickey-Fuller test is rejected in all lags the ARIMA (0, 1, 1) model will be used for the prediction of the inter West African freight rates time series. Notice as well that for the time charter prices two type of times series could be used for econometric ARIMA model selection. The original times series consisted of data sets registered from Wednesdays and Fridays. Because the times series needs to be evenly spread two times series are formed. One consists of the Wednesday data and the other one consists of the Friday data. Because the times series based on the datasets of Wednesdays contains less missing values, priority is given to these datasets to find an econometric ARIMA model. Next per suggested econometric ARIMA model and per time series an overview is made to see how well the t value is, if the null hypothesis of the parameter being redundant is rejected, the standard error, the AIC, the SBC, if parameters in the models are too much correlated, if the null hypothesis of the residuals being white noise are rejected or not together with the probability of white noise, how the residuals are distributed, what the QQ plot looks like and if the SAS 9.2 system gave a warning. The last columns of these tables indicate the econometric ARIMA model with the best fit per time series. Table 215 to Table 250 give these overviews per time series that have possible econometric ARIMA models. Per final selected econometric ARIMA model SAS 9.2, output values and graphs can be found in paragraphs R.3.2 to R.3.23.

Table 214: Overview characteristics per time series, the augmented Dickey-Fuller test results, the amount of suggested econometric ARIMA models and the final econometric ARIMA model

Characteristics						Augmented Dickey-Fuller Unit root test											
						D=0					D=1						
Time series		Data	Nr. Of observations	Nr. Of missing values	Type	Lag 0	Lag 1	Lag 2	Nr. of ARIMA models	Selected ARIMA Model	Lag 0	Lag 1	Lag 2	IACF	Nr. of ARIMA models	Selected ARIMA Model	Final ARIMA Model
TEU volumes	ASWAEB	Monthly	60	3	Trend	Rejected	Rejected	Not rejected	8	No suitable model	Rejected	Rejected	Rejected	Ok	3	ARIMA (2,1,0)	ARIMA (2,1,0)
	ASWEWB	Monthly	60	1	Trend	Rejected	Rejected	Not rejected	9	No suitable model	Rejected	Rejected	Rejected	Ok	5	ARIMA (3,1,0)	ARIMA (3,1,0)
	EURWANB	Monthly	60	0	Trend	Rejected	Rejected	Not rejected	4	No suitable model	Rejected	Rejected	Rejected	Ok	6	ARIMA (0,1,1)	ARIMA (0,1,1)
	EURWASB	Monthly	60	0	Trend	Rejected	Rejected	Rejected	1	No suitable model	Rejected	Rejected	Rejected	Ok	4	ARIMA (0,1,1)	ARIMA (0,1,1)
	SAWAEB	Monthly	60	0	Trend	Rejected	Not rejected	Not rejected	7	No suitable model	Rejected	Rejected	Rejected	Ok	6	ARIMA (0,1,1)	ARIMA (0,1,1)
	IWA	Monthly	60	0	Trend	Rejected	Rejected	Not rejected	4	No suitable model	Rejected	Rejected	Rejected	Ok	6	ARIMA (0,1,1)	ARIMA (0,1,1)
	Export WA	Monthly	60	0	Trend	Rejected	Rejected	Not rejected	4	No suitable model	Rejected	Rejected	Rejected	Ok	5	ARIMA (3,1,0)	ARIMA (3,1,0)
	Import WA	Monthly	60	0	Trend	Rejected	Rejected	Rejected	5	No suitable model	Rejected	Rejected	Rejected	Ok	5	ARIMA (3,1,0)	ARIMA (3,1,0)
Freight rates	ASWAEB	Monthly	60	3	Trend	Rejected	Rejected	Not rejected	7	No suitable model	Rejected	Rejected	Rejected	Ok	6	ARIMA (0,1,1)	ARIMA (0,1,1)
	ASWEWB	Monthly	60	1	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Not rejected	Ok	4	ARIMA (0,1,0)	ARIMA (0,1,0)
	EURWANB	Monthly	60	0	Trend	Rejected	Rejected	Rejected	5	No suitable model	Rejected	Rejected	Rejected	Not ok	/	/	No suitable model
	EURWANB	Monthly (log)	60	0	Trend	Rejected	Rejected	Rejected	4	No suitable model	Rejected	Rejected	Rejected	Not ok	/ /		No suitable model
	EURWASB	Monthly	60	0	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Rejected	Ok	5	ARIMA (0,1,1)	ARIMA (0,1,1)
	SAWAEB	Monthly	60	0	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Rejected	Ok	7	ARIMA (0,1,1)	ARIMA (0,1,1)
	IWA	Monthly	60	0	Trend	Rejected	Rejected	Not rejected	6	ARIMA (1,0,0)	Rejected	Rejected	Rejected	Ok	7	ARIMA (0,1,1)	ARIMA (0,1,1)
Charter prices	1.100	Weekly (Wednesday)	249	7	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Not rejected	Ok	6	ARIMA (3,1,0)	ARIMA (3,1,0)
	1.700	Weekly (Wednesday)	249	7	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Rejected	Ok	8	ARIMA (1,1,2)	ARIMA (1,1,2)
	2.500	Weekly (Wednesday)	249	7	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Rejected	Ok	4	ARIMA (1,1,2)	ARIMA (1,1,2)
	2.700	Weekly (Wednesday)	125	3	Trend	Not rejected	Not rejected	Not rejected	/	/	Not rejected	Not rejected	Not rejected	Not ok	/	No suitable model	No suitable model
	2.700	Weekly (Wednesday) (log)	125	3	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Not rejected	Not rejected	Ok	5	No suitable model	No suitable model
	2.700	Weekly (Friday)	125	3	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Not rejected	Not rejected	Ok	6	ARIMA (1,1,0)	ARIMA (1,1,0)
	3.500	Weekly (Wednesday)	125	3	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Not rejected	Ok	7	No suitable model	No suitable model
	3.500	Weekly (Wednesday) (log)	125	3	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Not rejected	Not rejected	Ok	8	No suitable model	No suitable model
	3.500	Weekly (Friday)	125	3	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Not rejected	Ok	6	ARIMA (1,1,1)	ARIMA (1,1,1)
	4.250	Weekly (Wednesday)	125	3	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Not rejected	Not rejected	Ok	6	No suitable model	No suitable model
	4.250	Weekly (Wednesday) (log)	125	3	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Not rejected	Not rejected	Ok	2	ARIMA (1,1,0)	ARIMA (1,1,0)
Bunker price	Bunker price	Weekdays	2710	0	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Rejected	Ok	6	ARIMA (1,1,3)	ARIMA (1,1,3)
Inflation	CPI G20	Monthly	204	0	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Rejected	Ok	8	No suitable model	No suitable model
	CPI G20	Monthly (log)	204	0	Trend	Not rejected	Not rejected	Not rejected	/	/	Rejected	Rejected	Rejected	Ok	5	No suitable model	No suitable model

Colour code: ● : Positive outcome ● : Negative outcome

TEU volumes

Table 215: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Asia West Africa, East bound time series

Asia - West Africa, East bound / Import Asia (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,0,3)	Not ok	Not rejected	322,0955	823,9444	832,1166	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	No suitable ARIMA model
ARIMA (2,0,2)	Ok	Rejected	338,6284	830,5650	840,7802	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,0,1)	Not ok	Not rejected	336,7937	829,9456	840,1609	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,0,0)	Not ok	Not rejected	325,3772	826,0143	836,2295	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (1,0,3)	Not ok	Not rejected	313,7294	821,8585	832,0737	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (2,0,3)	Not ok	Not rejected	320,2372	825,0922	837,3505	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,0,3)	Not ok	Not rejected	320,6234	826,9493	843,2937	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,0,0)	Not ok	Not rejected	329,7861	826,6344	834,8066	Ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: : Positive outcome : Negative outcome

Table 216: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Asia West Africa, East bound time series, which is differentiated once

Asia - West Africa, East bound / Import Asia (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,2)	Ok	Rejected	365,2938	779,7229	787,6041	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	ARIMA (2,1,0)
ARIMA (0,1,3)	Not ok	Not rejected	371,6494	781,5513	789,4325	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (1,1,3)	Not ok	Not rejected	366,6274	781,0163	790,8678	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	Unstable model	
ARIMA (2,1,0)	Ok	Rejected	364,1343	778,4566	784,3675	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (3,1,4)	Not ok	Not rejected	388,8712	789,8394	805,6018	Not ok	Rejected	<1%	No significant deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,1,4)	Not ok	Not rejected	370,1411	786,1974	805,9003	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: : Positive outcome : Negative outcome

Table 217: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Asia West Africa, West bound time series

Asia - West Africa, West bound / Export Asia (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,0,2)	Ok	Rejected	1.246,1600	1.012,3760	1.020,6860	Ok	Rejected	<1%	Deviation from normality	Deviation from normality	Unstable model	No suitable ARIMA model
ARIMA (4,0,0)	Not ok	Not rejected	1.217,3940	1.010,5370	1.020,9250	Ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,0,1)	Not ok	Not rejected	1.256,7590	1.014,2920	1.024,6800	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (2,0,2)	Not ok	Not rejected	1.266,0160	1.015,1580	1.025,5460	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,0,1)	Not ok	Not rejected	1.217,9130	1.011,4850	1.023,9500	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,0,1)	Not ok	Not rejected	1.231,1020	1.013,6320	1.028,1750	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (0,0,4)	Not ok	Not rejected	1.315,0280	1.019,6400	1.030,0280	Ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,0,1)	Not ok	Not rejected	1.217,9130	1.011,4850	1.023,9500	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,0,0)	Not ok	Not rejected	1.219,6500	1.011,6530	1.024,1180	Ok	Rejected	<5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 218: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Asia West Africa, West bound time series, which is differentiated once

Asia - West Africa, West bound / Export Asia (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,2)	Not ok	Not rejected	1.224,5260	975,2524	981,3816	Not ok	Not rejected	<5% but >1%	No significant deviation from normality	No significant deviation from normality	/	ARIMA (3,1,0)
ARIMA (3,1,0)	Ok	Rejected	1.210,8560	974,9072	983,0794	Ok	Not rejected	<5% but >1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (2,1,1)	Not ok	Not rejected	1.233,2040	976,9920	985,1642	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (0,1,1)	Ok	Rejected	1.222,9760	974,1539	978,2400	Not ok	Not rejected	<5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 219: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Europe - West Africa, North bound time series

Europe - West Africa, North bound / Import Europe (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,0,0)	Ok	Rejected	288,8419	850,8419	852,9362	/	Not rejected	>5%	Deviation from normality	Deviation from normality	/	No suitable ARIMA model
ARIMA (2,0,1)	Not ok	Not rejected	291,1077	854,9763	863,3536	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,0,3)	Not ok	Not rejected	268,3659	849,6037	868,4528	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (0,0,3)	Not ok	Not rejected	279,9036	850,2665	858,6438	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: : Positive outcome : Negative outcome

Table 220: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Europe - West Africa, North bound time series, which is differentiated once

Europe - West Africa, North bound / Import Europe (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,1)	Not ok	Not rejected	307,0223	846,1324	852,3650	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	ARIMA (0,1,1)
ARIMA (0,1,1)	Ok	Rejected	310,1870	846,3868	850,5418	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,0)	Ok	Rejected	313,5221	848,6044	854,8371	Ok	Not rejected	>5%	No significant deviation from normality	Small deviation from normality	/	
ARIMA (3,1,0)	Not ok	Not rejected	307,7497	847,3485	855,6587	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,1)	Not ok	Not rejected	309,2693	847,9298	856,2399	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,0)	Not ok	Not rejected	310,5858	849,3484	859,7361	Not ok	Not rejected	<5% but >1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (5,1,0)	Not ok	Not rejected	313,0045	851,1610	863,6262	Not ok	Not rejected	<5% but >1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (2,1,5)	Not ok	Not rejected	294,0491	845,5199	862,1402	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	

Colour code: : Positive outcome : Negative outcome

Table 221: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Europe - West Africa, South bound time series

Europe - West Africa, South bound / Export Europe (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,0,0)	Ok	Rejected	1.311,000	1.032,690	1.034,784	/	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	No suitable ARIMA model

Colour code: : Positive outcome : Negative outcome

Table 222: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Europe - West Africa, South bound time series, which is differentiated once

Europe - West Africa, South bound / Export Europe (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,2)	Not ok	Not rejected	1.324,047	1.018,593	1.024,825	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	ARIMA (0,1,1)
ARIMA (0,1,1)	Ok	Rejected	1.325,339	1.017,752	1.021,907	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (1,1,1)	Not ok	Not rejected	1.323,156	1.018,513	1.024,746	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (3,1,2)	Not ok	Not rejected	1.369,835	1.025,356	1.037,821	Not ok	Not rejected	<5% but >1%	No significant deviation from normality	No significant deviation from normality	Unstable model	
ARIMA (4,1,2)	Not ok	Not rejected	1.332,570	1.022,977	1.037,520	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (5,1,2)	Not ok	Not rejected	1.388,942	1.028,721	1.045,341	Not ok	Not rejected	<5% but >1%	No significant deviation from normality	No significant deviation from normality	Unstable model	
ARIMA (4,1,0)	Not ok	Not rejected	1.335,649	1.021,477	1.031,864	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 223: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the South America - West Africa, East bound time series

South America - West Africa, East bound / Export South America (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,0,1)	Ok	Rejected	351,2744	876,5832	882,8662	Ok	Not rejected	>5%	Deviation from normality	Deviation from normality	Unstable model	No suitable ARIMA model
ARIMA (3,0,0)	Ok	Rejected	358,5421	879,9786	888,3560	Ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (0,0,5)	Not ok	Not rejected	376,5701	887,6835	900,2496	Ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,0,1)	Not ok	Not rejected	397,7712	893,3572	903,8289	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,0,1)	Not ok	Not rejected	355,6821	880,8355	893,4015	Not ok	Not rejected	>5%	Deviation from normality	Deviation from normality	Unstable model	
ARIMA (5,0,1)	Not ok	Not rejected	357,7945	882,4245	897,0849	Not ok	Not rejected	>5%	Deviation from normality	Deviation from normality	Unstable model	
ARIMA (0,0,4)	Not ok	Not rejected	386,5820	889,9332	900,4049	Ok	Not rejected	<1%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 224: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the South America - West Africa, East bound time series, which is differentiated once

South America - West Africa, East bound / Export South America (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,1)	Ok	Rejected	345,5447	859,1245	863,2795	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (0,1,1)
ARIMA (3,1,0)	Not ok	Not rejected	351,5544	863,0517	871,3619	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,0)	Not ok	Not rejected	351,8128	864,0558	874,4435	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,2)	Not ok	Not rejected	352,8507	864,4034	874,7911	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 225: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Inter West Africa time series

Inter West Africa (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,0,0)	Ok	Rejected	574,4954	933,6833	935,7776	/	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	No suitable ARIMA model
ARIMA (2,0,1)	Not ok	Not rejected	574,6010	936,5742	944,9515	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,0,1)	Not ok	Not rejected	578,4491	938,2940	948,7657	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,0,2)	Not ok	Not rejected	593,5977	944,0308	960,7855	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 226: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Inter West Africa time series, which is differentiated once

Inter West Africa (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,1)	Not ok	Not rejected	591,7244	923,5546	929,7872	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	ARIMA (0,1,1)
ARIMA (2,1,1)	Not ok	Not rejected	596,8643	925,5121	933,8222	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (4,1,2)	Not ok	Not rejected	865,2528	972,0200	986,5627	Not ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	Unstable model	
ARIMA (0,1,1)	Ok	Rejected	589,0329	922,0609	926,2160	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (3,1,0)	Ok	Rejected	610,2358	928,1265	936,4366	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (5,1,0)	Ok	Rejected	608,7294	929,6494	942,1146	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 227: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Import West Africa time series

Import West Africa (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,0,1)	Ok	Rejected	2.105,9570	1.091,4980	1.097,7810	Not ok	Not rejected	<5% but >1%	Small deviation from normality	No significant deviation from normality	Unstable model	No suitable ARIMA model
ARIMA (4,0,0)	Not ok	Not rejected	2.070,5230	1.091,3190	1.101,7900	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,0,2)	Not ok	Not rejected	2.117,6170	1.094,9170	1.107,4830	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,0,1)	Not ok	Not rejected	2.101,8870	1.094,9000	1.109,5610	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (0,0,4)	/	/	/	/	/	/	/	/	/	/	Unstable model	

Colour code: : Positive outcome : Negative outcome

Table 228: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Import West Africa time series, which is differentiated once

Import West Africa (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,1)	Ok	Rejected	2.041,5000	1.068,7300	1.072,8850	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (3,1,0)
ARIMA (3,1,0)	Ok	Rejected	2.002,3440	1.068,3370	1.076,6480	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (2,1,2)	Not ok	Not rejected	2.035,8980	1.071,2160	1.081,6030	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,2)	Not ok	Not rejected	2.036,5360	1.073,0260	1.087,5690	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,0)	Not ok	Not rejected	2.013,9850	1.069,9390	1.080,3270	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: : Positive outcome : Negative outcome

Table 229: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Export West Africa time series

Export West Africa (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,0,0)	Ok	Rejected	702,8511	957,8816	959,9759	/	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	No suitable ARIMA model
ARIMA (2,0,1)	Not ok	Not rejected	712,0815	962,3161	970,6935	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,0,1)	Not ok	Not rejected	1.121,3520	1.017,7270	1.028,1990	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,0,1)	Not ok	Not rejected	696,1902	961,4257	973,9918	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (0,0,2)	Not ok	Not rejected	713,8643	961,6782	967,9612	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 230: Results of the tests and criteria per econometric ARIMA model for the TEU volumes of the Export West Africa time series, which is differentiated once

Export West Africa (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,3)	Ok	Rejected	702,8511	957,8816	959,9759	/	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (3,1,0)
ARIMA (5,1,0)	Not ok	Not rejected	723,5791	950,0440	962,5092	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (0,1,1)	Ok	Rejected	718,8086	945,5563	949,7114	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (2,1,2)	Not ok	Not rejected	746,2331	952,7846	963,1723	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (4,1,2)	Not ok	Not rejected	745,6164	954,4603	969,0031	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,1,2)	Not ok	Not rejected	701,7630	948,1620	964,7823	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (3,1,0)	Ok	Rejected	746,0356	951,8359	960,1461	Ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Average freight rate

Table 231: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the Asia - West Africa, East bound time series

Asia - West Africa, East bound (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,0,1)	Not ok	Not rejected	248,9627	792,6956	796,7817	Ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	No suitable model
ARIMA (1,0,1)	Ok	Rejected	243,2603	791,0082	797,1374	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,0,1)	Not ok	Not rejected	245,5427	793,0074	801,1796	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,0,1)	Ok	Rejected	233,1575	788,0214	798,2367	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,0,1)	Not ok	Not rejected	234,6276	789,6311	801,8894	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,0,0)	Not ok	Not rejected	239,3757	791,9151	804,1734	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (5,0,5)	Not ok	Not rejected	232,4725	792,6976	815,1712	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 232: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the Asia - West Africa, East bound time series, which is differentiated once

Asia - West Africa, East bound (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,1)	Ok	Rejected	251,5820	738,3123	742,2528	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (0,1,1)
ARIMA (0,1,5)	Not ok	Not rejected	235,4475	734,9576	746,7793	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (1,1,1)	Not ok	Not rejected	253,9621	740,2609	746,1717	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,0)	Ok	Rejected	243,6804	737,7166	747,5680	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,4)	Not ok	Not rejected	247,8530	742,9047	760,6373	Not ok	Rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,1,5)	Not ok	Not rejected	244,0876	742,0635	761,7664	Not ok	Not rejected	>5%	No significant deviation from normality	No significant deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 233: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the Asia - West Africa, West bound time series, which is differentiated once

Asia - West Africa, West bound (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,0)	Ok	Rejected	181,1353	755,4639	757,5070	/	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (0,1,0)
ARIMA (3,1,1)	Not ok	Not rejected	182,2222	759,9218	770,1371	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,1)	Not ok	Not rejected	182,9476	761,2679	773,5262	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,1,1)	Not ok	Not rejected	208,8867	776,8867	791,1881	Not ok	Rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ●: Positive outcome ●: Negative outcome

Table 234: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the Europe - West Africa, North bound time series

Europe - West Africa, North bound (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,0)	Ok	Rejected	136,6400	761,3462	763,4405	/	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	No suitable model
ARIMA (1,1,1)	Ok	Rejected	123,2333	750,8845	757,1676	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,1,0)	Not ok	Not rejected	126,8034	755,2496	763,6270	Ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,3)	Not ok	Not rejected	117,1249	749,2755	766,0303	Not ok	Not rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,1,3)	Not ok	Not rejected	115,8743	748,8222	767,6713	Not ok	Not rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ●: Positive outcome ●: Negative outcome

Table 235: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the Europe - West Africa, North bound time series, which is log distributed

Europe - West Africa, North bound (log) (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,1)	Ok	Rejected	0,1860	-28,1448	-21,9122	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	No suitable model
ARIMA (3,1,0)	Not ok	Not rejected	0,2099	-12,8987	-4,5885	Ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,3)	Not ok	Not rejected	0,1787	-28,3438	-11,7235	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,1,3)	Not ok	Not rejected	0,1898	-20,4115	-1,7137	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	

Colour code: ●: Positive outcome ●: Negative outcome

Table 236: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the Europe - West Africa, South bound time series, which is differentiated once

Europe - West Africa, South bound (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,1)	Ok	Rejected	85,1454	693,8345	697,9896	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (0,1,1)
ARIMA (1,1,0)	Ok	Rejected	85,5706	694,4224	698,5774	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (1,1,1)	Not ok	Not rejected	85,8525	695,7662	701,9988	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,1)	Ok	Rejected	86,0417	696,9628	705,2730	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,1,2)	Not ok	Not rejected	83,4403	696,0309	710,5736	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 237: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the South America - West Africa, East bound time series, which is differentiated once

South America - West Africa, East bound (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,0)	Ok	Rejected	145,9942	756,4870	758,5646	/	Rejected	<1%	Deviation from normality	Deviation from normality	/	ARIMA (0,1,1)
ARIMA (0,1,1)	Ok	Rejected	135,7056	748,8376	752,9927	Ok	Not rejected	>5%	Deviation from normality	Deviation from normality	Unstable model	
ARIMA (1,1,0)	Ok	Rejected	137,4697	750,3617	154,5168	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (1,1,1)	Not ok	Not rejected	136,7141	750,6671	756,8997	Not ok	Not rejected	>5%	Deviation from normality	Deviation from normality	Unstable model	
ARIMA (2,1,1)	Not ok	Not rejected	136,6351	751,5357	159,8458	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,1,1)	Not ok	Not rejected	134,4405	751,4406	763,9057	Not ok	Not rejected	>5%	Deviation from normality	Deviation from normality	Unstable model	
ARIMA (5,1,1)	Not ok	Not rejected	135,5981	753,3275	767,8702	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 238: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the inter West Africa time series

Inter West Africa (d=0)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,0,3)	Not ok	Not rejected	258,4241	840,6853	849,0627	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (1,0,0)
ARIMA (1,0,0)	Ok	Rejected	262,2347	840,5473	844,7360	Ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (1,0,2)	Not ok	Not rejected	260,3592	841,5805	849,9579	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (1,0,3)	Not ok	Not rejected	253,3670	839,2326	849,7043	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,0,2)	Not ok	Not rejected	258,2980	841,5456	852,0174	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,0,0)	Not ok	Not rejected	251,1278	837,2485	845,6259	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 239: Results of the tests and criteria per econometric ARIMA model for the average freight rates of the inter West Africa time series, which is differentiated once

Inter West Africa (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,1)	Ok	Rejected	264,4906	827,5811	831,7362	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (0,1,1)
ARIMA (0,1,2)	Not ok	Not rejected	265,8318	829,1337	835,3663	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,0)	Ok	Rejected	262,6422	827,7093	833,9419	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,2)	/	/	/	/	/	/	/	/	/	/	/	
ARIMA (3,1,1)	Not ok	Not rejected	255,3208	826,2275	836,6152	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,1,1)	Not ok	Not rejected	263,6997	830,9350	843,4002	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (5,1,1)	Not ok	Not rejected	260,8998	830,5515	845,0943	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Time charter prices

Table 240: Results of the tests and criteria per econometric ARIMA model for the charter prices of a 1.100TEU container vessel time series using the Wednesday data series; which is differentiated once.

1.100 TEU container vessel (Wednesday) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,4)	Ok	Rejected	86,4561	2 768,852	2 789,610	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (3,1,0)
ARIMA (2,1,3)	Not ok	Not rejected	86,9302	2 771,423	2 792,180	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,4)	Not ok	Not rejected	86,6412	2 770,829	2 795,046	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,1,0)	Ok	Rejected	86,7220	2 768,339	2 782,178	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,5)	Not ok	Not rejected	86,2670	2 771,682	2 806,278	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,2)	Not ok	Not rejected	86,2057	2 769,428	2 797,105	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 241: Results of the tests and criteria per econometric ARIMA model for the charter prices of a 1.700TEU container vessel time series using the Wednesday data series, which is differentiated once

1.700 TEU container vessel (Wednesday) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,2)	Ok	Rejected	106,5098	2 864,938	2 878,777	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (1,1,2)
ARIMA (1,1,4)	Not ok	Not rejected	106,1595	2 865,346	2 886,104	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,2)	Not ok	Not rejected	105,9395	2 863,395	2 880,693	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,1,0)	Not ok	Not rejected	106,7311	2 865,914	2 879,752	Ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,1,2)	Not ok	Not rejected	106,0481	2 864,853	2 885,610	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,2)	Not ok	Not rejected	106,2300	2 866,630	2 890,847	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,0)	Not ok	Not rejected	106,3154	2 866,036	2 886,794	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,2)	Not ok	Not rejected	106,4570	2 868,600	2 896,277	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 242: Results of the tests and criteria per Econometric ARIMA model for the charter prices of a 2.500TEU container vessel time series using the Wednesday data series, which is differentiated once

2.500 TEU container vessel (Wednesday) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,0)	Ok	Rejected	211,9906	3 186,467	3 193,387	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (1,1,2)
ARIMA (1,1,2)	Ok	Rejected	207,5122	3 178,406	3 192,244	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,1)	Ok	Rejected	207,7295	3 178,989	3 192,736	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,0)	Not ok	Not rejected	208,3922	3 181,375	3 198,673	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 243: Results of the tests and criteria per econometric ARIMA model for the charter prices of a 2.700TEU container vessel time series using the Wednesday data series, which is differentiated once and log distributed

2.700 TEU container vessel (Wednesday) (log) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,4)	Not ok	Not rejected	0,0138	-670,148	-653,524	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	No suitable model
ARIMA (2,1,1)	Ok	Rejected	0,0139	-670,808	-659,725	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,1,0)	Not ok	Not rejected	0,0141	-667,657	-656,574	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,3)	Ok	Rejected	0,0138	-668,486	-646,321	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,3)	Not ok	Not rejected	0,0138	-667,177	-642,241	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 244: Results of the tests and criteria per econometric ARIMA model for the charter prices of a 2.700TEU container vessel time series using the Friday data series, which is differentiated once

2.700 TEU container vessel (Friday) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,0)	Ok	Rejected	169,2698	1 508,582	1 514,072	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (1,1,0)
ARIMA (1,1,1)	Not ok	Not rejected	168,7488	1 508,851	1 517,085	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (1,1,2)	Not ok	Not rejected	167,1191	1 507,587	1 518,567	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,2)	Not ok	Not rejected	167,5138	1 509,089	1 522,814	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,1,0)	Not ok	Not rejected	166,3043	1 506,463	1 517,443	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,1)	Not ok	Not rejected	167,9841	1 511,624	1 530,838	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 245: Results of the tests and criteria per econometric ARIMA model for the charter prices of a 3.500TEU container vessel time series using the Wednesday data series, which is differentiated once

3.500 TEU container vessel (Wednesday) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,4)	Not ok	Not rejected	246,4652	1 640,416	1 657,040	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	No suitable model
ARIMA (2,1,0)	Not ok	Not rejected	250,0725	1 640,964	1 649,276	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,2)	Not ok	Not rejected	249,9665	1 642,794	1 656,647	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,3)	Not ok	Not rejected	246,7523	1 640,690	1 657,315	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,1,1)	/	/	/	/	/	/	/	/	/	/	/	
ARIMA (4,1,0)	Not ok	Not rejected	245,5901	1 638,625	1 652,479	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,4)	Not ok	Not rejected	247,8213	1 644,5070	1 669,4430	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: ●: Positive outcome ●: Negative outcome

Table 246: Results of the tests and criteria per econometric ARIMA model for the charter prices of an 3.500TEU container vessel time series using the Wednesday data series, which is differentiated once and log distributed

3.500 TEU container vessel (Wednesday) (log) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,4)	Not ok	Not rejected	0,0200	-582,953	-566,329	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	No suitable model
ARIMA (2,1,3)	Not ok	Not rejected	0,0199	-583,852	-567,228	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,1,1)	Not ok	Not rejected	0,0203	-580,529	-566,676	Ok	Rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,1,2)	Ok	Rejected	0,0202	-580,295	-563,671	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,1,3)	Not ok	Not rejected	0,0200	-582,001	-562,606	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (4,1,0)	Not ok	Not rejected	0,0200	-582,916	-569,063	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,3)	Not ok	Not rejected	0,0201	-580,068	-557,903	Not ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,1)	Not ok	Not rejected	0,0205	-575,313	-555,918	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ●: Positive outcome ●: Negative outcome

Table 247: Results of the tests and criteria per econometric ARIMA model for the charter prices of a 3.500TEU container vessel time series using the Friday data series, which is differentiated once

3.500 TEU container vessel (Friday) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,0)	Ok	Rejected	278,6588	1 623,236	1 628,725	Ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	ARIMA (1,1,1)
ARIMA (1,1,1)	Ok	Rejected	263,4022	1 611,263	1 619,498	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (1,1,5)	Not ok	Not rejected	264,9781	1 616,453	1 635,667	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,2)	Not ok	Not rejected	265,4954	1 615,011	1 628,736	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	
ARIMA (3,1,2)	Not ok	Not rejected	266,1150	1 616,497	1 632,967	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,0)	Not ok	Not rejected	264,7369	1 615,303	1 631,773	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Table 248: Results of the tests and criteria per econometric ARIMA model for the charter prices of a 4.250TEU container vessel time series using the Wednesday data series, which is differentiated once

4.250 TEU container vessel (Wednesday) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,5)	Not ok	Not rejected	345,7497	1 720,300	1 736,924	Ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	No suitable model
ARIMA (1,1,1)	Not ok	Not rejected	329,9924	1 706,411	1 714,723	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,0)	Not ok	Not rejected	330,2708	1 706,610	1 714,922	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,1)	Not ok	Not rejected	331,4251	1 708,410	1 719,493	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,0)	Not ok	Not rejected	332,7501	1 710,305	1 724,158	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,3)	Not ok	Not rejected	337,2785	1 717,242	1 742,178	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

Table 249: Results of the tests and criteria per econometric ARIMA model for the charter prices of a 4.250TEU container vessel time series using the Wednesday data series, which is differentiated once and log distributed

4.250 TEU container vessel (Wednesday) (log) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,0)	Ok	Rejected	0,0194	-594,006	-588,465	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	ARIMA (1,1,0)
ARIMA (1,1,5)	Not ok	Not rejected	0,0195	587,239	-567,845	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	

Colour code: ● : Positive outcome ● : Negative outcome

Average bunker prices

Table 250: Results of the tests and criteria per econometric ARIMA model for the average bunker prices time series, which is differentiated once

Average bunker prices (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (1,1,0)	Ok	Rejected	3,6700	14 734,200	14 746,010	Ok	Rejected	<1%	Small deviation from normality	Small deviation from normality	/	**ARIMA (1,1,3)**
ARIMA (1,1,3)	Ok	Rejected	3,6570	14 718,040	14 747,560	Ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (2,1,3)	Not ok	Not rejected	3,6566	14 718,430	14 753,860	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (3,1,1)	Ok	Rejected	3,6582	14 719,820	14 749,340	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	/	
ARIMA (4,1,0)	Not ok	Not rejected	3,6649	14 729,650	14 759,170	Not ok	Not rejected	<5% but >1%	Small deviation from normality	Small deviation from normality	/	
ARIMA (5,1,5)	Not ok	Not rejected	3,6487	14 711,710	14 776,660	Not ok	Not rejected	>5%	Small deviation from normality	Small deviation from normality	Unstable model	

Colour code: : Positive outcome : Negative outcome

Consumer price index

Table 251: Results of the tests and criteria per econometric ARIMA model for the consumer price index series, which is differentiated once

CPI G20 (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,3)	Not ok	Not rejected	0,1671	-155,3500	-141,8680	Ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	**No suitable model**
ARIMA (1,1,2)	Not ok	Not rejected	0,1674	-154,5500	141,0670	Not ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (1,1,3)	Not ok	Not rejected	0,1664	-156,0490	-139,1360	Not ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (2,1,0)	Ok	Rejected	0,0166	-157,8640	-147,7520	Ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (2,1,2)	/	/	/	/	/	/	/	/	/	/	/	
ARIMA (3,1,1)	Not ok	Not rejected	0,1665	-155,8240	-138,9710	Not ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (4,1,1)	Not ok	Not rejected	0,1669	-153,8320	-133,6080	Not ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (5,1,1)	Not ok	Not rejected	0,1663	-154,4690	-130,8750	Not ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	

Colour code: : Positive outcome : Negative outcome

Table 252: Results of the tests and criteria per econometric ARIMA model for the consumer price index, which is differentiated once and log distributed

CPI G20 (log) (d=1)	T value	Conditional least squares estimation	Standard error	AIC	SBC	Correlation parameters	Autocorrelation residuals (white noise)	White noise Probability	Distribution of residuals	QQ-plot	Warning	Final model
ARIMA (0,1,1)	Ok	Rejected	0,0021	-2 037,2400	-2 030,5000	Ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	No suitable model
ARIMA (2,1,0)	Ok	Rejected	0,0021	-2 042,5000	-2 032,3900	Ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (2,1,2)	Not ok	Not rejected	0,0021	-2 039,5000	-2 022,6500	Not ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (3,1,1)	Not ok	Not rejected	0,0021	-2 039,0600	-2 022,2000	Not ok	Rejected	<1%	No significant deviation from normality	No significant deviation from normality	/	
ARIMA (3,1,2)	Ok	Rejected	0,0020	-2 060,3300	-2 040,1000	Not ok	Not rejected	<5% but >1%	No significant deviation from normality	No significant deviation from normality	Unstable model	

Colour code: ● : Positive outcome ● : Negative outcome

R.3.2 Summary results Monte Carlo simulations

An overview of the prediction intervals and results for the Weibull probability density functions can be seen in Table 253. The table also indicates if the Weibull probability density function is used reflectectly

Table 253: Prediction intervals per times series and Weibull probability density functions

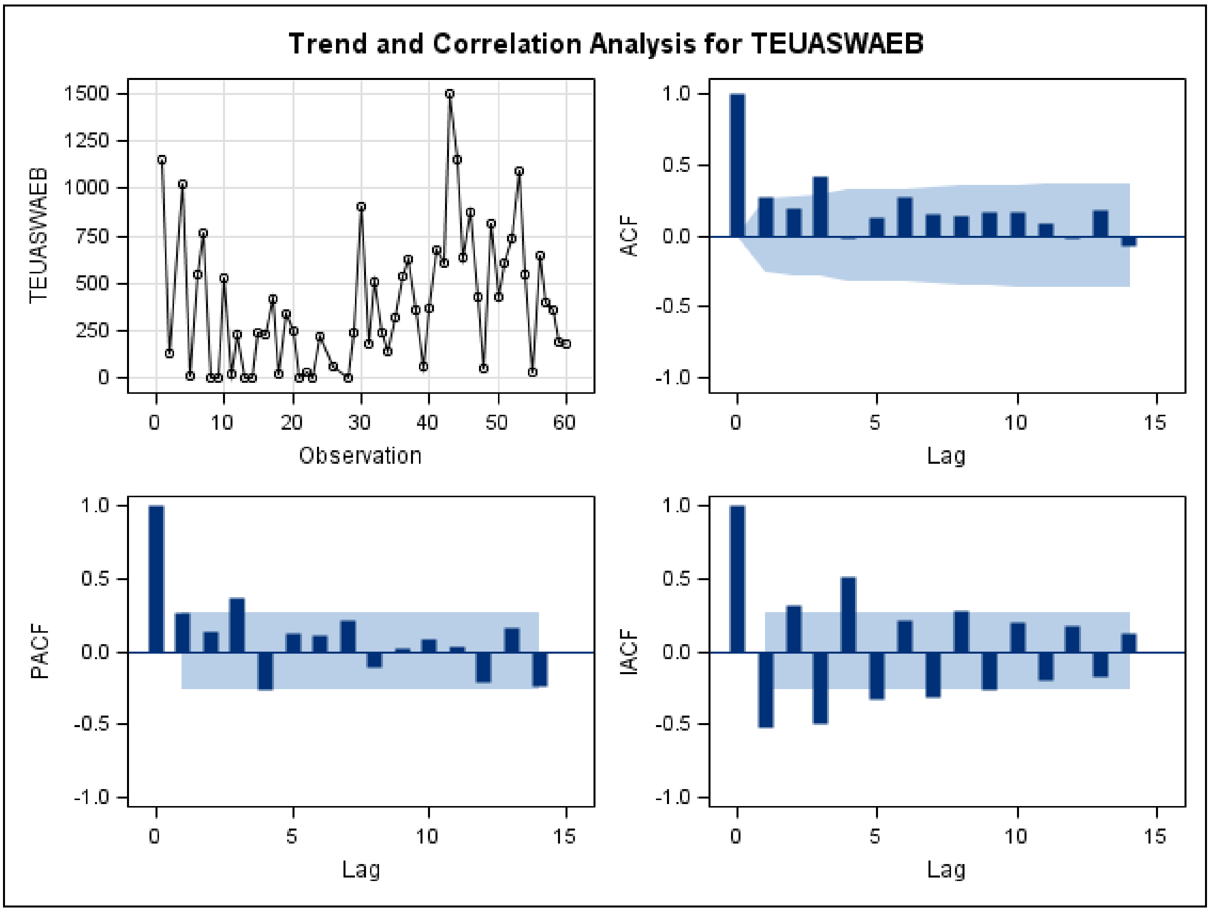
Time series		Lower prediction interval	Lower prediction interval after simulation	Delta lower predictio interval	Upper prediction interval	Upper prediction interval after simulation	Delta upper prediction interval	Shape parameter	Scale parameter	Location parameter	Reflection	# runs	Prediction horizon
TEU volumes	ASWAEB	0	11	11	901	890	11	1,8	65	-52	No	135	48
	ASWEWB	0	90	90	8.916	8.968	52	1,8	660	-520	Yes	225	48
	EURWANB	0	6	6	430	426	4	1,8	30	-25	Yes	5	48
	EURWASB	0	30	30	8.155	8.278	123	1,6	530	-390	Yes	125	48
	SAWAEB	0	24	24	2.432	2.565	133	1,6	165	-122	Yes	45	48
	IWA	0	-1	1	1.995	1.950	45	2	155	-135	No	60	48
	Export WA	0	415	415	21.497	20.779	718	1,6	200	-170	No	115	48
	Import WA	0	53	53	3.326	3.271	55	1,6	1.400	-1050	Yes	80	48
Net freight rates	ASWAEB	441	444	3	661	682	21	1,6	15	-12	Yes	5	48
	ASWEWB	1.509	1.499	10	2.264	2.189	75	1,8	50	-43	No	30	48
	EURWANB	504	513	9	757	750	7	2	18	-16	No	85	48
	EURWASB	1.604	1.592	12	2.405	2.364	41	1,8	55	-45	No	15	48
	SAWAEB	1.428	1.387	41	2.142	2.168	26	1,6	50	-38	No	15	48
	IWA	1.196	1.204	8	1.794	1.839	45	1,6	40	-30	Yes	15	48
Charter prices	1.100	4.000	4.032	32	8.706	9.052	346	1,6	170	-145	No	130	180
	1.700	4.000	3.945	55	10.551	10.374	177	2	260	-227	No	155	180
	2.500	5.000	4.993	7	10.936	10.650	286	1,8	210	-180	Yes	215	180
	2.700	5.000	4.853	147	11.204	11.212	8	1,8	225	-190	Yes	5	180
	3.500	6.000	6.134	134	12.824	13.011	187	1,6	225	-195	Yes	95	180
	4.250	7.000	6.625	375	14.105	13.957	148	1,6	360	-285	Yes	425	180
Bunker price	Bunker price	498	474	24	747	744	3	2	4	-3,49	Yes	95	934

R.3.3 TEU volumes: Asia – West Africa, East bound: ARIMA (2, 1, 0)

Descriptive statistics

Mean of Working Series	398,6842
Standard Deviation	354,6047
Number of Observations	60
Embedded missing values in working series	3

Figure 275: Trend and correlation analysis for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model (1)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests

Table 254: Augmented Dickey-Fuller unit root tests for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model

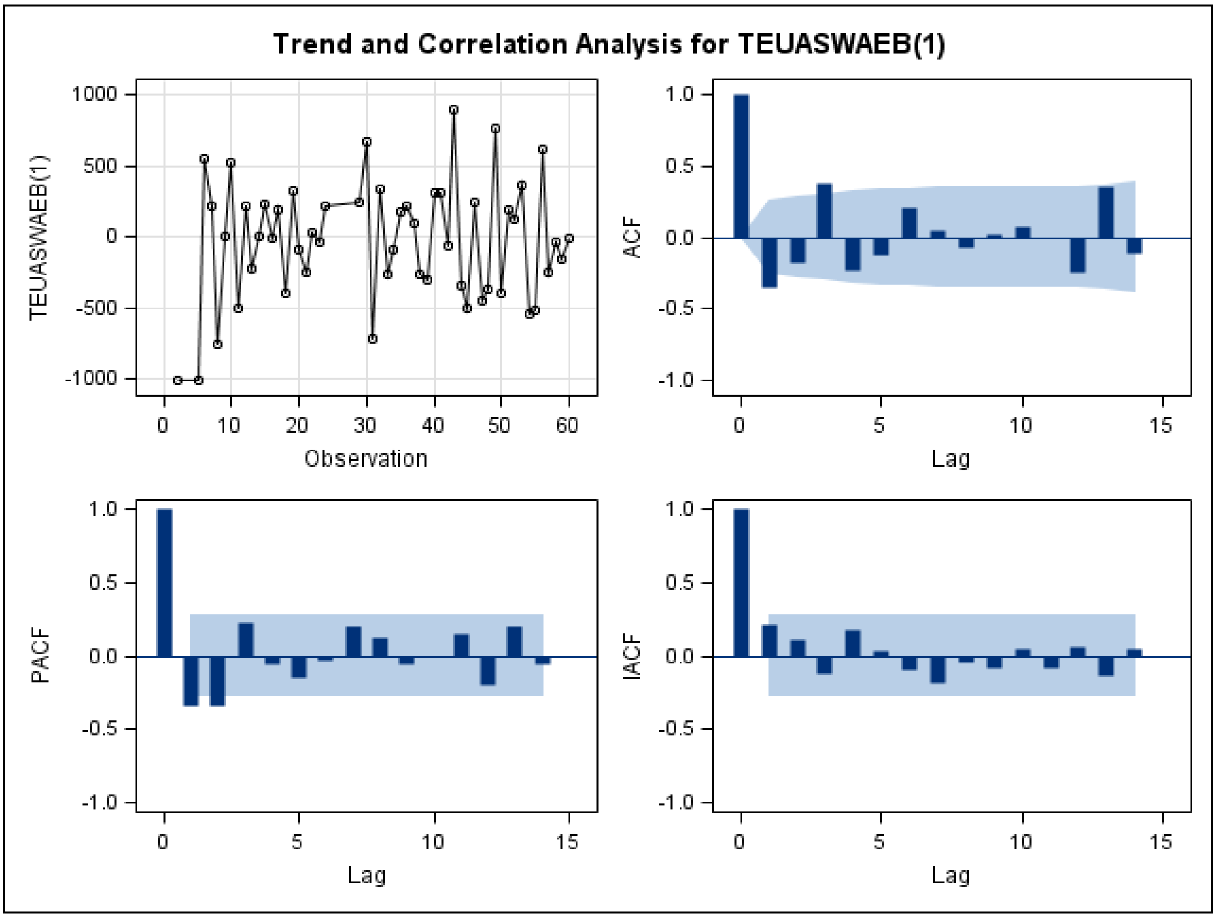
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-18,9021	0,0014	-3,85	0,0002		
	1	-7,1248	0,0603	-1,87	0,0586		
	2	-3,8994	0,1697	-1,58	0,1073		
Single Mean	0	-39,0135	0,0005	-5,90	0,0001	17,67	0,0010
	1	-25,1518	0,0011	-3,43	0,0143	5,88	0,0235
	2	-11,0570	0,0858	-2,04	0,268	2,29	0,5033
Trend	0	-43,3642	<0,0001	-6,75	<0,0001	23,39	0,0010
	1	-33,4449	0,0007	-3,83	0,0232	7,36	0,0353
	2	-18,3412	0,0629	-2,53	0,3118	3,21	0,5530

Source: SAS 9.2 (16/10/2013)

Descriptive statistics after differentiating

Period(s) of Differentiating	1
Mean of Working Series	-31,0377
Standard Deviation	416,241
Number of Observations	59
Observation(s) eliminated by differentiating	1
Embedded missing values in working series	6

Figure 276: Trend and correlation analysis for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model (2)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 255: Augmented Dickey-Fuller unit root tests after differentiating for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-68,3920	<0,0001	-11,14	<0,0001		
	1	-146,4010	0,0001	-9,25	<0,0001		
	2	-94,9927	<0,0001	-4,76	<0,0001		
Single Mean	0	-68,4083	0,0004	-11,02	0,0001	60,83	0,0010
	1	-147,3280	0,0001	-9,20	0,0001	42,37	0,0010
	2	-97,5228	0,0004	-4,74	0,0004	11,24	0,0010
Trend	0	-68,3416	<0,0001	-10,90	<0,0001	59,61	0,0010
	1	-147,3830	0,0001	-9,10	<0,0001	41,38	0,0010
	2	-97,8371	<0,0001	-4,69	0,0024	10,98	0,0010

Source: SAS 9.2 (16/10/2013)

ARIMA (2, 1, 0)

Conditional least squares estimation

Table 256: Conditional least squares estimation for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-13,6468	25,34491	-0,54	0,5927	0
AR1.1	-0,56818	0,12992	-4,37	<0,0001	1
AR1.2	-0,47358	0,12761	-3,71	0,0005	2

Source: SAS 9.2 (24/09/2013)

Fit statistics

Constant Estimate	-27,8635
Variance Estimate	132.593,8
Std Error Estimate	364,1343
AIC	778,4566
SBC	784,3675
Number of Residuals	53

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 257: Correlations of parameter estimates for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model

Parameter	MU	AR1.1	AR1.2
MU	1,000	0,006	-0,036
AR1.1	0,006	1,000	0,414
AR1.2	-0,036	0,414	1,000

Source: SAS 9.2 (24/09/2013)

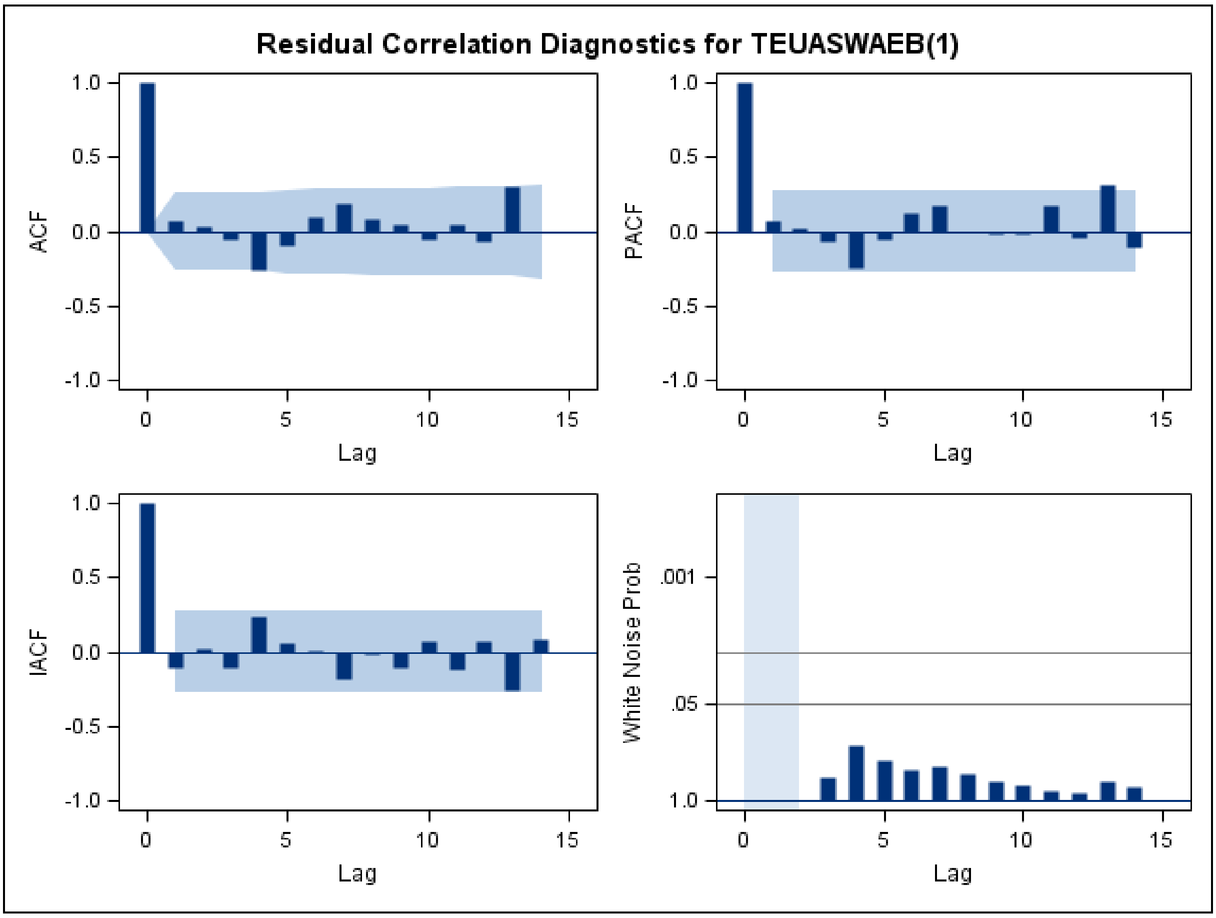
Autocorrelation check residuals

Table 258: Autocorrelation check residuals for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	4,12	4	0,3898	0,073	0,029	-0,060	-0,254	-0,094	0,087
12	6,42	10	0,7784	0,182	0,082	0,040	-0,061	0,050	-0,077
18	11,56	16	0,774	0,301	-0,006	-0,011	-0,040	-0,122	-0,208
24	12,04	22	0,9565	-0,029	0,048	0,035	-0,103	-0,039	0,034

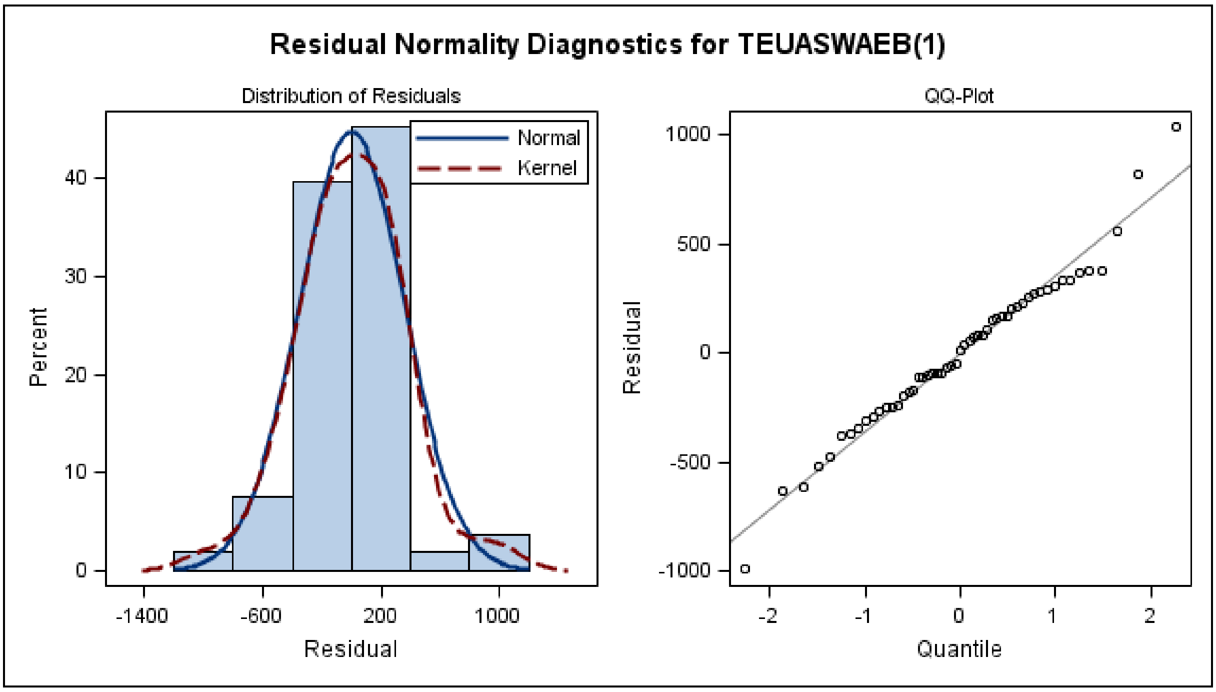
Source: SAS 9.2 (24/09/2013)

Figure 277: Residual correlation diagnostics for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model



Source: SAS 9.2 (24/09/2013)

Figure 278: Residual Normality Diagnostics for the TEU volumes of the Asia – West Africa, East bound time series and a fitted ARIMA (2, 1, 0) model



Source: SAS 9.2 (24/09/2013)

Model

Estimated Mean	-13,6468
Period(s) of Differentiating	1

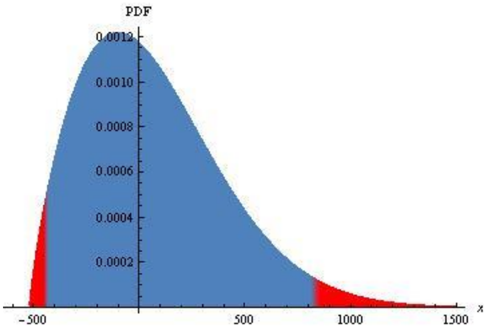
Autoregressive factors

Factor 1: 1 + 0,56818 B^(1) + 0,47358 B^(2)

Weibull ()

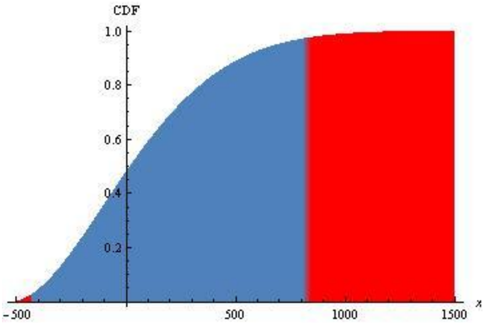
Probability density function

Figure 279: Probability density function Weibull (1.8, 660, -520)



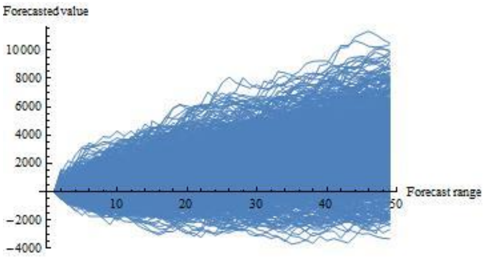
Cumulative density function

Figure 280: Cumulative density function Weibull (1.8, 660, -520)



Possible prediction paths

Figure 281: Possible prediction paths 48 steps ahead Weibull (1.8, 660, -520)

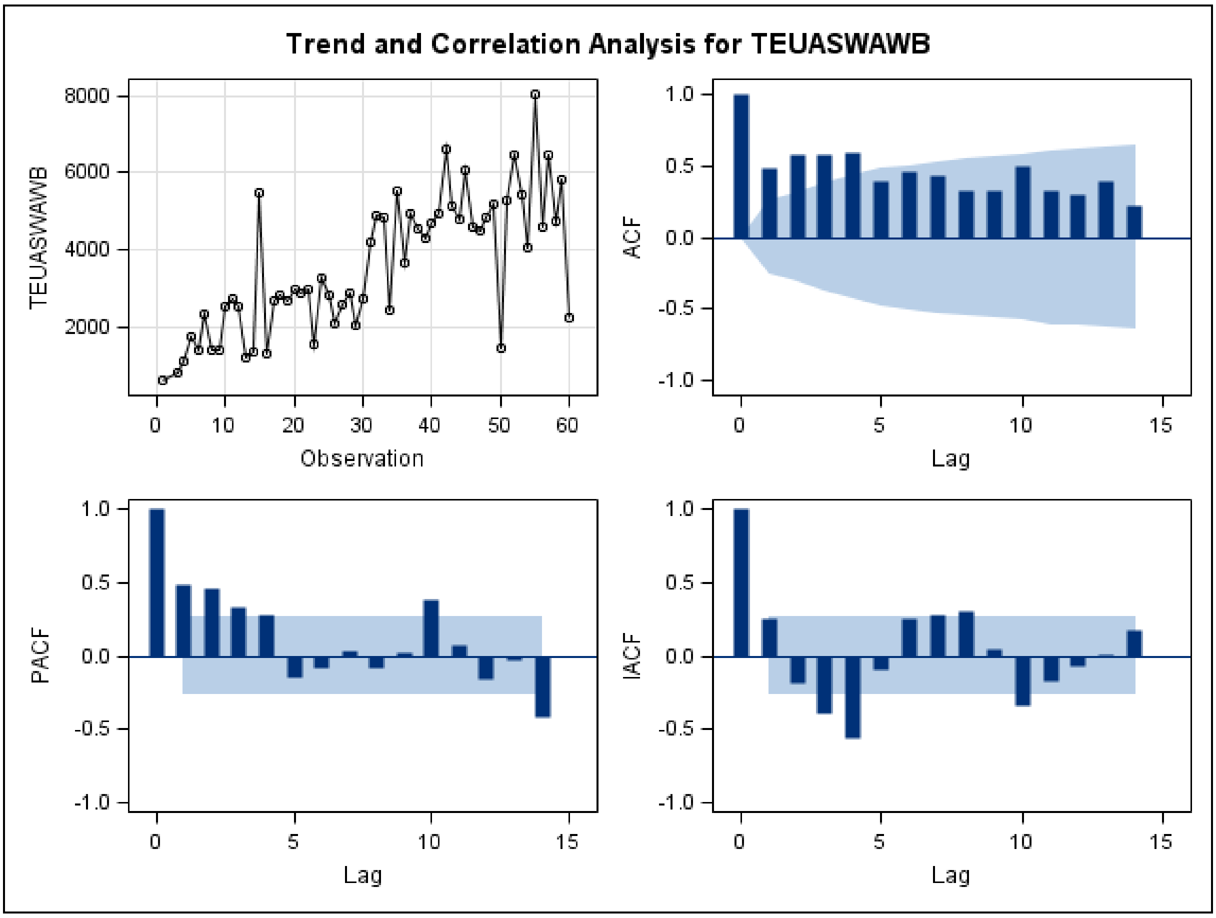


R.3.4 TEU volumes: Asia – West Africa, West bound: ARIMA (3, 1, 0)

Descriptive statistics

Mean of Working Series	3.573,39
Standard Deviation	1.722,524
Number of Observations	60
Embedded missing values in working series	1

Figure 282: Trend and correlation analysis for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model (1)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests

Table 259: Augmented Dickey-Fuller unit root tests for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model

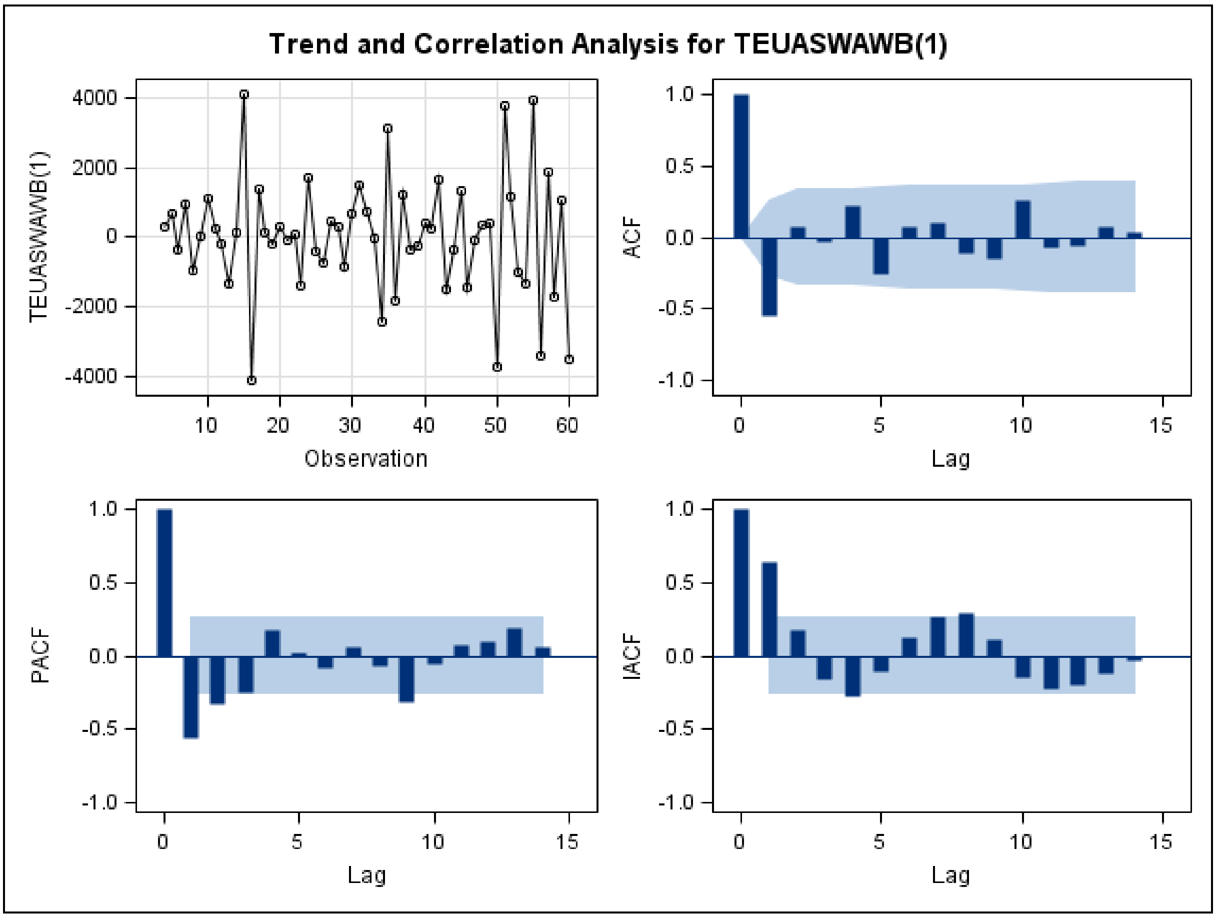
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-4,8365	0,126	-1,55	0,1124		
	1	-0,9844	0,472	-0,58	0,4601		
	2	-0,1392	0,6477	-0,12	0,6377		
Single Mean	0	-28,9685	0,0005	-4,44	0,0007	9,85	0,0010
	1	-12,5928	0,058	-2,67	0,0853	3,65	0,1519
	2	-6,8300	0,2684	-1,99	0,2895	2,18	0,5217
Trend	0	-66,6342	0,0001	-7,95	<0,0001	31,91	0,0010
	1	-60,6452	0,0001	-4,84	0,0013	12,07	0,0010
	2	-47,4767	<0,0001	-3,41	0,0598	6,21	0,0637

Source: SAS 9.2 (16/10/2013)

Descriptive statistics after differentiating

Period(s) of Differentiating	1
Mean of Working Series	25,12281
Standard Deviation	1.680,855
Number of Observations	57
Observation(s) eliminated by differentiating	1

Figure 283: Trend and correlation analysis for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model (2)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 260: Augmented Dickey-Fuller unit root tests after differentiating for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-89,5618	<0,0001	-13,93	<0,0001		
	1	-201,0980	0,0001	-9,44	<0,0001		
	2	317,8581	0,9999	-8,16	<0,0001		
Single Mean	0	-89,7008	0,0005	-13,83	0,0001	95,65	0,0010
	1	-204,9250	0,0001	-9,40	0,0001	44,23	0,0010
	2	283,1213	0,9999	-8,24	0,0001	34,01	0,0010
Trend	0	-89,7593	0,0001	-13,77	<0,0001	95,01	0,0010
	1	-207,3850	0,0001	-9,39	<0,0001	44,16	0,0010
	2	277,9109	0,9999	-8,25	<0,0001	34,24	0,0010

Source: SAS 9.2 (24/09/2013)

ARIMA (3, 1, 0)

Conditional least squares estimation

Table 261 Conditional least squares estimation for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	63,5975	51,07587	1,25	0,2186	0
AR1.1	-1,01789	0,13597	-7,49	<0,0001	1
AR1.2	-0,75004	0,16677	-4,5	<0,0001	2
AR1.3	-0,42604	0,13748	-3,1	0,0031	3

Source: SAS 9.2 (16/10/2013)

Fit statistics

Constant Estimate	203,1282
Variance Estimate	1.466.173
Std Error Estimate	1.210,856
AIC	974,9072
SBC	983,0794
Number of Residuals	57

* AIC and SBC do not include log determinant,

Correlations of parameter estimates

Table 262: Correlations of parameter estimates for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model

Parameter	MU	AR1.1	AR1.2	AR1.3
MU	1,000	-0,038	-0,043	-0,047
AR1.1	-0,038	1,000	0,681	0,439
AR1.2	-0,043	0,681	1,000	0,678
AR1.3	-0,047	0,439	0,678	1,000

Source: SAS 9.2 (16/10/2013)

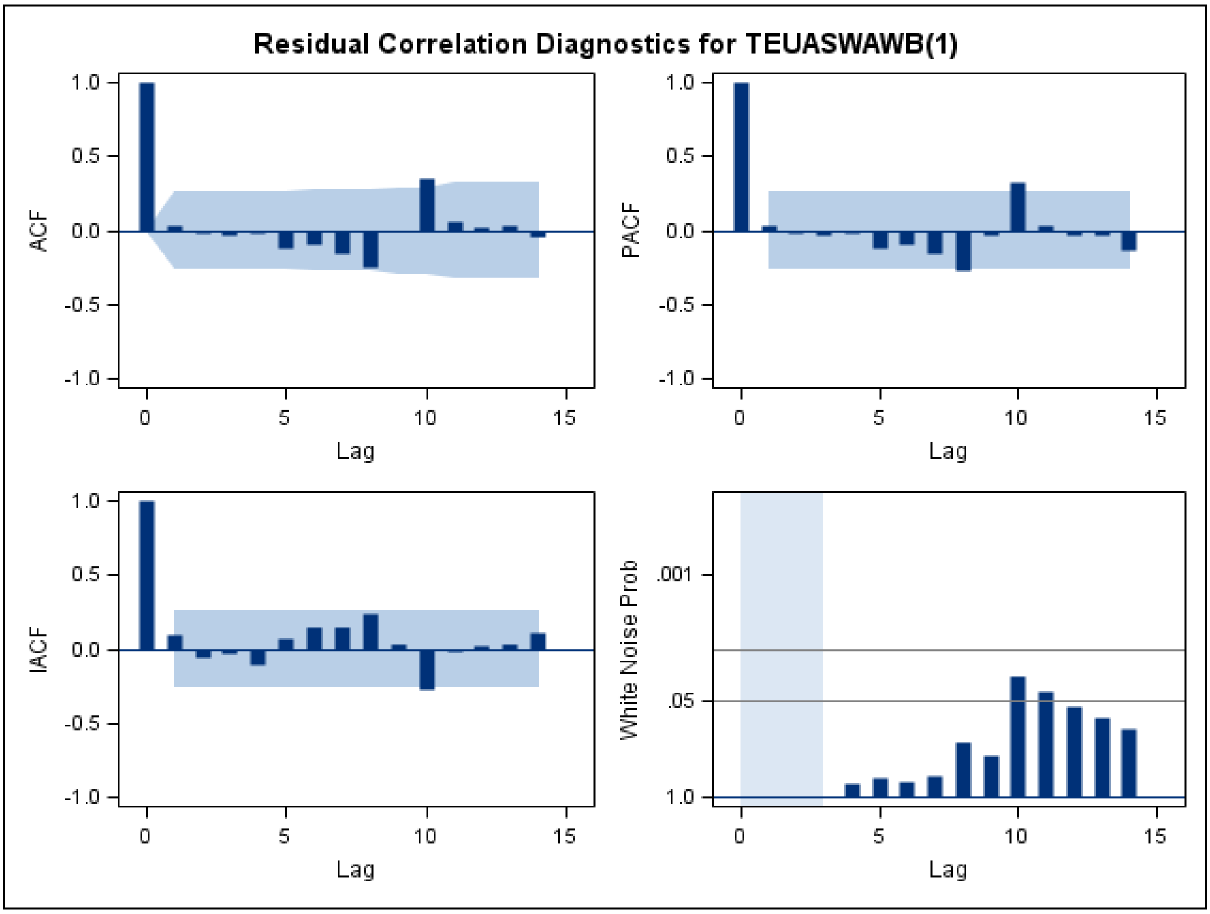
Autocorrelation check residuals

Table 263: Autocorrelation check residuals for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	1,74	3	0,6274	0,038	-0,014	-0,033	-0,019	-0,121	-0,095
12	16,41	9	0,0588	-0,152	-0,248	-0,007	0,346	0,060	0,022
18	19,93	15	0,1747	0,039	-0,046	-0,038	-0,000	-0,056	-0,182
24	30,39	21	0,0845	-0,227	0,207	0,100	0,104	0,002	0,019

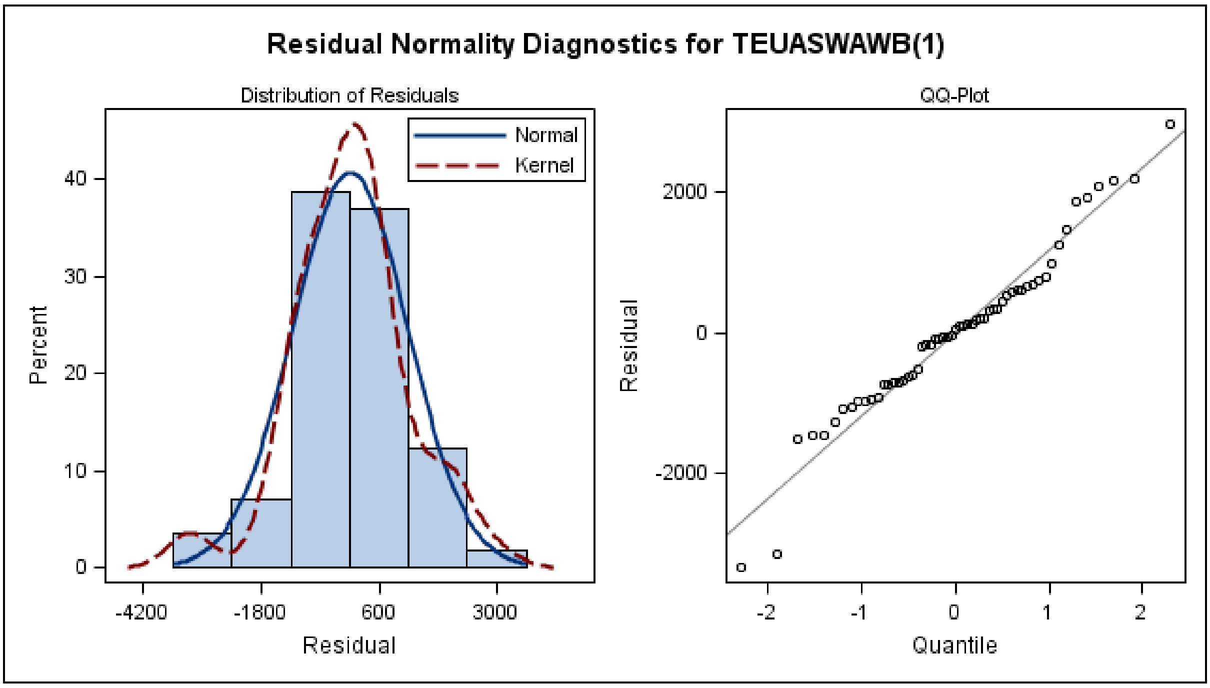
Source: SAS 9.2 (16/10/2013)

Figure 284: Residual correlation diagnostics for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model



Source: SAS 9.2 (16/10/2013)

Figure 285: Residual normality diagnostics for the TEU volumes of the Asia – West Africa, West bound time series and a fitted ARIMA (3, 1, 0) model



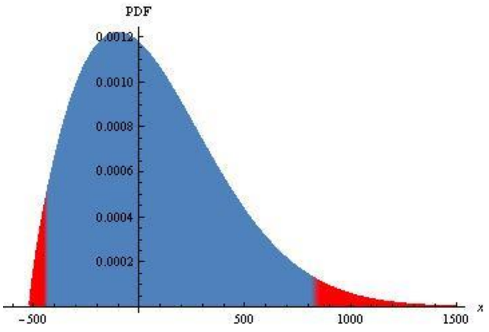
Source: SAS 9.2 (16/10/2013)

Model
Estimated Mean 63,5975
Period(s) of Differentiating 1
Moving average factors
Factor 1: 1 + 1,01789 Bˆ(1) + 0,75004 Bˆ(2) + 0,42604 Bˆ(3)

Weibull (1.8, 660, -520)

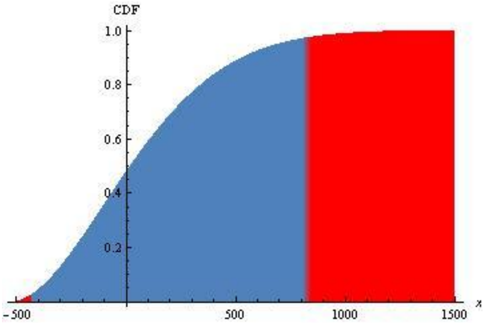
Probability density function

Figure 286: Probability density function Weibull (1.8, 660, -520)



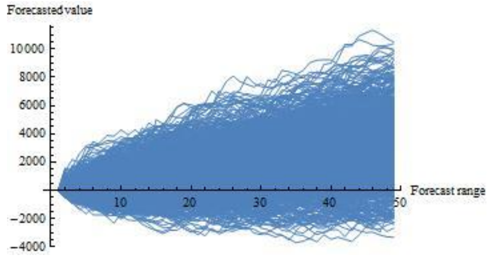
Cumulative density function

Figure 287: Cumulative density function Weibull (1.8, 660, -520)



Possible prediction paths

Figure 288: Possible prediction paths 48 steps ahead Weibull (1.8, 660, -520)

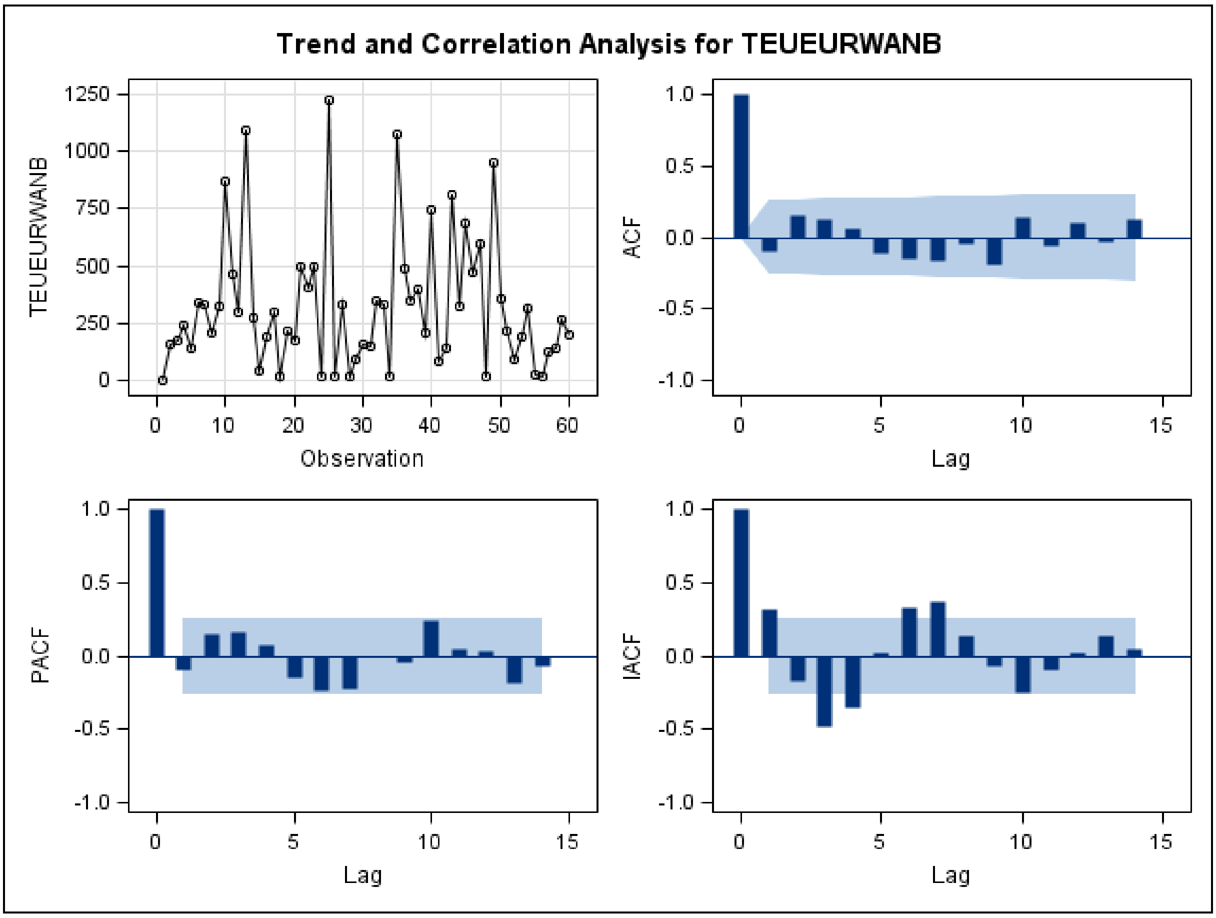


R.3.5 TEU volumes: Europe – West Africa, North bound: ARIMA (0, 1, 1)

Descriptive statistics

Mean of Working Series	320,9333
Standard Deviation	285,6432
Number of Observations	60

Figure 289: Trend and correlation analysis for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model (1)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests

Table 264: Augmented Dickey-Fuller unit root tests for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model

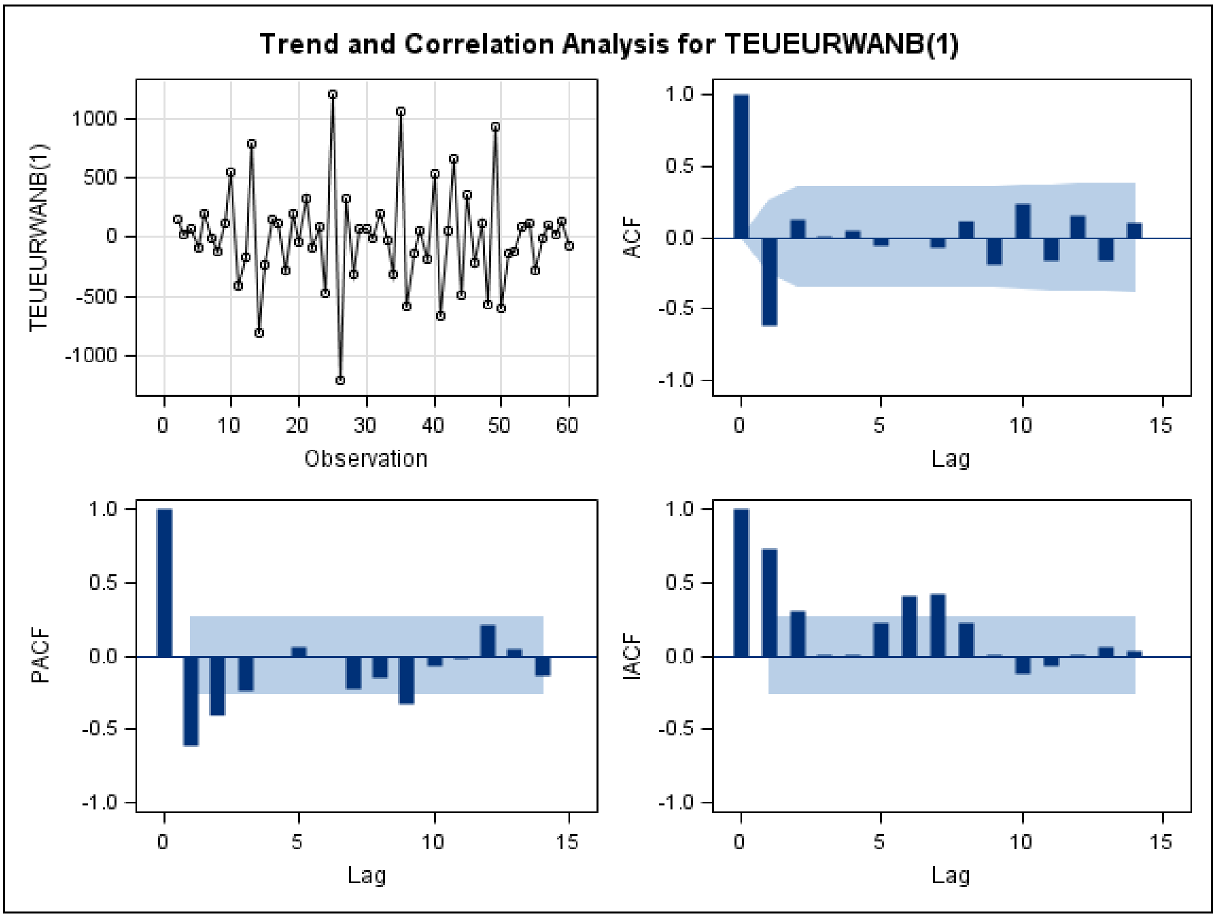
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-28,1784	<0,0001	-4,26	<0,0001		
	1	-9,2314	0,0313	-2,09	0,0359		
	2	-4,0897	0,1602	-1,35	0,1623		
Single Mean	0	-64,4893	0,0005	-8,36	0,0001	34,99	0,0010
	1	-47,5605	0,0005	-4,82	0,0003	11,60	0,0010
	2	-31,2544	0,0005	-3,43	0,0136	5,89	0,0182
Trend	0	-64,4886	0,0001	-8,30	<0,0001	34,50	0,0010
	1	-47,6610	0,0001	-4,79	0,0014	11,57	0,0010
	2	-31,4082	0,0019	-3,43	0,0568	6,05	0,0716

Source: SAS 9.2 (16/10/2013)

Descriptive statistics after differentiating

Period(s) of Differentiating	1
Mean of Working Series	3,322034
Standard Deviation	423,4708
Number of Observations	59
Observation(s) eliminated by differentiating	1

Figure 290: Trend and correlation analysis for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model (2)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 265: Augmented Dickey-Fuller unit root tests after differentiating for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-93,7431	<0,0001	-15,52	<0,0001		
	1	-217,1930	0,0001	-10,25	<0,0001		
	2	1719,8990	0,9999	-7,55	<0,0001		
Single Mean	0	-93,7483	0,0005	-15,38	0,0001	118,29	0,0010
	1	-217,2460	0,0001	-10,16	0,0001	51,63	0,0010
	2	1718,2580	0,9999	-7,48	0,0001	27,96	0,0010
Trend	0	-93,8064	0,0001	-15,26	<0,0001	116,50	0,0010
	1	-219,2720	0,0001	-10,10	<0,0001	51,04	0,0010
	2	1364,2770	0,9999	-7,45	<0,0001	27,77	0,0010

Source: SAS 9.2 (16/10/2013)

ARIMA (0, 1, 1)

Conditional least squares estimation

Table 266: Conditional least squares estimation for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	171.997	719.384	0,24	0,8119	0
MA1.1	0,83779	0,07593	11,03	<,0001	1

Source: SAS 9.2 (16/10/2013)

Fit statistics

Constant Estimate	1,719971
Variance Estimate	96.215,97
Std Error Estimate	310,187
AI	846,3868
SBC	850,5418
Number of Residuals	59

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 267: Correlations of parameter estimates for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model

Parameter	MU	MA1.1
MU	1,000	0,203
MA1.1	0,203	1,000

Source: SAS 9.2 (16/10/2013)

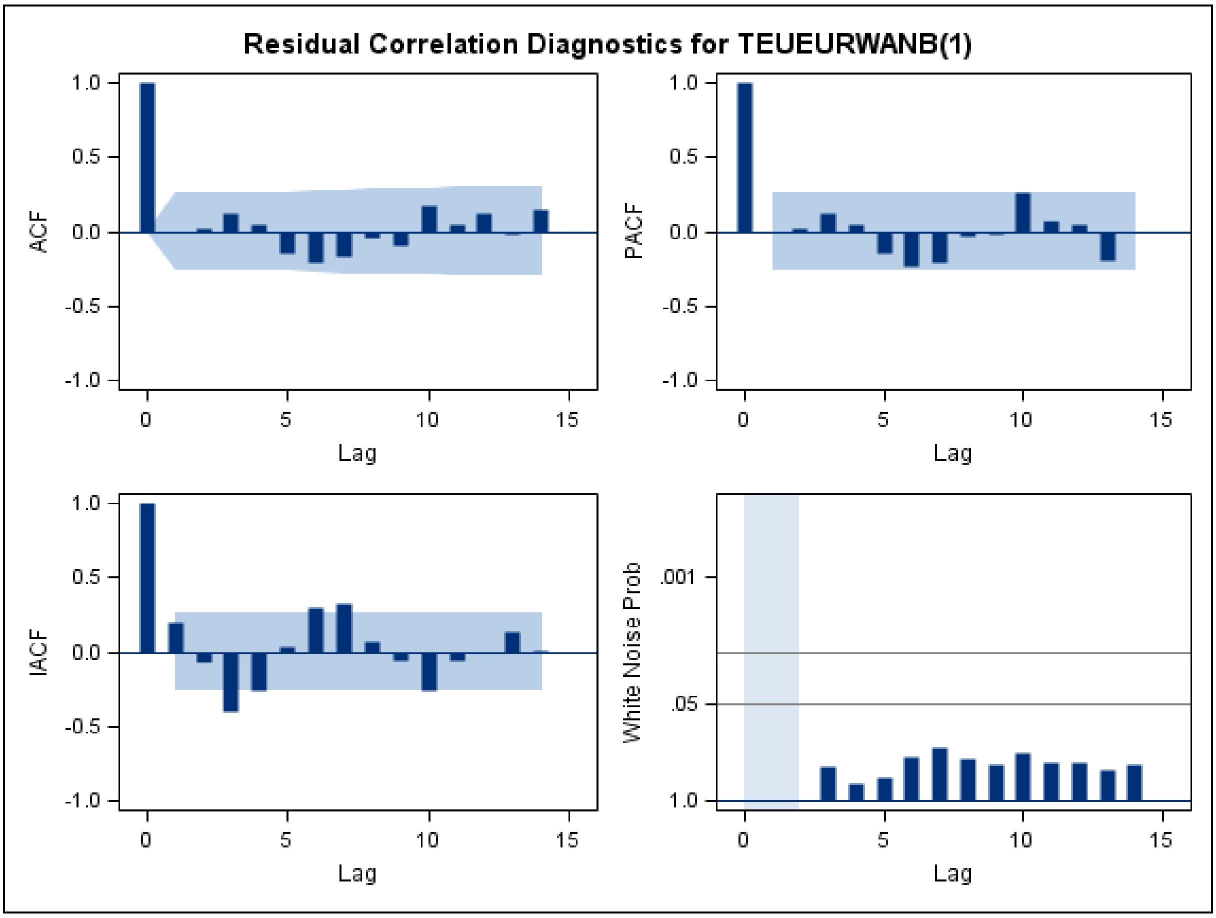
Autocorrelation check residuals

Table 268: Autocorrelation check residuals for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	5,07	5	0,4078	-0,136	0,143	0,126	0,080	-0,080	-0,106
12	10,97	11	0,446	-0,123	0,013	-0,123	0,180	-0,035	0,128
18	17,68	17	0,4091	-0,064	0,110	0,062	-0,166	-0,181	0,006
24	27,33	23	0,2423	-0,059	-0,093	-0,140	0,192	-0,082	0,154

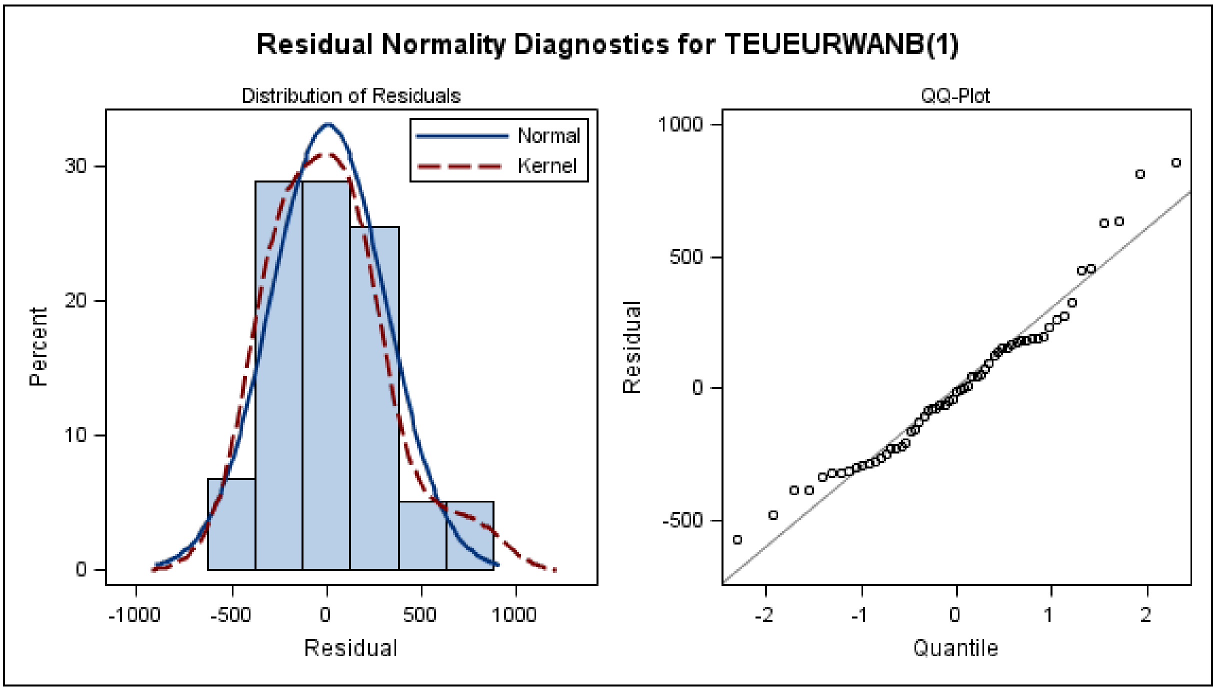
Source: SAS 9.2 (16/10/2013)

Figure 291: Residual correlation diagnostics for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2 (16/10/2013)

Figure 292: Residual Diagnostics for the TEU volumes of the Europe – West Africa, North bound time series and a fitted ARIMA (0, 1, 1) model



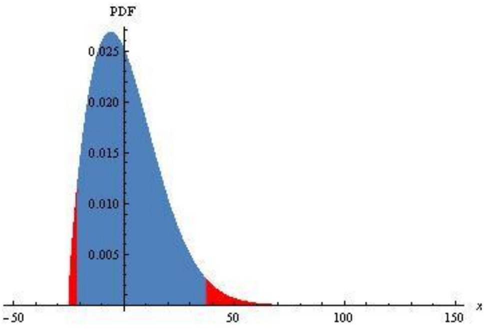
Source: SAS 9.2 (16/10/2013)

Model
Estimated Mean 1,719971
Period(s) of Differentiating 1
Moving average factors
Factor 1: 1 - 0,83779 Bˆ(1)

Weibull ()

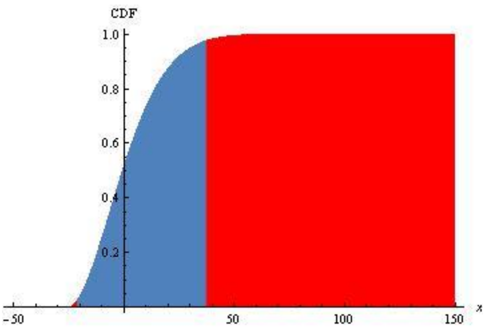
Probability density function

Figure 293: Probability density function Weibull (1.8, 30, -25)



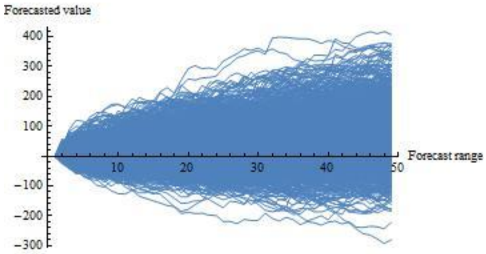
Cumulative density function

Figure 294: Cumulative density function Weibull (1.8, 30, -25)



Possible prediction paths

Figure 295: Possible prediction paths 48 steps ahead Weibull (1.8, 30, -25)

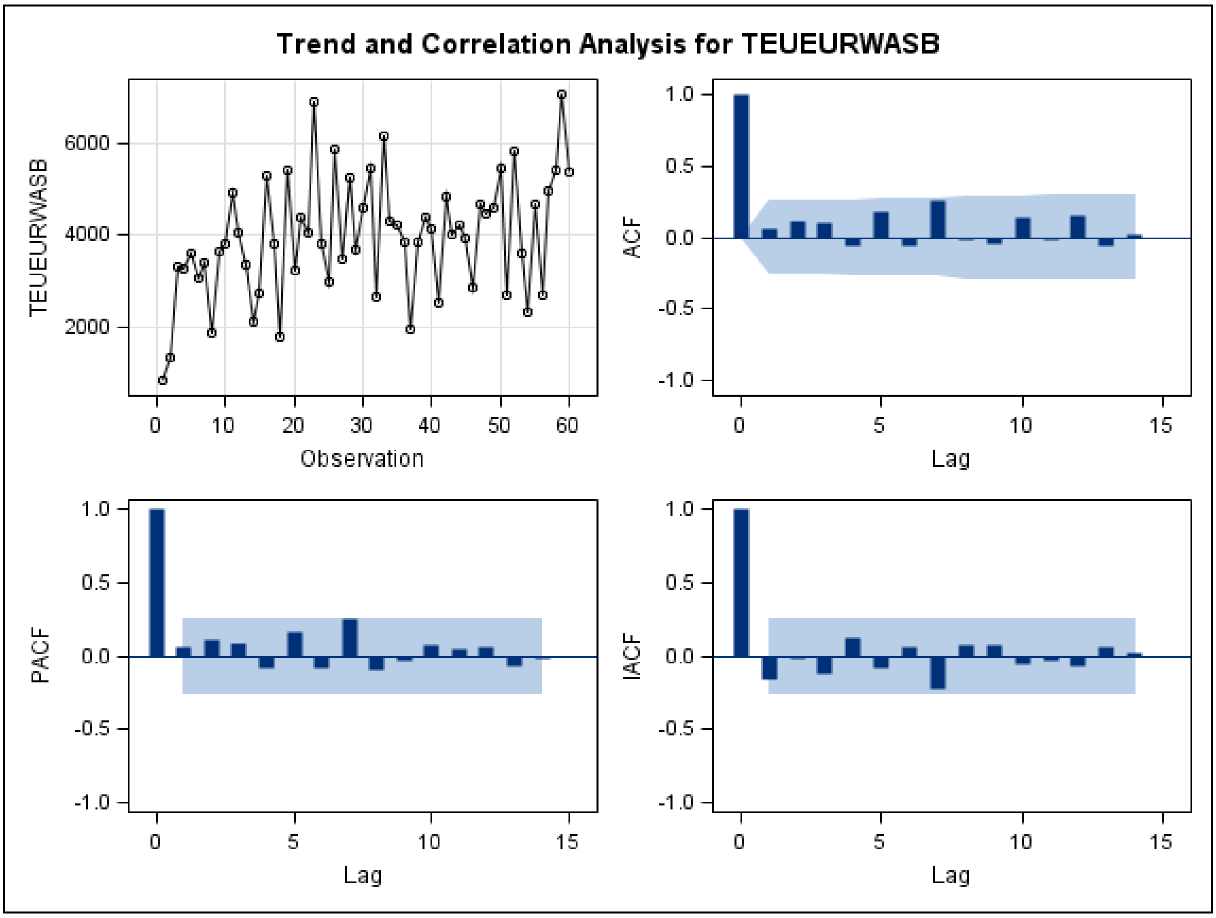


R.3.6 TEU volumes: Europe – West Africa, South bound: ARIMA(0, 1, 0)

Descriptive statistics

Mean of Working Series	3.952,217
Standard Deviation	1.300,029
Number of Observations	60

Figure 296: Trend and correlation analysis for the TEU volumes of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model (1)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests

Table 269: Augmented Dickey-Fuller unit root tests of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

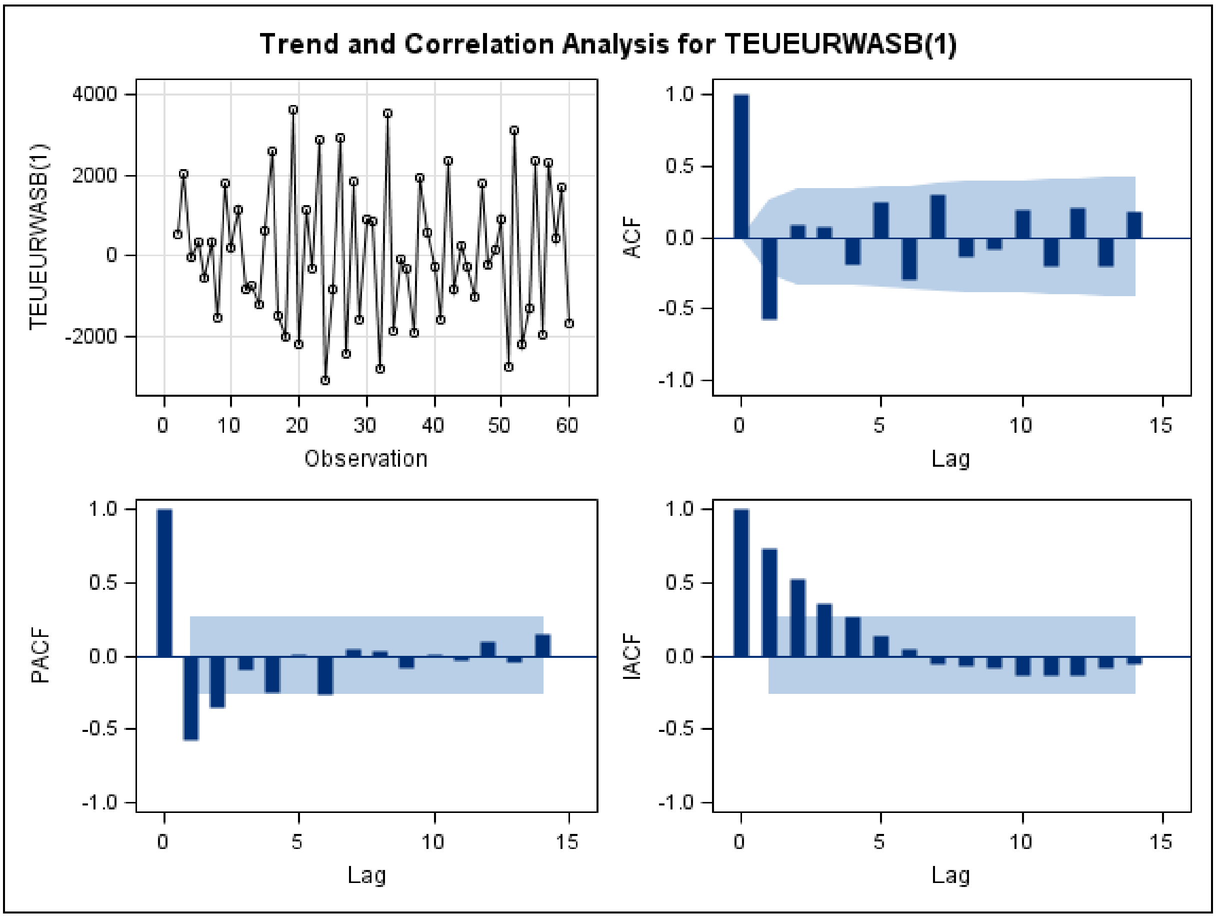
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-4,3690	0,1465	-1,36	0,1582		
	1	-0,3982	0,5893	-0,23	0,6007		
	2	0,3163	0,7546	0,27	0,7597		
Single Mean	0	-55,1630	0,0005	-7,38	0,0001	27,31	0,0010
	1	-45,1975	0,0005	-4,90	0,0002	12,36	0,0010
	2	-32,3708	0,0005	-3,37	0,0159	6,09	0,0139
Trend	0	-62,3163	0,0001	-8,17	<0,0001	33,44	0,0010
	1	-59,2499	0,0001	-5,50	0,0002	15,16	0,0010
	2	-49,7772	0,0001	-3,94	0,0164	7,77	0,0188

Source: SAS 9.2 (16/10/2013)

Descriptive statistics after differentiating

Period(s) of Differentiating	1
Mean of Working Series	77,9322
Standard Deviation	1.735,416
Number of Observations	59
Observation(s) eliminated by differentiating	1

Figure 297: Trend and correlation analysis for the TEU volumes of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model (2)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 270: Augmented Dickey-Fuller unit root tests after differentiating of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-91,5593	<0,0001	-14,45	<0,0001		
	1	-189,8520	0,0001	-9,79	<0,0001		
	2	-400,3500	0,0001	-6,66	<0,0001		
Single Mean	0	-91,8377	0,0005	-14,40	0,0001	103,75	0,0010
	1	-194,6450	0,0001	-9,79	0,0001	47,98	0,0010
	2	-464,6970	0,0001	-6,68	0,0001	22,32	0,0010
Trend	0	-91,8367	0,0001	-14,28	<0,0001	101,98	0,0010
	1	-194,5380	0,0001	-9,70	<0,0001	47,06	0,0010
	2	-456,0760	0,0001	-6,61	<0,0001	21,96	0,0010

Source: SAS 9.2 (16/10/2013)

ARIMA (1, 1, 1)

Conditional least squares estimation

Table 271: Conditional least squares estimation of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	62,14112	40,35596	1,54	0,1291	0
MA1.1	0,77708	0,08523	9,12	<0,0001	1

Source: SAS 9.2 (16/10/2013)

Fit statistics

Constant Estimate	62,14112
Variance Estimate	1.756.524
Std Error Estimate	1.325,339
AIC	1.017,752
SBC	1.021,907
Number of Residuals	59

* AIC and SBC do not include log determinant,

Correlations of parameter estimates

Table 272: Correlations of parameter estimates of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

Parameter	MU	MA1.1
MU	1,000	-0,008
MA1.1	-0,008	1,000

Source: SAS 9.2 (16/10/2013)

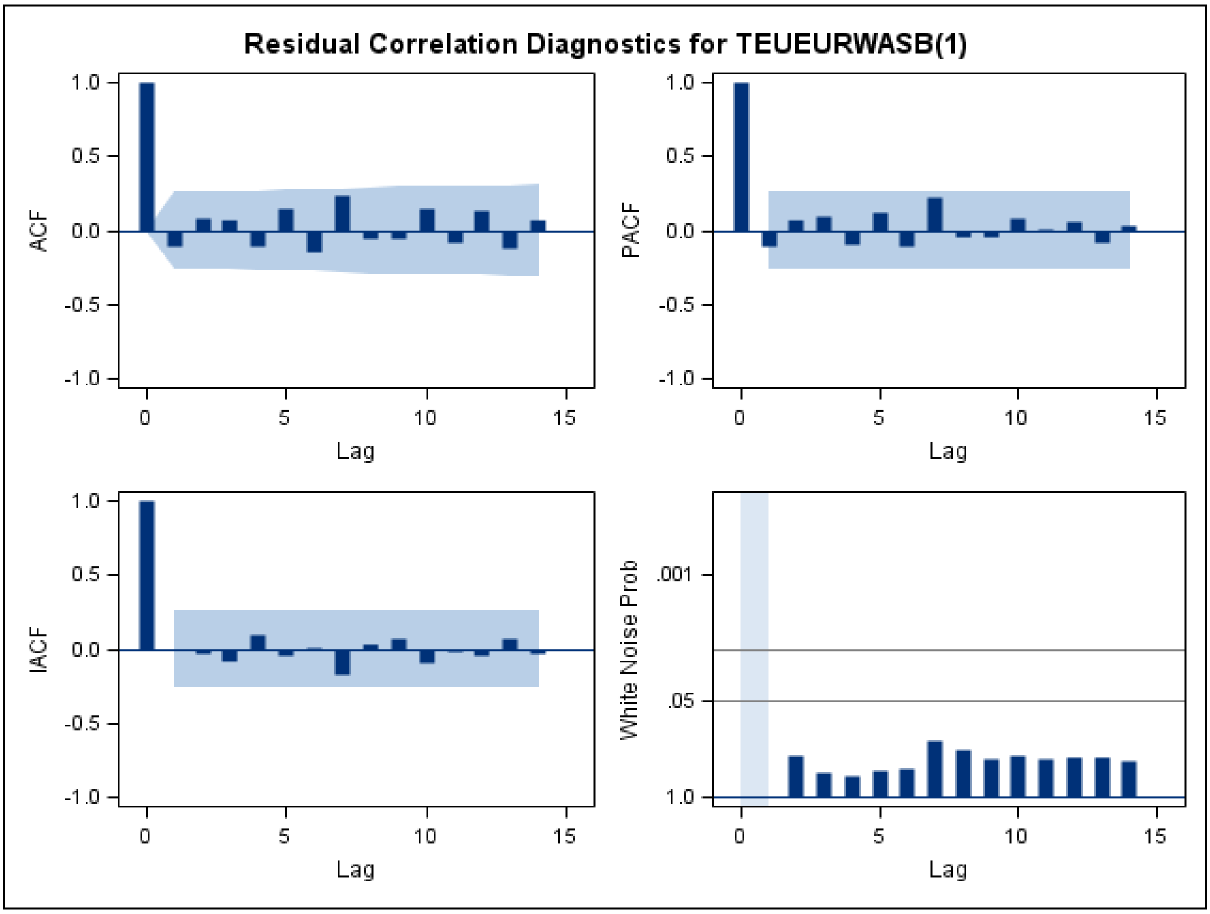
Autocorrelation check residuals

Table 273: Autocorrelation check residuals of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	5,05	5	0,4096	-0,110	0,078	0,071	-0,110	0,146	-0,143
12	12,92	11	0,2984	0,238	-0,060	-0,058	0,145	-0,089	0,131
18	22,39	17	0,1703	-0,122	0,073	-0,145	0,071	0,181	-0,183
24	31,18	23	0,1183	0,251	-0,095	-0,067	-0,031	-0,090	0,097

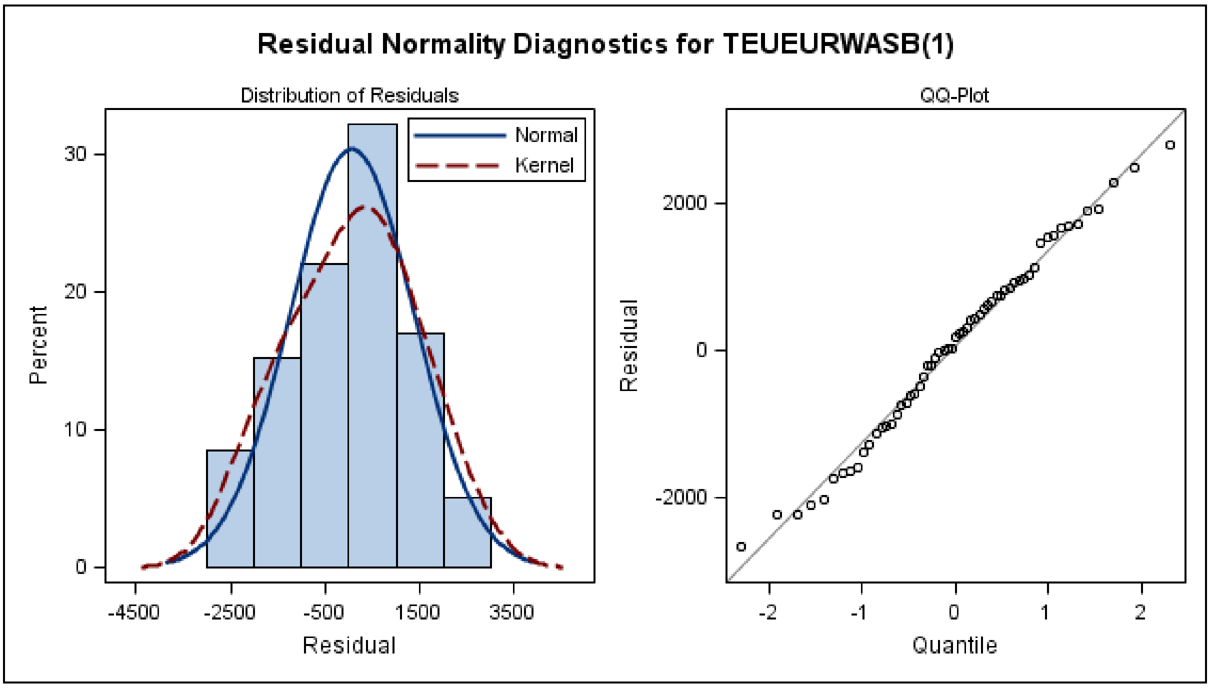
Source: SAS 9.2 (16/10/2013)

Figure 298: Residual correlation diagnostics for the TEU volumes of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model



Source: SAS 9.2 (16/10/2013)

Figure 299: Residual normality diagnostics for the TEU volumes of the Europe – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model



Source: SAS 9.2 (16/10/2013)

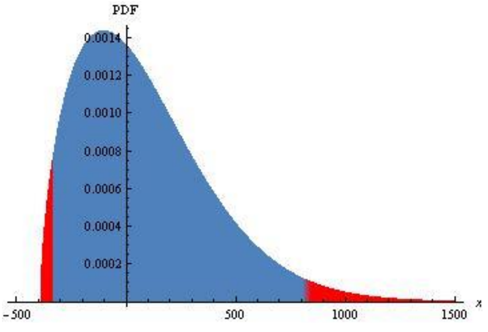
Model
Estimated Mean 62,14112
Period(s) of Differentiating 1

Moving average factors
Factor 1: 1 - 0,77708 Bˆ(1)

Weibull (1.6, 520, -390)

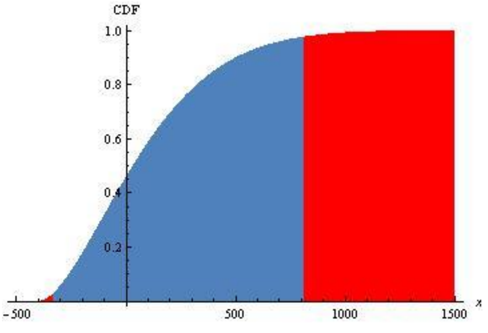
Probability density function

Figure 300: Probability density function Weibull (1.6, 520, -390)



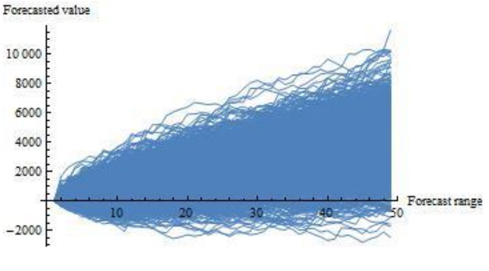
Cumulative density function

Figure 301: Cumulative density function Weibull (1.6, 520, -390)



Possible prediction paths

Figure 302: Possible prediction paths 48 steps ahead Weibull (1.6, 520, -390)

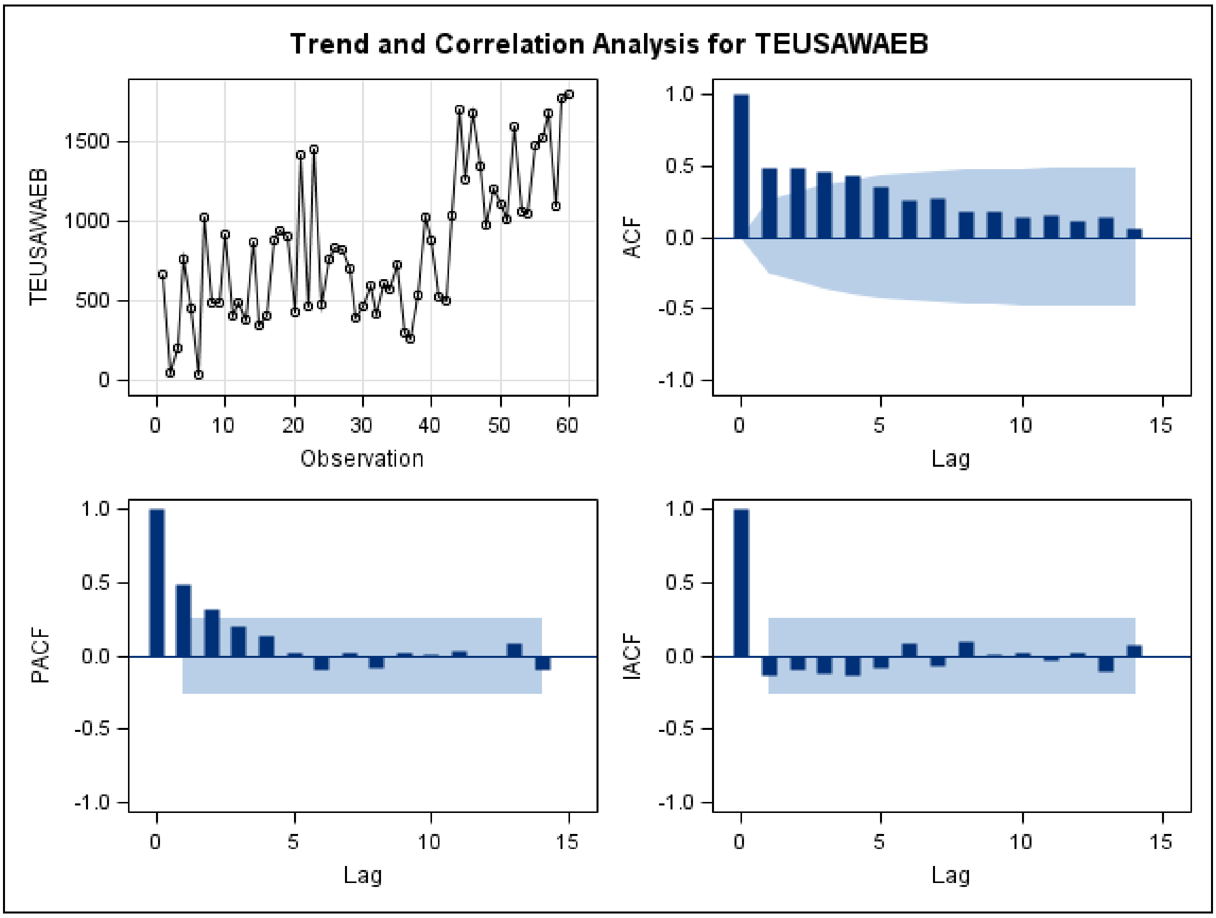


R.3.7 TEU volumes: South America – West Africa, East bound: ARIMA(0, 1, 0)

Descriptive statistics

Mean of Working Series	837,0833
Standard Deviation	449,7963
Number of Observations	60

Figure 303: Trend and correlation analysis for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model (1)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests

Table 274: Augmented Dickey-Fuller unit root tests for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

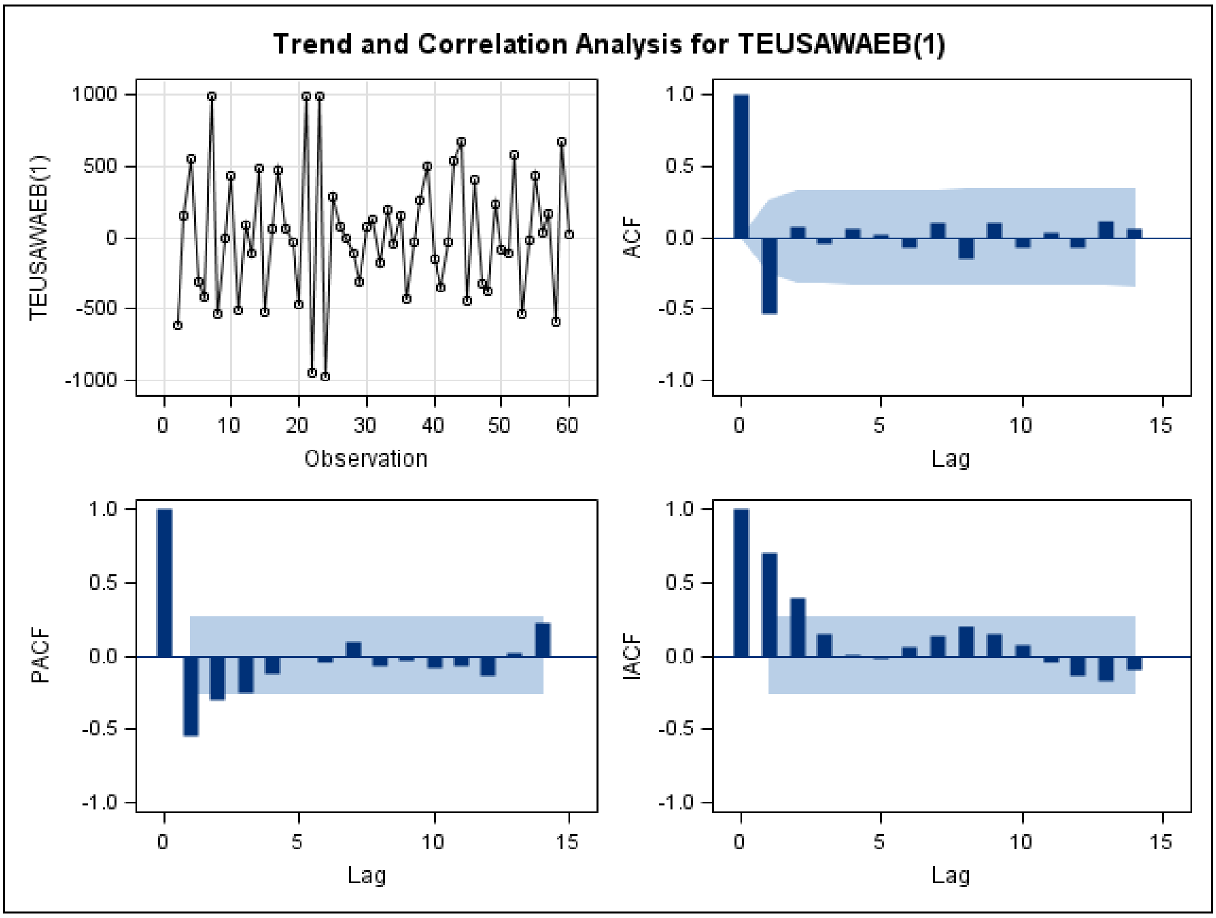
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-5,0118	0,1193	-1,39	0,1517		
	1	-0,1098	0,6545	-0,05	0,6615		
	2	0,7065	0,8507	0,48	0,8162		
Single Mean	0	-27,6593	0,0006	-3,96	0,0029	7,91	0,0010
	1	-10,6735	0,0987	-2,01	0,2833	2,37	0,4727
	2	-5,6306	0,3618	-1,39	0,5819	1,60	0,6666
Trend	0	-49,4030	0,0001	-6,30	<0,0001	19,98	0,0010
	1	-29,4486	0,0035	-3,54	0,0445	6,34	0,0571
	2	-18,4336	0,0665	-2,57	0,2965	3,35	0,5149

Source: SAS 9.2 (16/10/2013)

Descriptive statistics after differentiating

Period(s) of Differentiating	1
Mean of Working Series	19,10169
Standard Deviation	439,7658
Number of Observations	59
Observation(s) eliminated by differentiating	1

Figure 304: Trend and correlation analysis for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model (2)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 275: Augmented Dickey-Fuller unit root tests after differentiating for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-89,1191	<0,0001	-14,07	<0,0001		
	1	-174,7350	0,0001	-9,05	<0,0001		
	2	-2312,8500	0,0001	-7,10	<0,0001		
Single Mean	0	-89,3442	0,0005	-14,06	0,0001	98,83	0,0010
	1	-179,2730	0,0001	-9,14	0,0001	41,77	0,0010
	2	37791,9700	0,9999	-7,22	0,0001	26,06	0,0010
Trend	0	-89,4739	0,0001	-13,95	<0,0001	97,35	0,0010
	1	-179,6650	0,0001	-9,06	<0,0001	41,08	0,0010
	2	10777,0900	0,9999	-7,20	<0,0001	26,06	0,0010

Source: SAS 9.2 (16/10/2013)

ARIMA(0, 1, 0)

Conditional least squares estimation

Table 276: Conditional least squares estimation for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	17,99244	11,41482	1,58	0,1205	0
MA1.1	0,75935	0,08905	8,53	<0,0001	1

Source: SAS 9.2 (24/09/2013)

Fit statistics

Constant Estimate	17,99244
Variance Estimate	119.401,1
Std Error Estimate	345,5447
AIC	859,1245
SBC	863,2795
Number of Residuals	59

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 277: Correlations of parameter estimates for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

Parameter	MU	MA1.1
MU	1,000	-0,138
MA1.1	-0,138	1,000

Source: SAS 9.2 (24/09/2013)

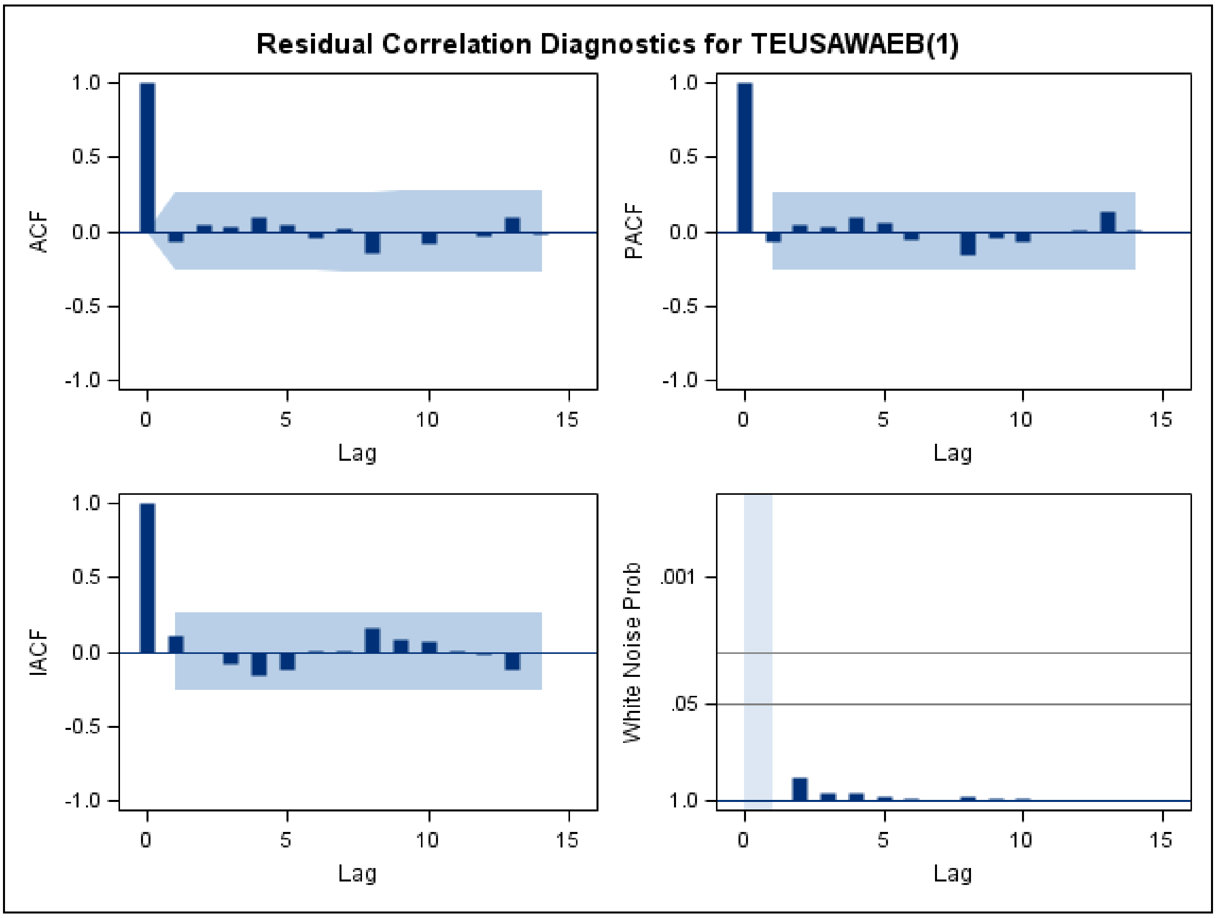
Autocorrelation check residuals

Table 278: Autocorrelation check residuals for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	2,95	5	0,7076	0,019	-0,019	0,007	-0,135	0,222	-0,010
12	5,53	11	0,9031	-0,027	-0,061	-0,111	-0,077	-0,196	0,055
18	13,47	17	0,7045	0,249	0,266	0,115	-0,293	0,016	0,042
24	16,31	23	0,8416	0,023	0,014	-0,207	-0,128	-0,127	-0,131

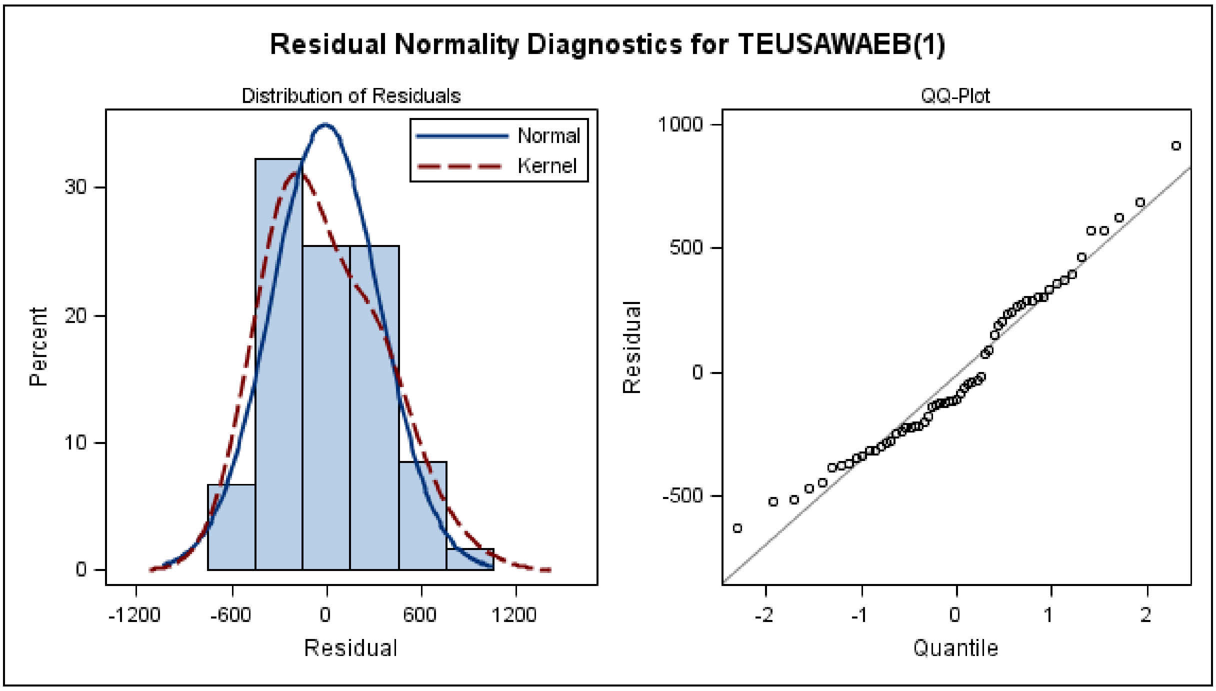
Source: SAS 9.2 (24/09/2013)

Figure 305: Residual correlation diagnostics for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model



Source: SAS 9.2 (24/09/2013)

Figure 306: Residual normality diagnostics for the TEU volumes of the South America – West Africa, South bound time series and a fitted ARIMA(0, 1, 0) model



Source: SAS 9.2 (24/09/2013)

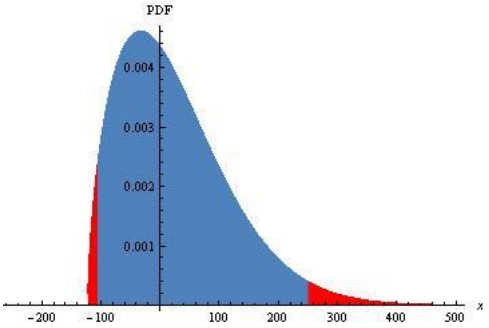
Model
Estimated Mean 17,99244
Period(s) of Differentiating 1

Moving average factors
Factor 1: 1 - 0,75935 Bˆ(1)

Weibull (1.6, 165, -122)

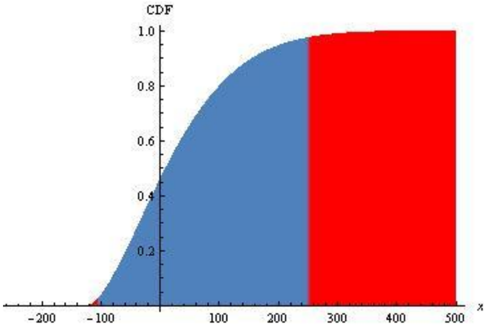
Probability density function

Figure 307: Probability density function Weibull (1.6, 165, -122)



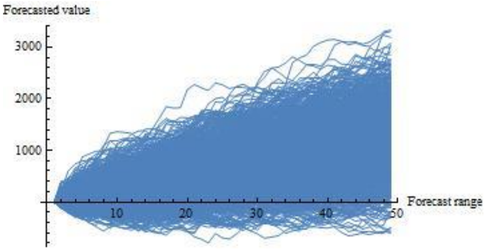
Cumulative density function

Figure 308: Cumulative density function Weibull (1.6, 165, -122)



Possible prediction paths

Figure 309: Possible prediction paths 48 steps ahead Weibull (1.6, 165, -122)

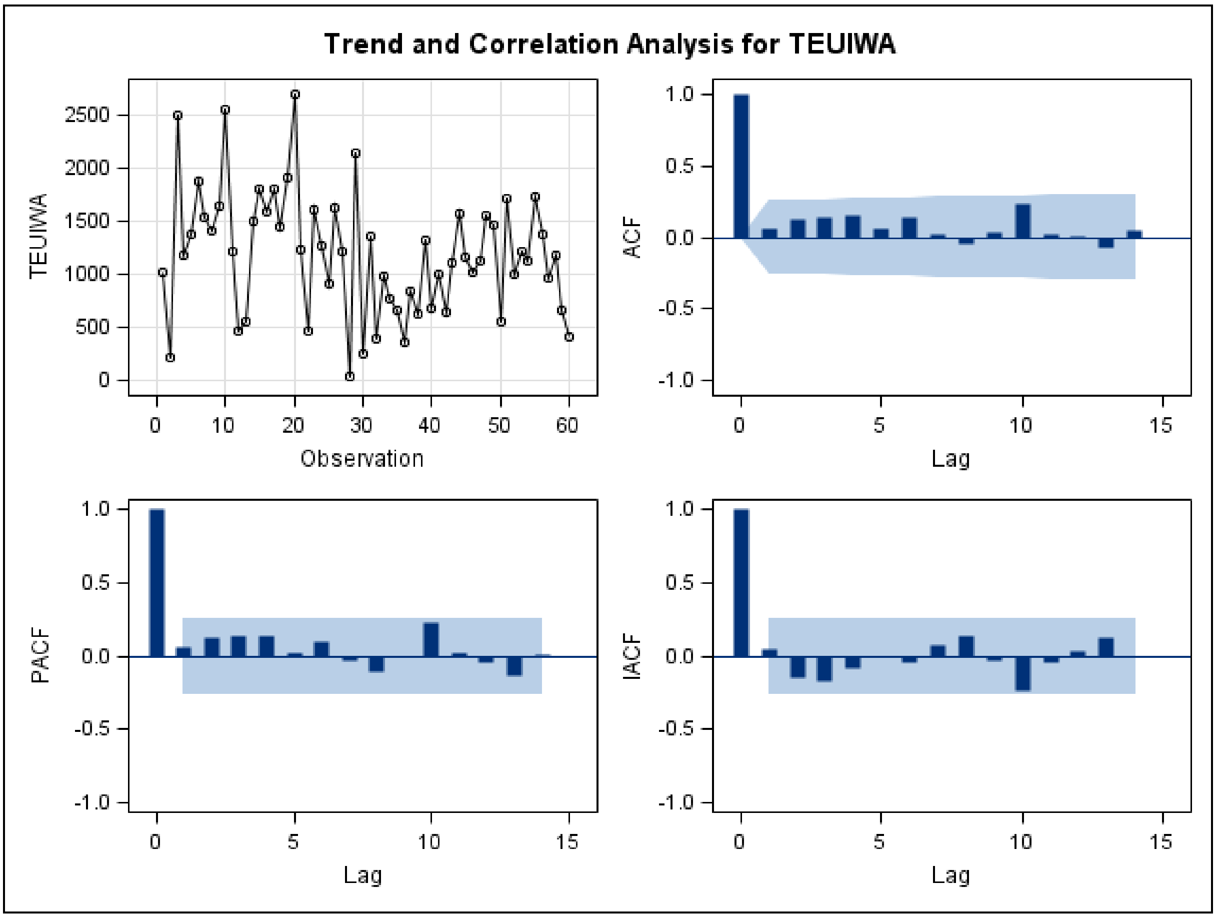


R.3.8 TEU volumes: Inter West Africa: ARIMA (0, 1, 1)

Descriptive statistics

Mean of Working Series	1.193,917
Standard Deviation	569,6878
Number of Observations	60

Figure 310: Trend and correlation analysis for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model (1)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests

Table 279: Augmented Dickey-Fuller unit root tests for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model

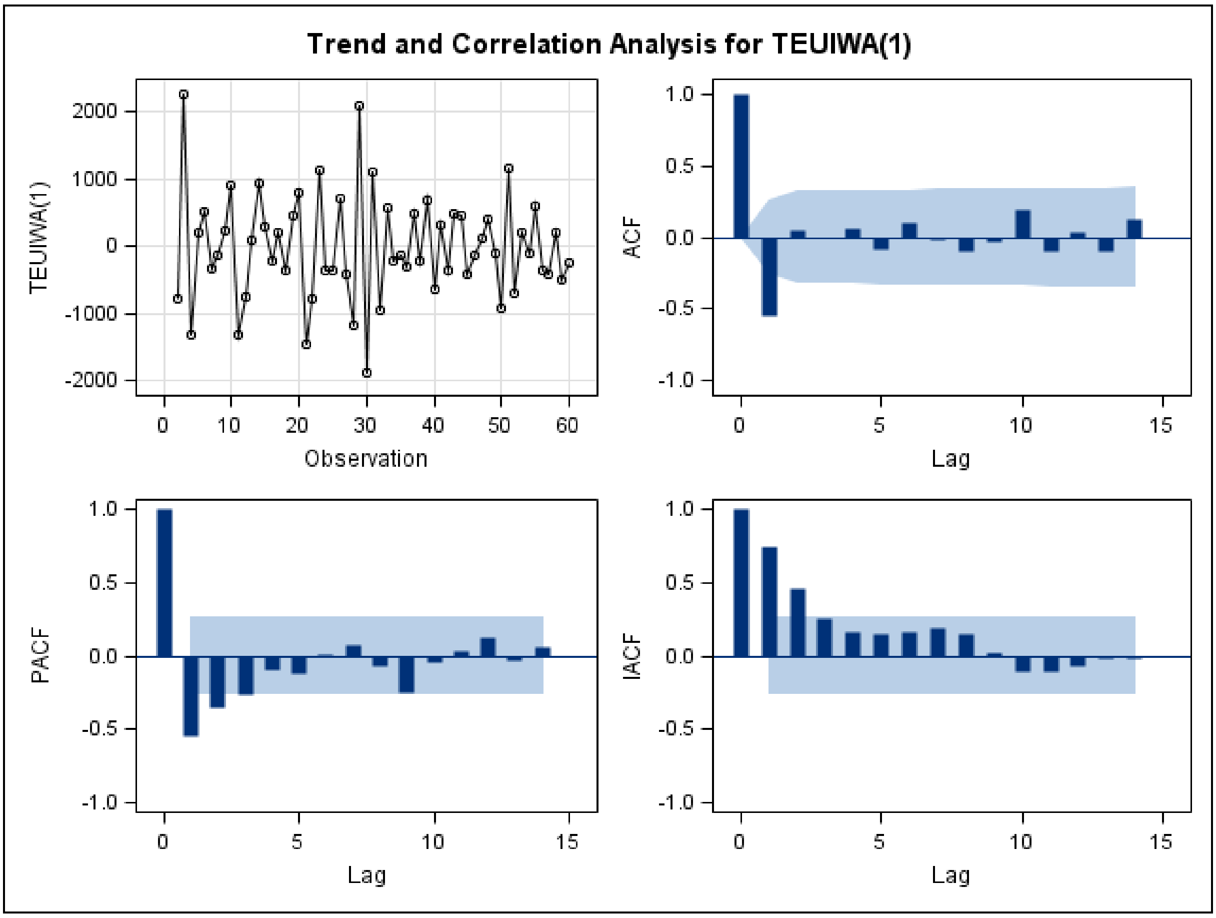
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-10,4033	0,0218	-2,40	0,017		
	1	-3,2572	0,2113	-1,25	0,1905		
	2	-2,0411	0,323	-1,15	0,2238		
Single Mean	0	-55,5802	0,0005	-7,02	0,0001	24,62	0,0010
	1	-42,7129	0,0005	-4,50	0,0006	10,10	0,0010
	2	-25,6004	0,0011	-3,01	0,0394	4,63	0,0547
Trend	0	-59,3499	0,0001	-7,51	<0,0001	28,26	0,0010
	1	-53,4200	0,0001	-5,26	0,0003	14,24	0,0010
	2	-34,9773	0,0006	-3,48	0,0508	6,11	0,0687

Source: SAS 9.2 (16/10/2013)

Descriptive statistics after differentiating

Period(s) of Differentiating	1
Mean of Working Series	-10,1017
Standard Deviation	782,3281
Number of Observations	59
Observation(s) eliminated by differentiating	1

Figure 311: Trend and correlation analysis for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model (2)



Source: SAS 9.2 (24/09/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 280: Augmented Dickey-Fuller unit root tests after differentiating for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-89,5917	<0,0001	-14,06	<0,0001		
	1	-172,4120	0,0001	-9,77	<0,0001		
	2	3880,6980	0,9999	-7,60	<0,0001		
Single Mean	0	-89,5917	0,0005	-13,94	0,0001	97,12	0,0010
	1	-172,1840	0,0001	-9,69	0,0001	47,10	0,0010
	2	3851,6100	0,9999	-7,55	0,0001	28,51	0,0010
Trend	0	-89,7277	0,0001	-13,90	<0,0001	96,62	0,0010
	1	-172,9320	0,0001	-9,60	<0,0001	46,18	0,0010
	2	3216,0000	0,9999	-7,49	<0,0001	28,07	0,0010

Source: SAS 9.2 (16/10/2013)

Conditional least squares estimation

Table 281: Conditional least squares estimation for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-3,37737	12,3948	-0,27	0,7862	0
MA1.1	0,85299	0,07067	12,07	<0,0001	1

Source: SAS 9.2 (24/09/2013)

Fit statistics

Constant Estimate	-3,37737
Variance Estimate	346.959,8
Std Error Estimate	589,0329
AIC	922,0609
SBC	926,216
Number of Residuals	59

* AIC and SBC do not include log determinant Correlations of parameter estimates

Correlations of Parameter Estimates

Table 282: Correlations of Parameter Estimates for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model

Parameter	MU	MA1.1
MU	1,000	0,161
MA1.1	0,161	1,000

Source: SAS 9.2 (24/09/2013)

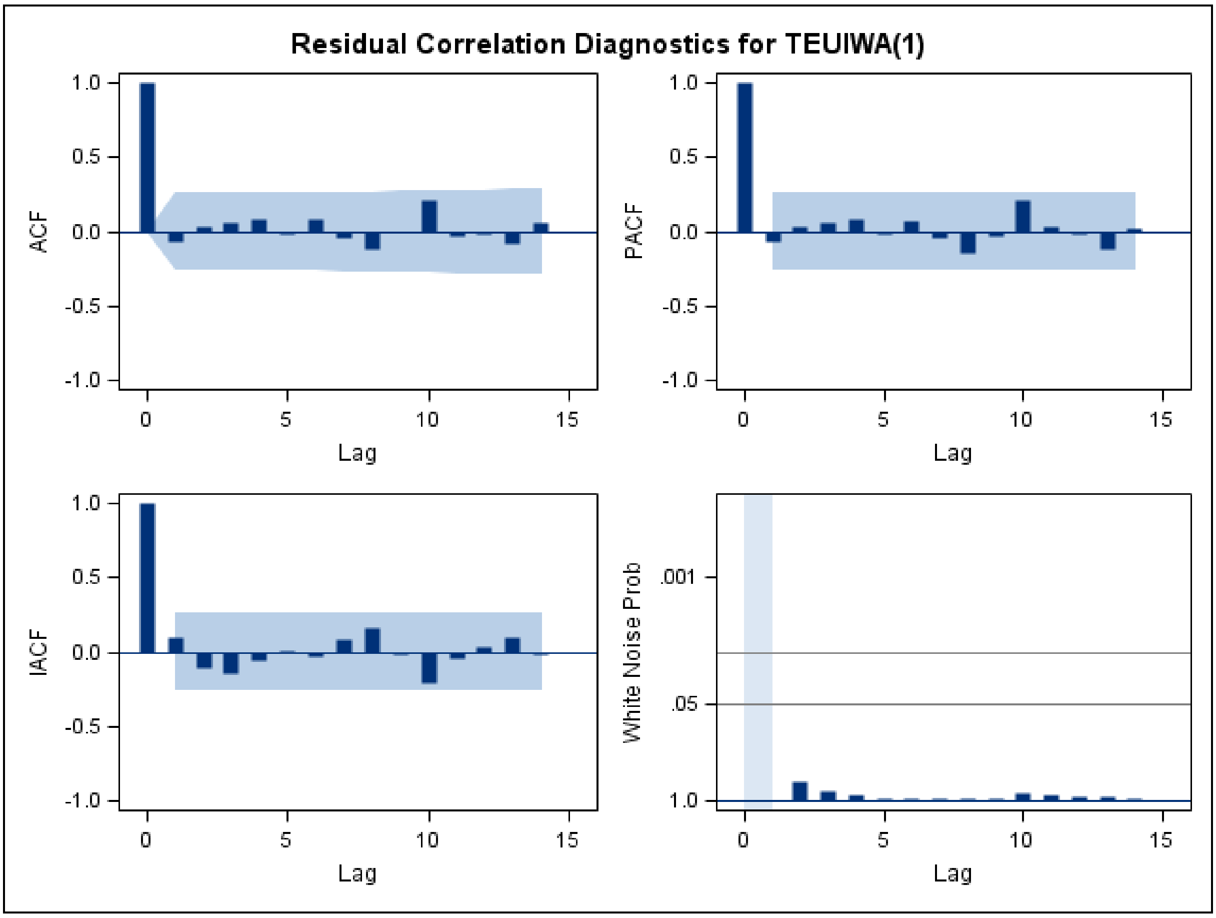
Autocorrelation check residuals

Table 283: Autocorrelation check residuals for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	2,95	5	0,7076	0,019	-0,019	0,007	-0,135	0,222	-0,010
12	5,53	11	0,9031	-0,027	-0,061	-0,111	-0,077	-0,196	0,055
18	13,47	17	0,7045	0,249	0,266	0,115	-0,293	0,016	0,042
24	16,31	23	0,8416	0,023	0,014	-0,207	-0,128	-0,127	-0,131

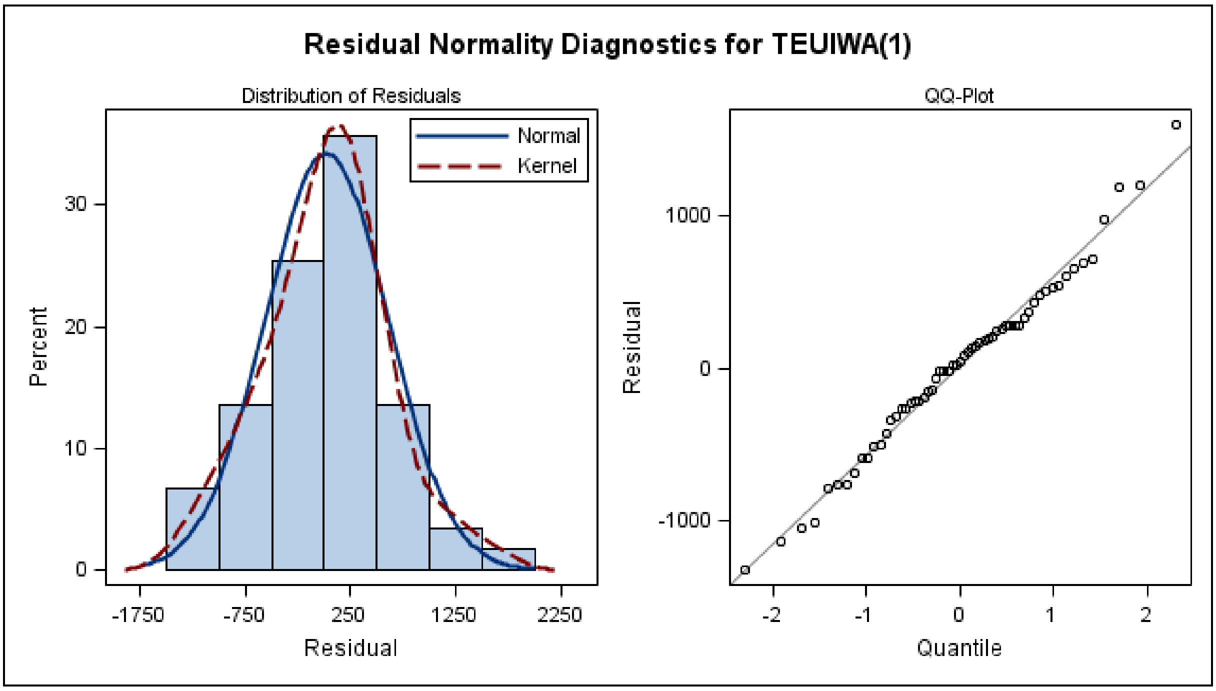
Source: SAS 9.2 (24/09/2013)

Figure 312: Residual correlation diagnostics for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2 (24/09/2013)

Figure 313: Residual normality diagnostics for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2 (24/09/2013)

Model

Estimated Mean	-3,37737
Period(s) of Differentiating	1

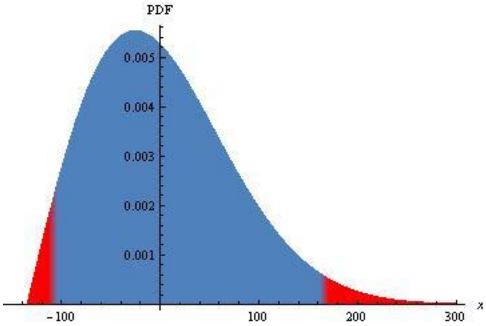
Moving average factors

Factor 1: 1 - 0,85299 Bˆ(1)

Weibull (2, 155, -135))

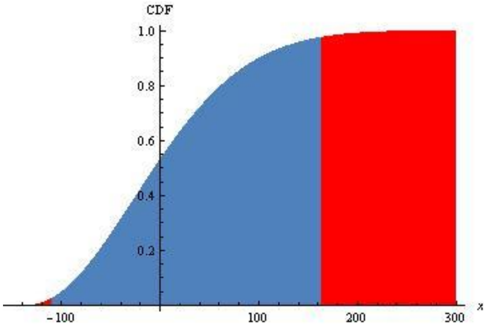
Probability density function

Figure 314: Probability density function Weibull (2, 155, -135)



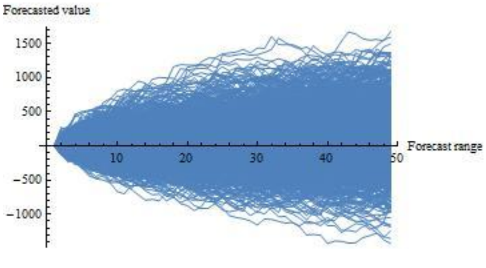
Cumulative density function

Figure 315: Cumulative density function Weibull (2, 155, -135)



Possible prediction paths

Figure 316: Possible prediction paths 48 steps ahead Weibull (2, 155, -135)

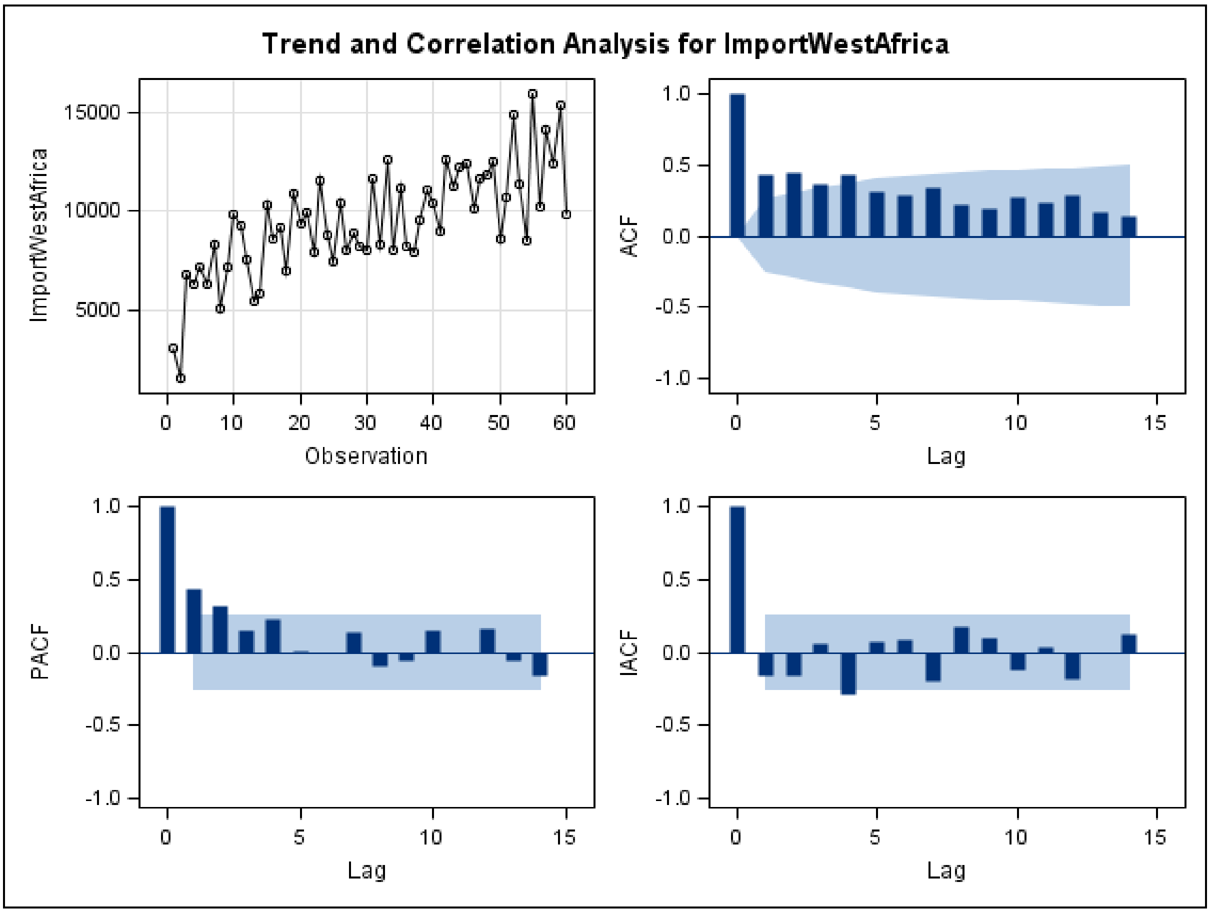


R.3.9 Import West Africa: ARIMA (3, 1, 0)

Descriptive statistics

Mean of Working Series	9.497,05
Standard Deviation	2.704,674
Number of Observations	60

Figure 317: Trend and correlation analysis for the TEU volumes of the Import West Africa time series and a fitted ARIMA (3, 1, 0) model



Source: SAS 9.2 (20/11/2013)

Augmented Dickey-Fuller unit root tests

Table 284: Augmented Dickey-Fuller unit root tests for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

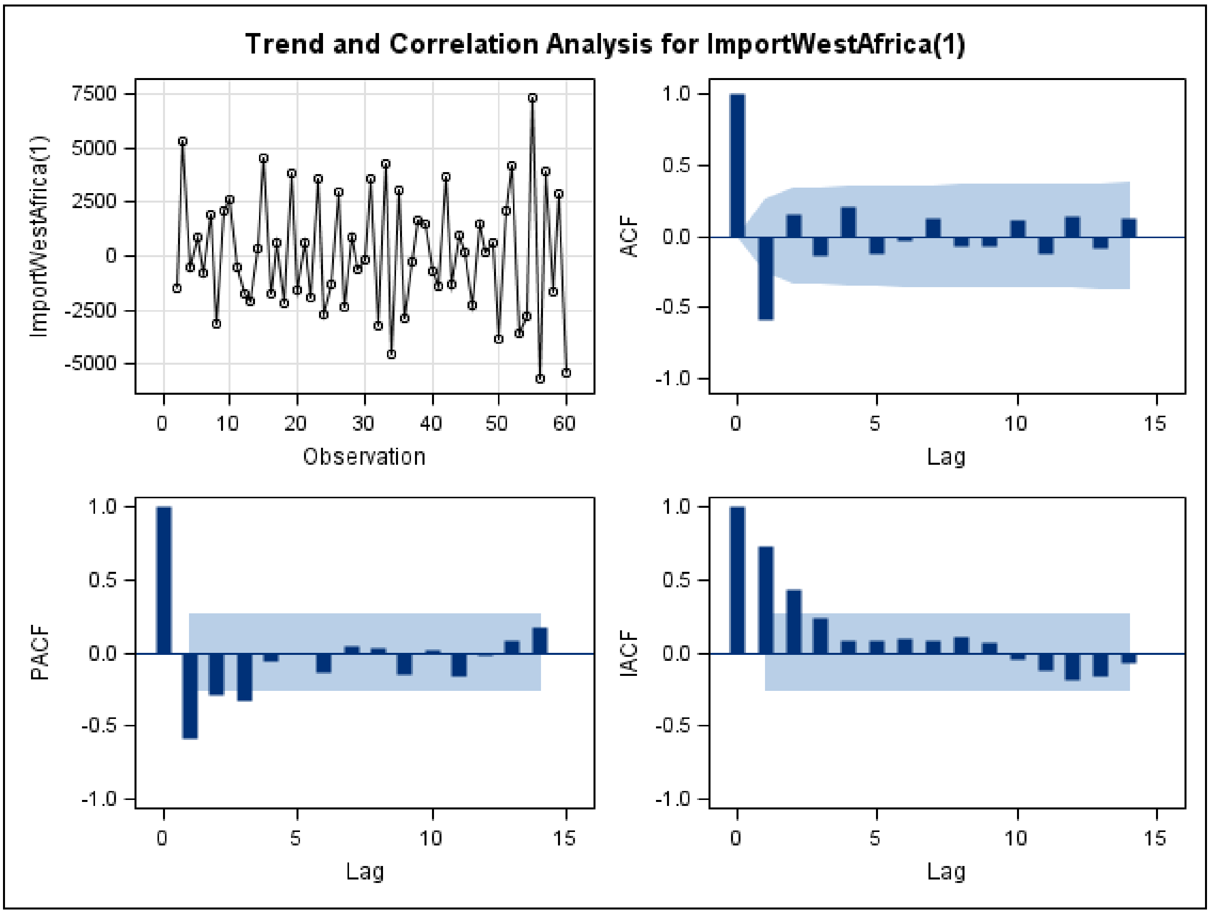
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-1,9142	0,3381	-0,88	0,3319		
	1	0,1428	0,7122	0,13	0,72		
	2	0,3971	0,7752	0,50	0,8201		
Single Mean	0	-33,7484	0,0005	-5,08	0,0001	12,97	0,0010
	1	-18,0492	0,0121	-3,66	0,0071	7,23	0,0010
	2	-10,9597	0,0911	-2,64	0,0915	4,08	0,0868
Trend	0	-70,3220	0,0001	-9,09	<0,0001	41,60	0,0010
	1	-77,3383	0,0001	-6,85	<0,0001	24,08	0,0010
	2	-114,2780	0,0001	-5,75	<0,0001	16,82	0,0010

Source: SAS 9.2 (20/11/2013)

Descriptive statistics after differentiating

Period(s) of Differentiating	1
Mean of Working Series	114,8814
Standard Deviation	2.794,114
Number of Observations	59
Observation(s) eliminated by differentiating	1

Figure 318: Trend and correlation analysis for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model (2)



Source: SAS 9.2 (20/11/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 285: Augmented Dickey-Fuller unit root tests after differentiating for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-93,9780	<0,0001	-14,85	<0,0001		
	1	-169,4100	0,0001	-9,12	<0,0001		
	2	474,2275	0,9999	-8,68	<0,0001		
Single Mean	0	-94,4308	0,0005	-14,85	0,0001	110,36	0,0010
	1	-177,4100	0,0001	-9,18	0,0001	42,24	0,0010
	2	361,1647	0,9999	-8,92	0,0001	39,94	0,0010
Trend	0	-94,4616	0,0001	-14,82	<0,0001	110,02	0,0010
	1	-179,5980	0,0001	-9,15	<0,0001	41,83	0,0010
	2	350,6019	0,9999	-8,88	<0,0001	39,42	0,0010

Source: SAS 9.2 (20/11/2013)

ARIMA (3, 1, 0)

Conditional least squares estimation

Table 286: Conditional least squares estimation for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	163,5797	87,33873	1,87	0,0664	0
AR1.1	-0,96119	0,12788	-7,52	<0,0001	1
AR1.2	-0,65832	0,1587	-4,15	0,0001	2
AR1.3	-0,41174	0,129	-3,19	0,0023	3

Source: SAS 9.2 (20/11/2013)

Fit statistics

Constant Estimate	495,8522
Variance Estimate	4.009.382
Std Error Estimate	2.002,344
AIC	1.068,337
SBC	107,648
Number of Residuals	59

* AIC and SBC do not include log determinant.

Correlations of Parameter Estimates

Table 287: Correlations of Parameter Estimates for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

Parameter	MU	AR1.1	AR1.2	AR1.3
MU	1,000	-0,029	-0,027	-0,025
AR1.1	-0,029	1,000	0,646	0,333
AR1.2	-0,027	0,646	1,000	0,642
AR1.3	-0,025	0,333	0,642	1,000

Source: SAS 9.2 (20/11/2013)

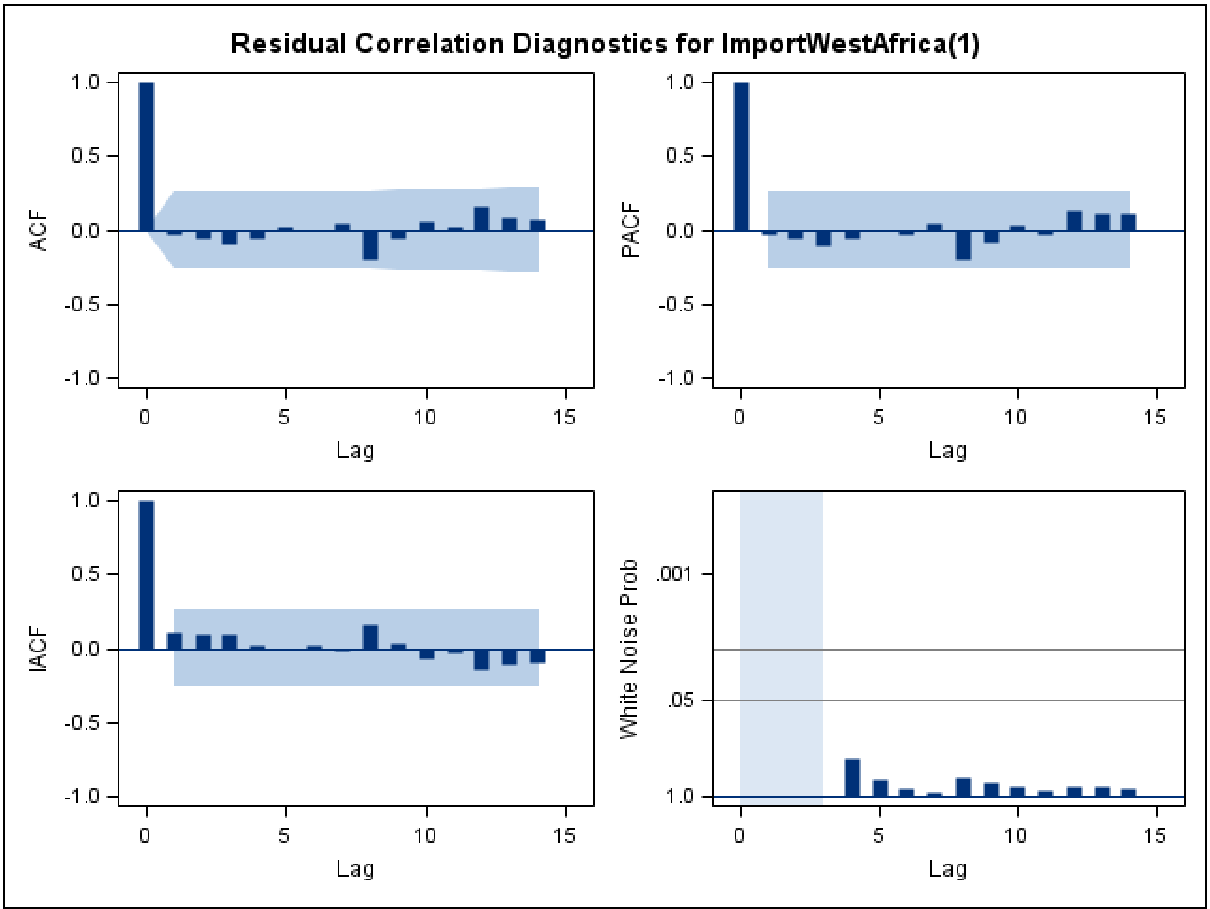
Autocorrelation check residuals

Table 288: Autocorrelation check residuals for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	1,06	3	0,7871	-0,032	-0,054	-0,099	-0,050	0,016	-0,010
12	6,22	9	0,7176	0,050	-0,195	-0,059	0,053	0,015	0,155
18	13,45	15	0,5673	0,086	0,077	-0,155	0,148	-0,055	-0,156
24	16,16	21	0,7604	0,003	-0,116	-0,043	0,004	0,057	0,097

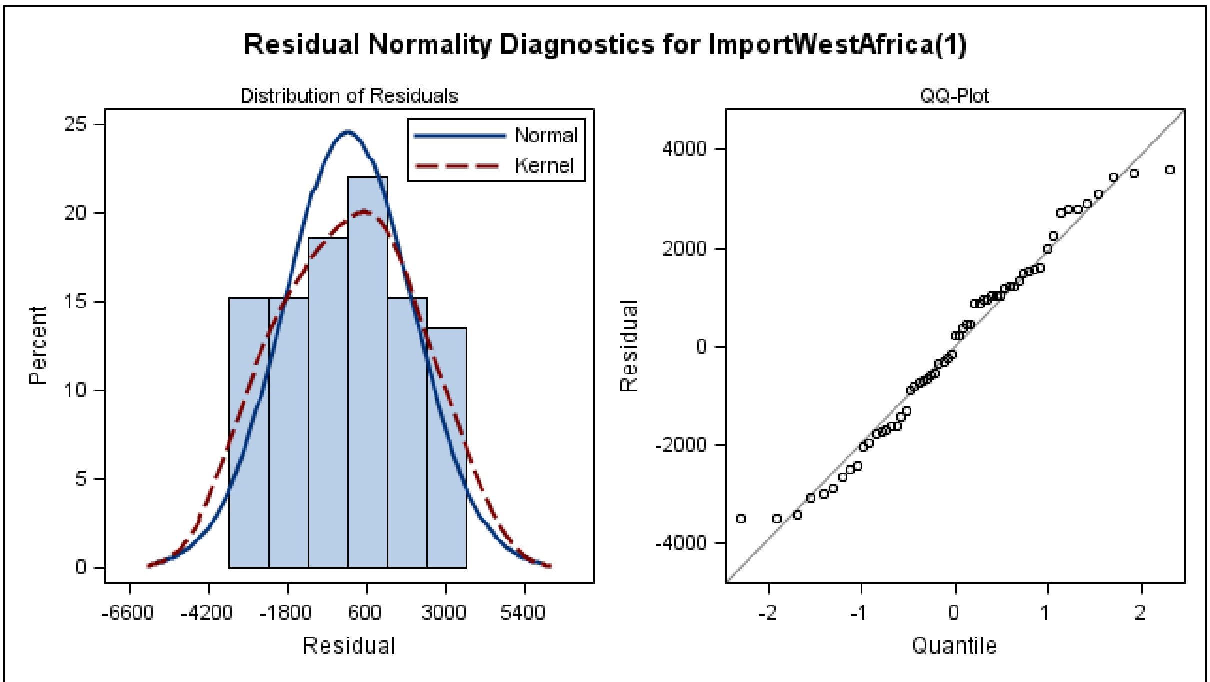
Source: SAS 9.2 (20/11/2013)

Figure 319: Residual correlation diagnostics for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model



Source: SAS 9.2 (20/11/2013)

Figure 320: Residual normality diagnostics for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model



Source: SAS 9.2 (20/11/2013)

Model

Estimated Mean 163,5797

Period(s) of Differentiating 1

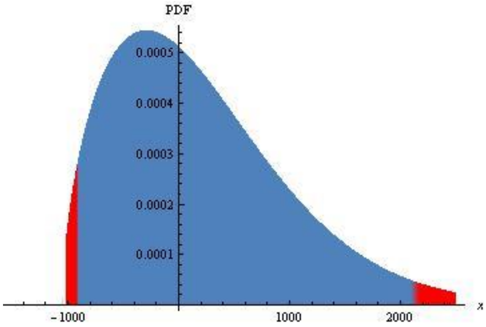
Auto regressive factors

Factor 1: 1 + 0,96119 B^(1) + 0,65832 B^(2) + 0,41174 B^(3)

Weibull (1.6, 1.400, -1.050)

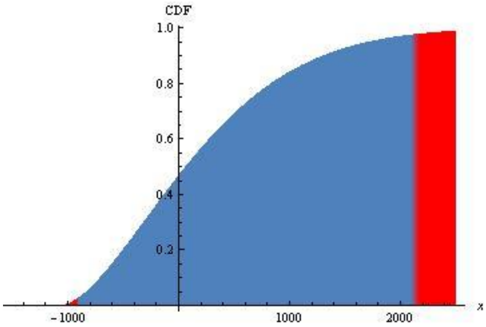
Probability density function

Figure 321: Probability density function Weibull (1.6, 1.400, -1.050)



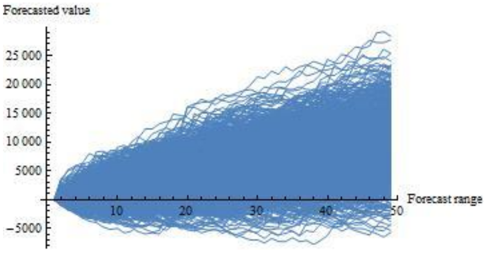
Cumulative density function

Figure 322: Cumulative density function Weibull (1.6, 1.400, -1.050)



Possible prediction paths

Figure 323: Possible prediction paths 48 steps ahead Weibull (1.6, 1.400, -1.050)

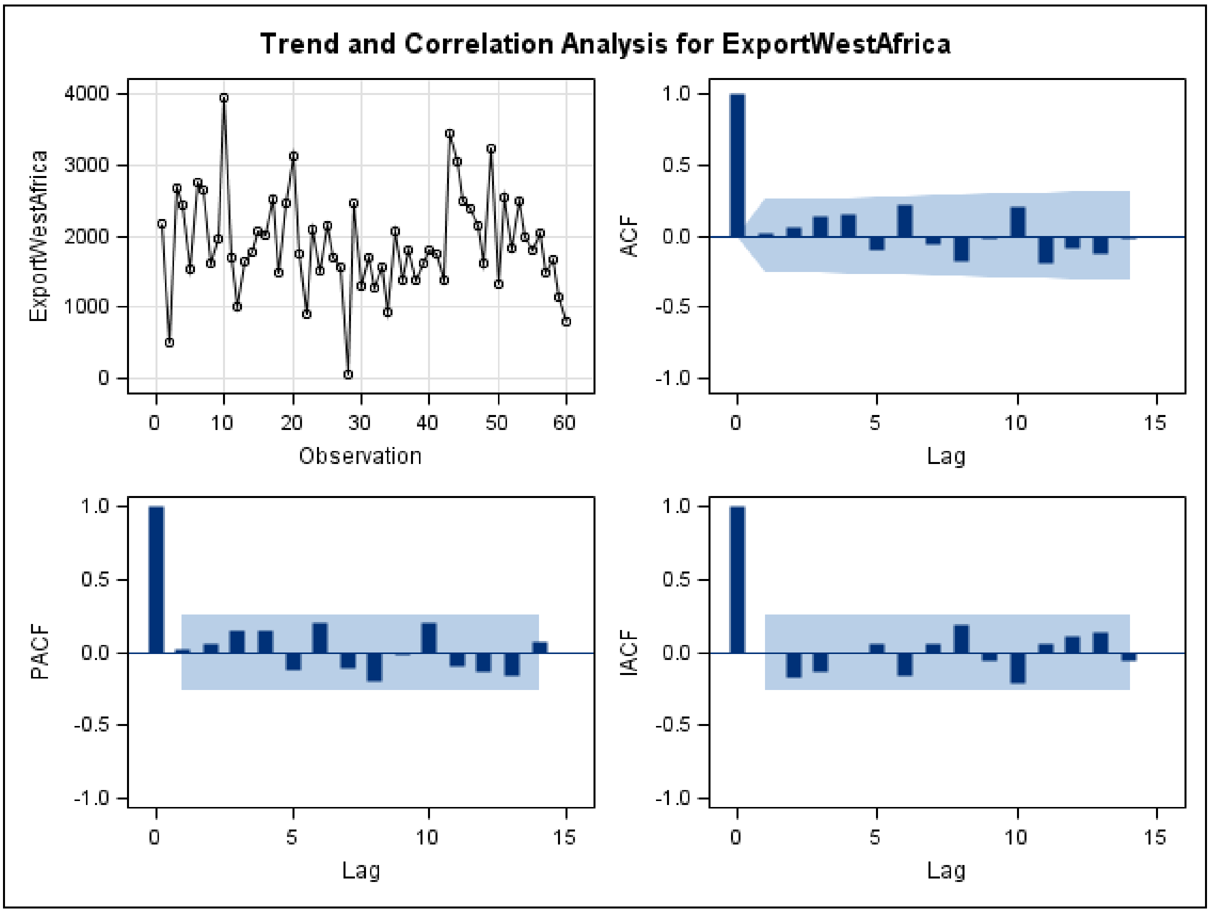


R.3.10 Export West Africa: ARIMA (3, 1, 0)

Descriptive statistics

Mean of Working Series	1895,15
Standard Deviation	696,9694
Number of Observations	60

Figure 324: Trend and correlation analysis for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model (1)



Source: SAS 9.2 (20/11/2013)

Augmented Dickey-Fuller unit root tests

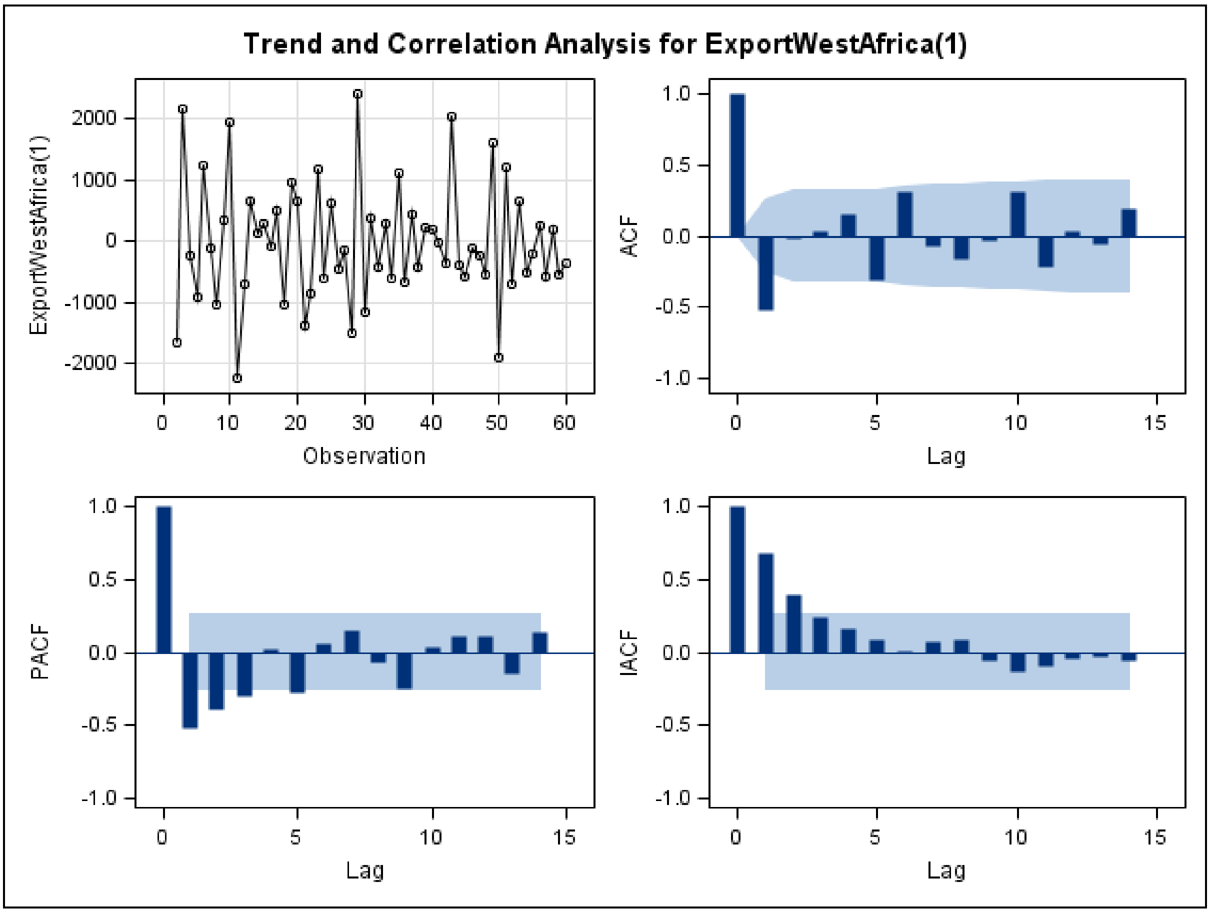
Table 289: Augmented Dickey-Fuller unit root tests for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-7,2364	0,059	-2,02	0,0423		
	1	-2,1795	0,3075	-1,04	0,2666		
	2	-1,2323	0,4314	-0,88	0,3323		
Single Mean	0	-57,7230	0,0005	-7,24	0,0001	26,23	0,0010
	1	-48,7760	0,0005	-4,73	0,0003	11,21	0,0010
	2	-29,8106	0,0005	-3,11	0,031	4,90	0,0446
Trend	0	-57,8579	0,0001	-7,20	<0,0001	25,99	0,0010
	1	-48,9433	0,0001	-4,75	0,0016	11,69	0,0010
	2	-29,9800	0,0029	-3,13	0,1101	5,08	0,1757

Source: SAS 9.2 (20/11/2013)

Descriptive statistics after differentiating

Figure 325: Trend and correlation analysis for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model (2)



Source: SAS 9.2 (20/11/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 290: Augmented Dickey-Fuller unit root tests after differentiating for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-88,2005	<0,0001	-13,90	<0,0001		
	1	-192,1420	0,0001	-9,87	<0,0001		
	2	775,6151	0,9999	-8,08	<0,0001		
Single Mean	0	-88,2053	0,0005	-13,78	0,0001	94,91	0,0010
	1	-192,1600	0,0001	-9,78	0,0001	47,91	0,0010
	2	771,3312	0,9999	-8,03	0,0001	32,28	0,0010
Trend	0	-88,2866	0,0001	-13,74	<0,0001	94,49	0,0010
	1	-194,0010	0,0001	-9,74	<0,0001	47,44	0,0010
	2	718,4663	0,9999	-7,99	<0,0001	31,94	0,0010

Source: SAS 9.2 (20/11/2013)

ARIMA (3, 1, 0)

Conditional least squares estimation

Table 291: Conditional least squares estimation for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-12057258	34,84301	-36	0,7196	0
AR1.1	-0,86385	0,12862	-6.072	<0,0001	1
AR1.2	-0,64315	0,15147	-4.025	<0,0001	2
AR1.3	-0,32063	0,12895	-2.049	160	3

Source: SAS 9.2 (20/11/2013)

Fit statistics

Constant Estimate	-35.5506
Variance Estimate	556569.1
Std Error Estimate	746.0356
AIC	951.8359
SBC	960.1461
Number of Residuals	59

* AIC and SBC do not include log determinant.

Correlations of Parameter Estimates

Table 292: Correlations of Parameter Estimates for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

Parameter	MU	AR1.1	AR1.2	AR1.3
MU	1,000	-0,008	-0,012	-0,008
AR1.1	-0,008	1,000	0,629	0,407
AR1.2	-0,012	0,629	1,000	0,629
AR1.3	-0,008	0,407	0,629	1,000

Source: SAS 9.2 (20/11/2013)

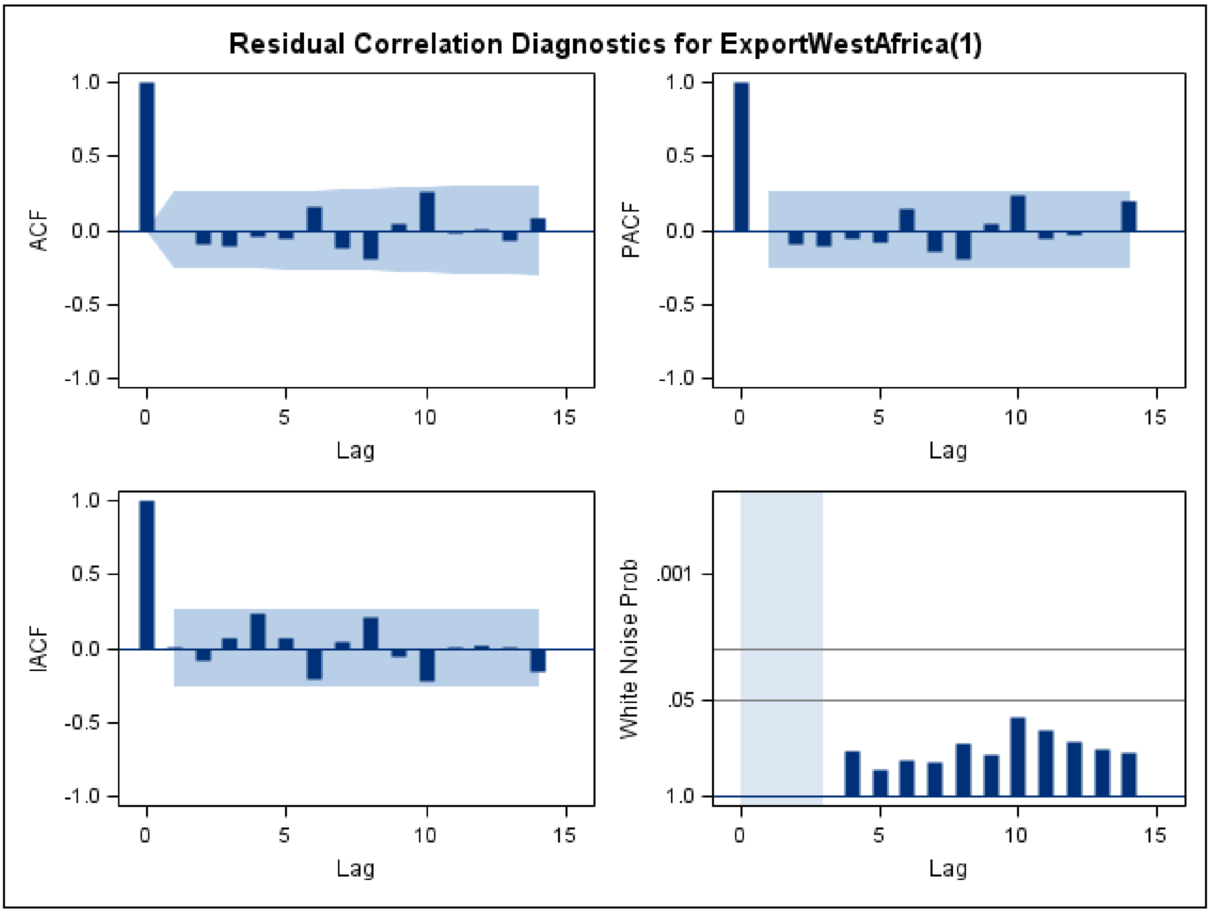
Autocorrelation check residuals

Table 293: Autocorrelation check residuals for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	3,48	3	0,3228	-0,001	-0,097	-0,102	-0,047	-0,059	0,165
12	12,61	9	0,1809	-0,123	-0,202	0,045	0,261	-0,024	0,001
18	19,74	15	0,182	-0,067	0,085	-0,129	-0,028	-0,161	-0,171
24	25,02	21	0,2461	0,034	0,167	-0,149	-0,053	-0,042	0,024

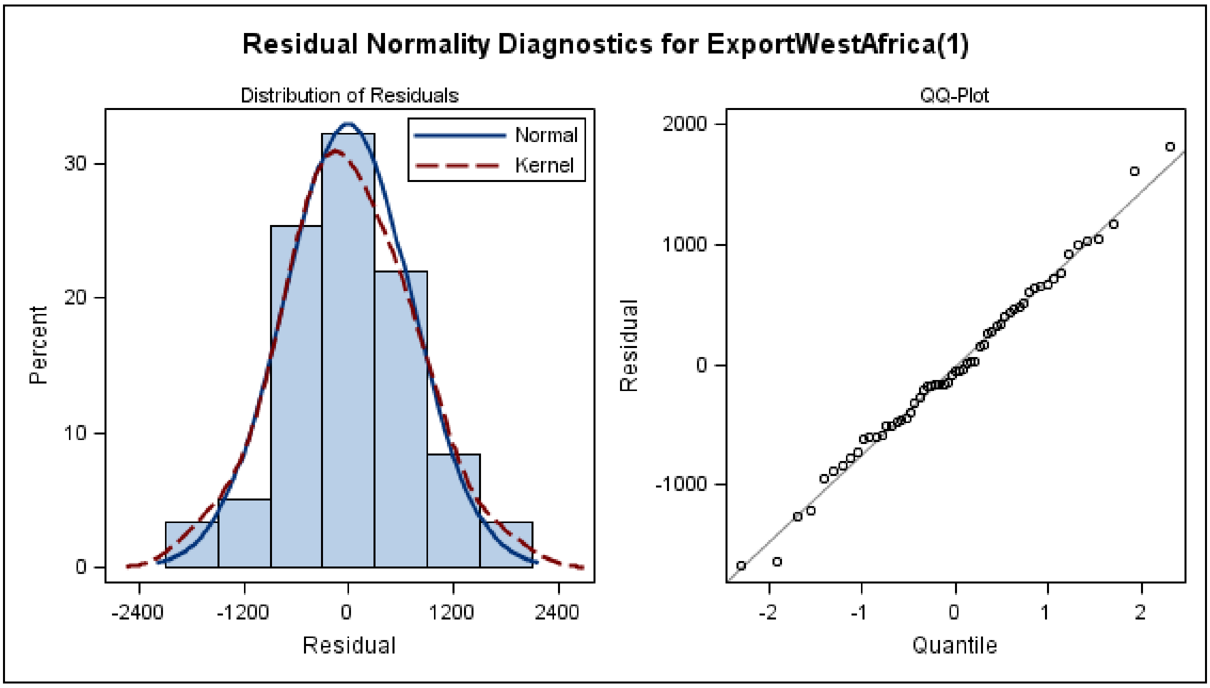
Source: SAS 9.2 (20/11/2013)

Figure 326: Residual correlation diagnostics for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model



Source: SAS 9.2 (20/11/2013)

Figure 327: Residual normality diagnostics for the TEU volumes of the Inter West Africa time series and a fitted ARIMA (3, 1, 0) model



Source: SAS 9.2 (20/11/2013)

Model

Estimated Mean -12,5726

Period(s) of Differentiating 1

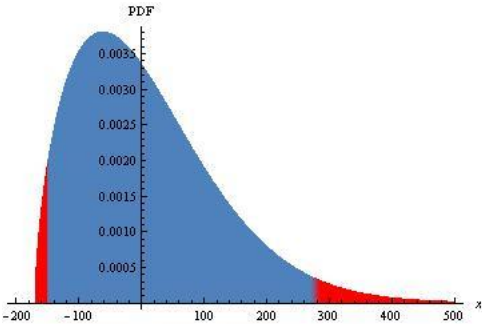
Autoregressive Factors

Factor 1: 1 + 0,86385 B^(1) + 0,64315 B^(2) + 0,32063 B^(3)

Weibull (1.6, 200, -170)

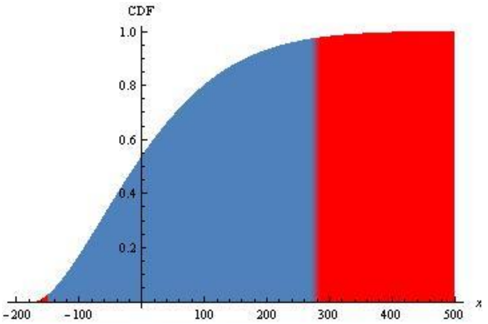
Probability density function

Figure 328: Probability density function Weibull (1.6, 200, -170)



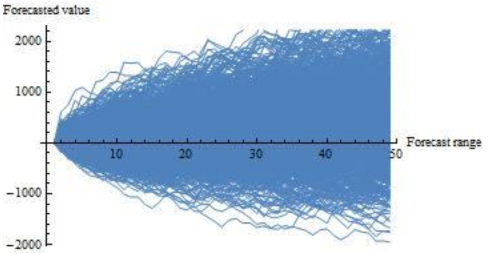
Cumulative density function

Figure 329: Cumulative density function Weibull (1.6, 200, -170)



Possible prediction paths

Figure 330: Possible prediction paths 48 steps ahead Weibull (1.6, 200, -170)

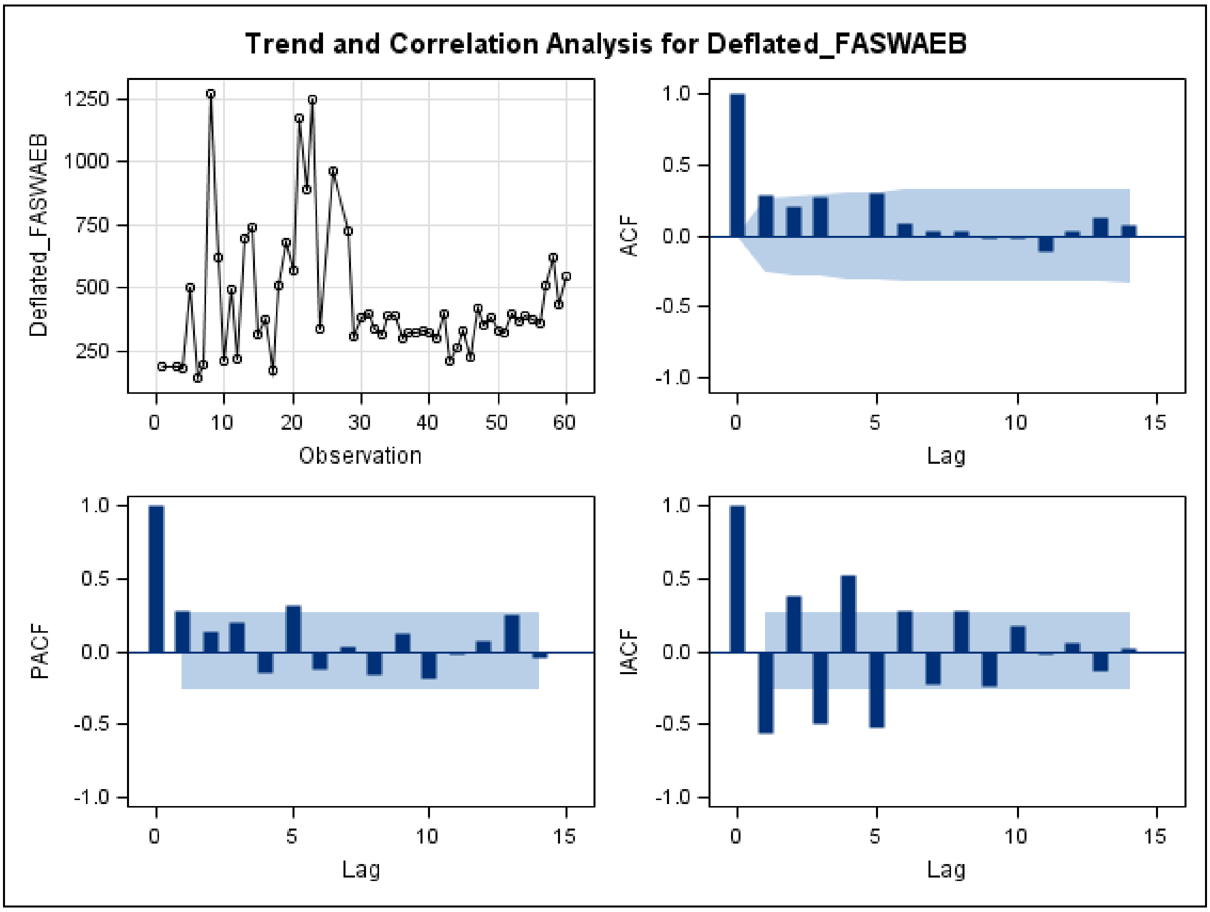


R.3.11 Average net freight rates: Asia – West Africa, East bound: ARIMA (0, 1, 1)

Descriptive statistics

Mean of Working Series	442,161
Standard Deviation	253,1796
Number of Observations	60
Embedded missing values in working series	3

Figure 331: Trend and correlation analysis for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model (1)



Source: SAS 9.2 (07/03/2014)

Augmented Dickey-Fuller unit root tests

Table 294: Augmented Dickey-Fuller unit root tests for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

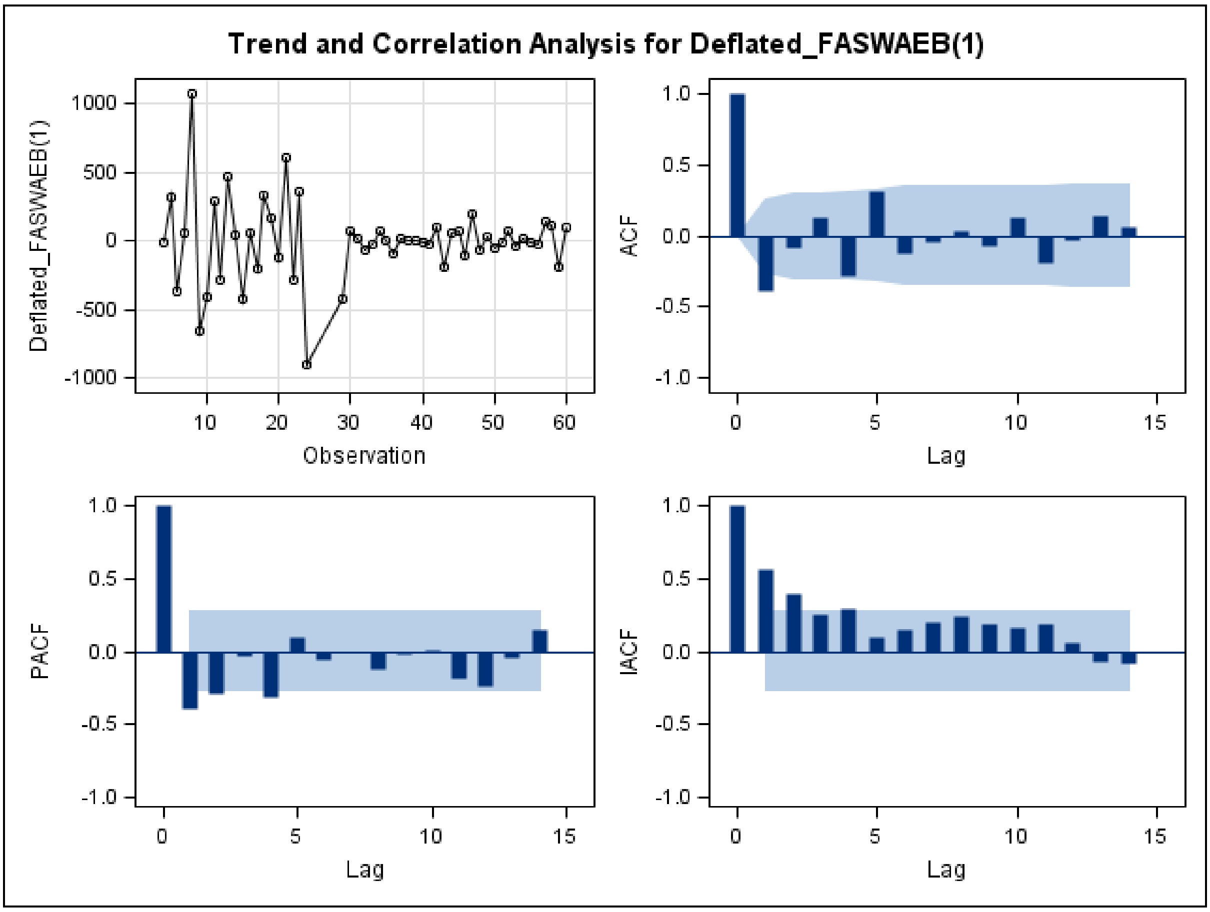
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-9,2760	0,0306	-2,27	0,0234		
	1	-2,9518	0,234	-1,02	0,2723		
	2	-0,8534	0,4948	-0,40	0,5344		
Single Mean	0	-37,6090	0,0005	-5,41	0,0001	14,63	0,0010
	1	-29,5133	0,0004	-3,69	0,0069	6,90	0,0010
	2	-19,5227	0,007	-2,51	0,1195	3,29	0,2581
Trend	0	-38,9554	0,0001	-5,52	0,0002	15,23	0,0010
	1	-32,5208	0,0011	-3,90	0,0191	7,67	0,0207
	2	-23,0979	0,0181	-2,70	0,2419	3,66	0,4681

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	-0,55718
Standard Deviation	292,9922
Number of Observations	57
Observation(s) eliminated by differencing	1
Embedded missing values in working series	4

Figure 332: Trend and correlation analysis for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 295: Augmented Dickey-Fuller unit root tests after differentiating for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-74,5368	<0,0001	-10,52	<0,0001		
	1	-143,4210	0,0001	-7,86	<0,0001		
	2	-251,6400	0,0001	-5,21	<0,0001		
Single Mean	0	-74,6932	0,0004	-10,44	0,0001	54,51	0,0010
	1	-146,0760	0,0001	-7,80	0,0001	30,52	0,0010
	2	-305,7790	0,0001	-5,23	0,0001	13,72	0,0010
Trend	0	-74,8164	<0,0001	-10,34	<0,0001	53,53	0,0010
	1	-146,6620	0,0001	-7,71	<0,0001	29,79	0,0010
	2	-327,2710	0,0001	-5,20	0,0005	13,51	0,0010

Source: SAS 9.2(25/03/2014)

ARIMA (0, 1, 1)

Conditional least squares estimation

Table 296: Conditional least squares estimation for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	8,62236	11,10908	0,78	0,4412	0
MA1.1	0,703	0,09998	7	<0,0001	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	8,622355
Variance Estimate	63.293,48
Std Error Estimate	251,582
AIC	738,3123
SBC	742,2528
Number of Residuals	53

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 297: Correlations of parameter estimates for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

Parameter	MU	MA1.1
MU	1,000	-0,074
MA1.1	-0,074	1,000

Source: SAS 9.2(25/03/2014)

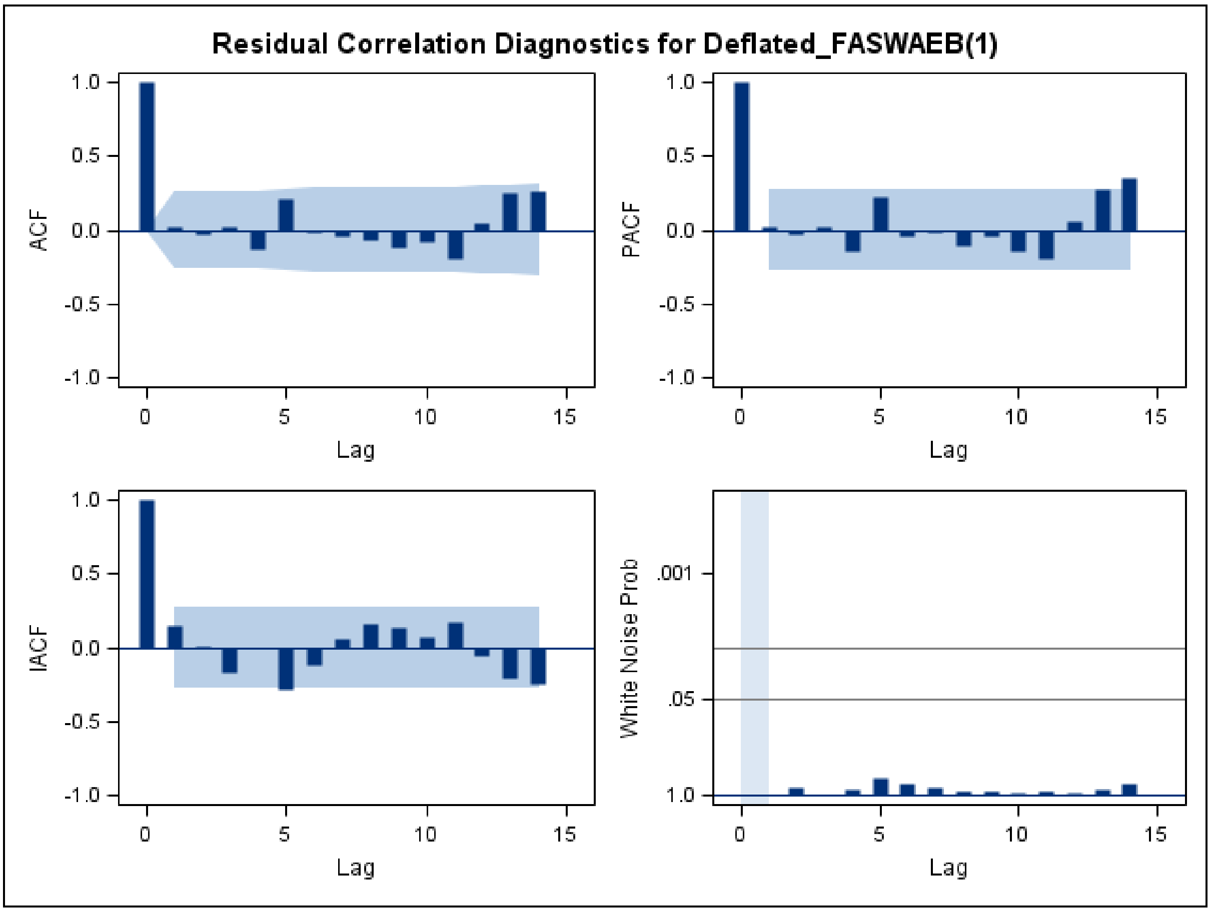
Autocorrelation check residuals

Table 298: Autocorrelation check residuals for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	2,96	5	0,7066	0,021	-0,030	0,018	-0,137	0,219	-0,006
12	5,51	11	0,9041	-0,041	-0,064	-0,113	-0,075	-0,191	0,055
18	13,59	17	0,6958	0,250	0,271	0,129	-0,287	0,018	0,052
24	16,39	23	0,838	0,019	0,016	-0,208	-0,127	-0,120	-0,134

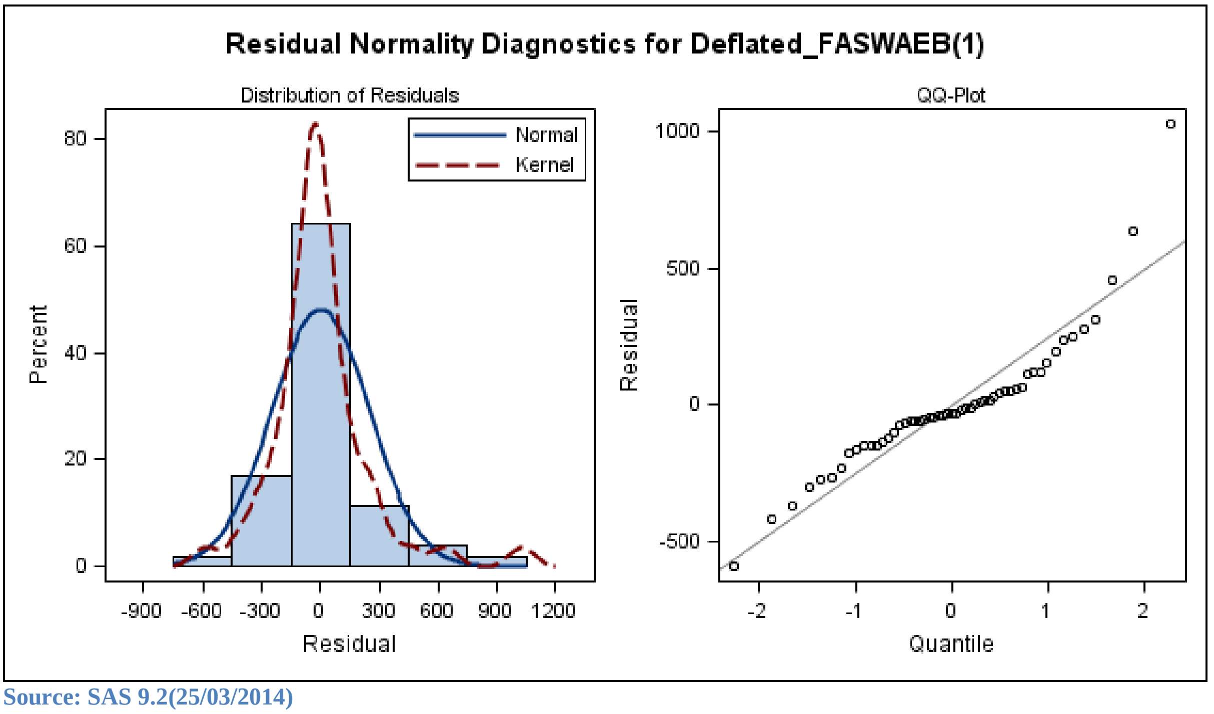
Source: SAS 9.2(25/03/2014)

Figure 333: Residual correlation diagnostics for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2(25/03/2014)

Figure 334: Residual normality diagnostics for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2(25/03/2014)

Model

Estimated Mean	8,622355
Period(s) of Differencing	1

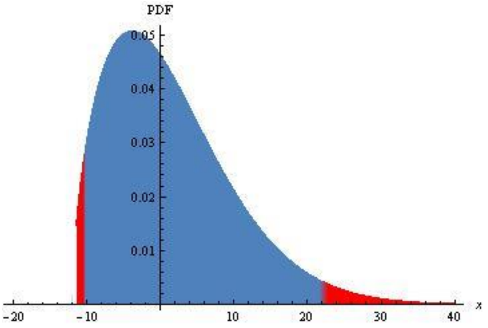
Autoregressive Factors

Factor 1: 1 - 0.703 B^(1)

Weibull (1.6, 24, -18)

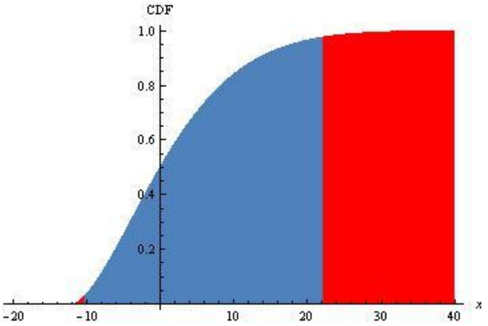
Probability density function

Figure 335: Probability density function Weibull (1.6, 15, -12)



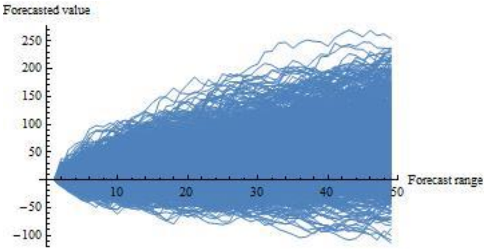
Cumulative density function

Figure 336: Cumulative density function Weibull (1.6, 15, -12)



Possible prediction paths

Figure 337: Possible prediction paths 48 steps ahead Weibull (1.6, 15, -12)

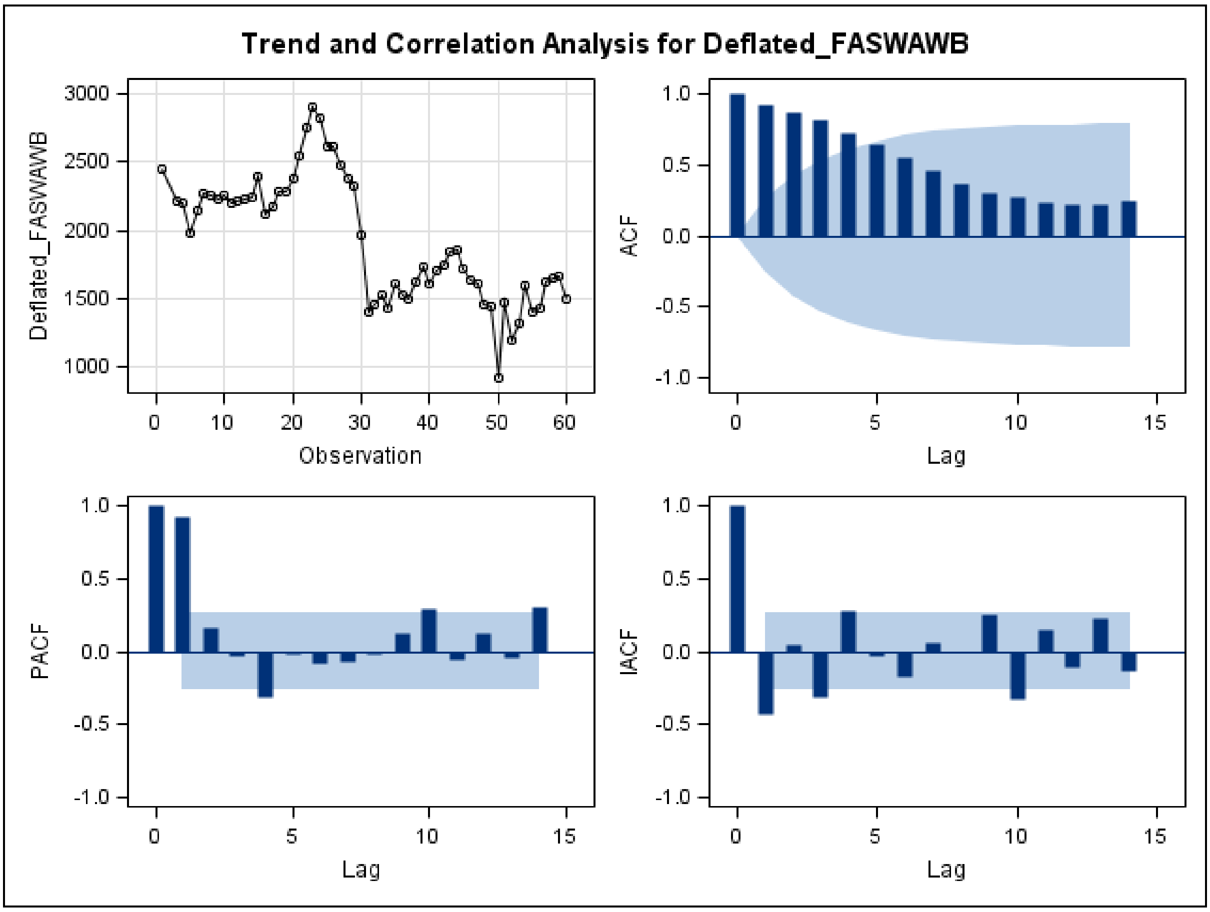


R.3.12 Average net freight rates: Asia – West Africa, West bound: ARIMA (0, 1, 0)

Descriptive statistics

Mean of Working Series	1.933,64
Standard Deviation	450,4917
Number of Observations	60
Embedded missing values in working series	1

Figure 338: Trend and correlation analysis for the average freight rates of the Asia – West Africa, West bound time series and a fitted ARIMA (0, 1, 0) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 299: Augmented Dickey-Fuller unit root tests for the average freight rates of the Asia – West Africa, West bound time series and a fitted ARIMA (0, 1, 0) model

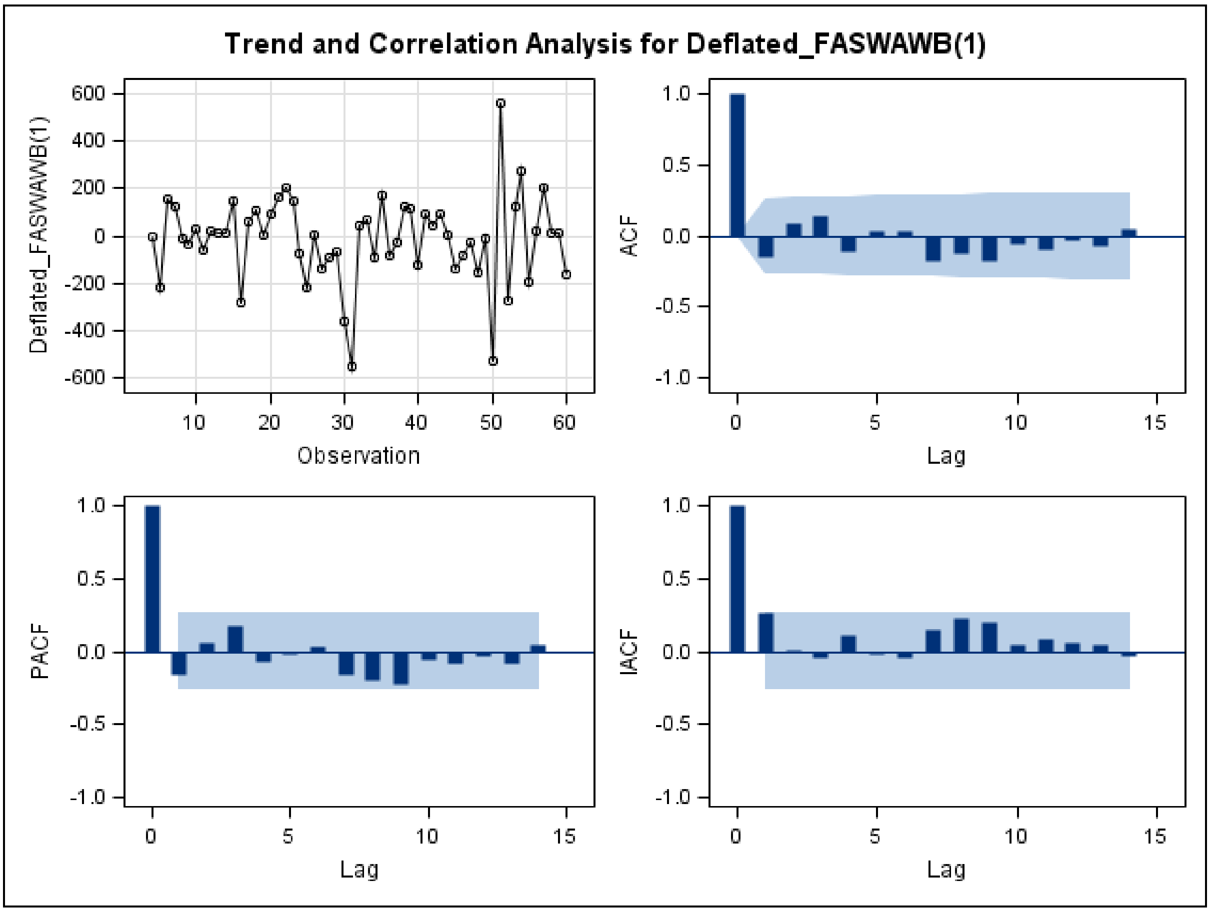
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-0,5708	0,5514	-0,83	0,3524		
	1	-0,5016	0,5662	-0,84	0,3478		
	2	-0,4146	0,5854	-0,65	0,43		
Single Mean	0	-4,2896	0,4941	-1,42	0,5654	1,15	0,7795
	1	-3,3100	0,6087	-1,21	0,6639	0,91	0,8410
	2	-3,6836	0,5631	-1,21	0,6634	0,81	0,8643
Trend	0	-9,7481	0,418	-2,29	0,4333	2,63	0,6546
	1	-8,3893	0,5231	-2,02	0,5806	2,05	0,7694
	2	-12,4303	0,251	-2,43	0,3601	3,06	0,5711

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	-12,531
Standard Deviation	179,5393
Number of Observations	57
Observation(s) eliminated by differencing	1

Figure 339: Trend and correlation analysis for the average freight rates of the Asia – West Africa, West bound time series and a fitted ARIMA (0, 1, 0) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 300: Augmented Dickey-Fuller unit root tests after differentiating for the average freight rates of the Asia – West Africa, West bound time series and a fitted ARIMA (0, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-64,4550	<0,0001	-8,57	<0,0001		
	1	-55,5260	<0,0001	-5,21	<0,0001		
	2	-32,3570	<0,0001	-3,42	0,001		
Single Mean	0	-64,6965	0,0005	-8,54	0,0001	36,46	0,0010
	1	-56,0733	0,0005	-5,18	0,0001	13,43	0,0010
	2	-32,9752	0,0005	-3,41	0,0146	5,82	0,0197
Trend	0	-64,6957	0,0001	-8,46	<0,0001	35,82	0,0010
	1	-56,0897	<0,0001	-5,14	0,0005	13,32	0,0010
	2	-33,0667	0,001	-3,39	0,064	5,74	0,0865

Source: SAS 9.2(25/03/2014)

ARIMA (0, 1, 0)

Conditional least squares estimation

Table 301: Conditional least squares estimation for the average freight rates of the Asia – West Africa, West bound time series and a fitted ARIMA (0, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-12,53104	23,99195	-0,52	0,6035	0

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	-12,531
Variance Estimate	32.809,99
Std Error Estimate	181,1353
AIC	755,4639
SBC	757,507
Number of Residuals	57

* AIC and SBC do not include log determinant.

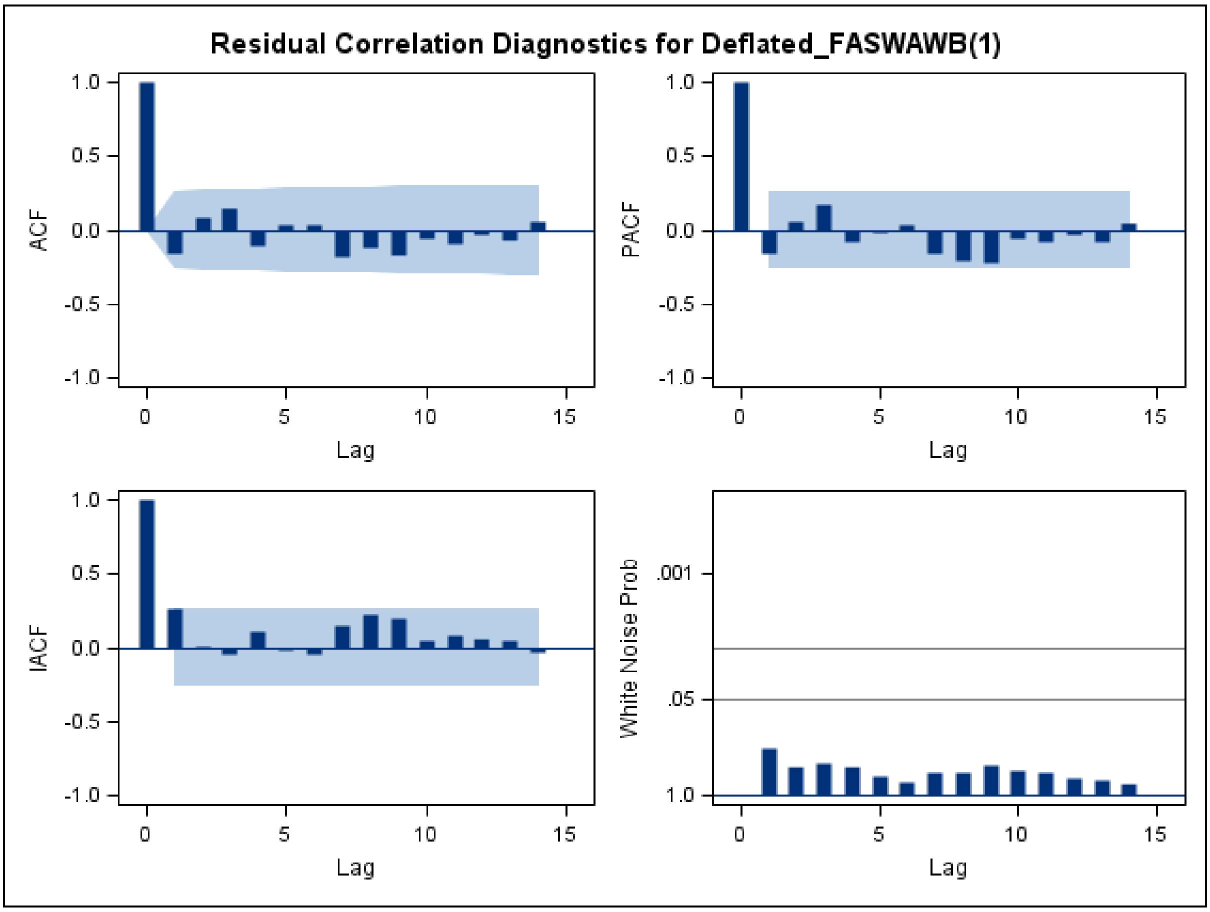
Autocorrelation check residuals

Table 302: Autocorrelation check residuals for the average freight rates of the Asia – West Africa, West bound time series and a fitted ARIMA (0, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	4,15	6	0,6566	-0,153	0,084	0,146	-0,113	0,036	0,037
12	10,47	12	0,575	-0,182	-0,121	-0,174	-0,059	-0,093	-0,033
18	13,26	18	0,7762	-0,067	0,054	0,108	0,085	-0,077	0,048
24	17,63	24	0,8204	0,165	0,004	0,022	0,016	-0,118	-0,071

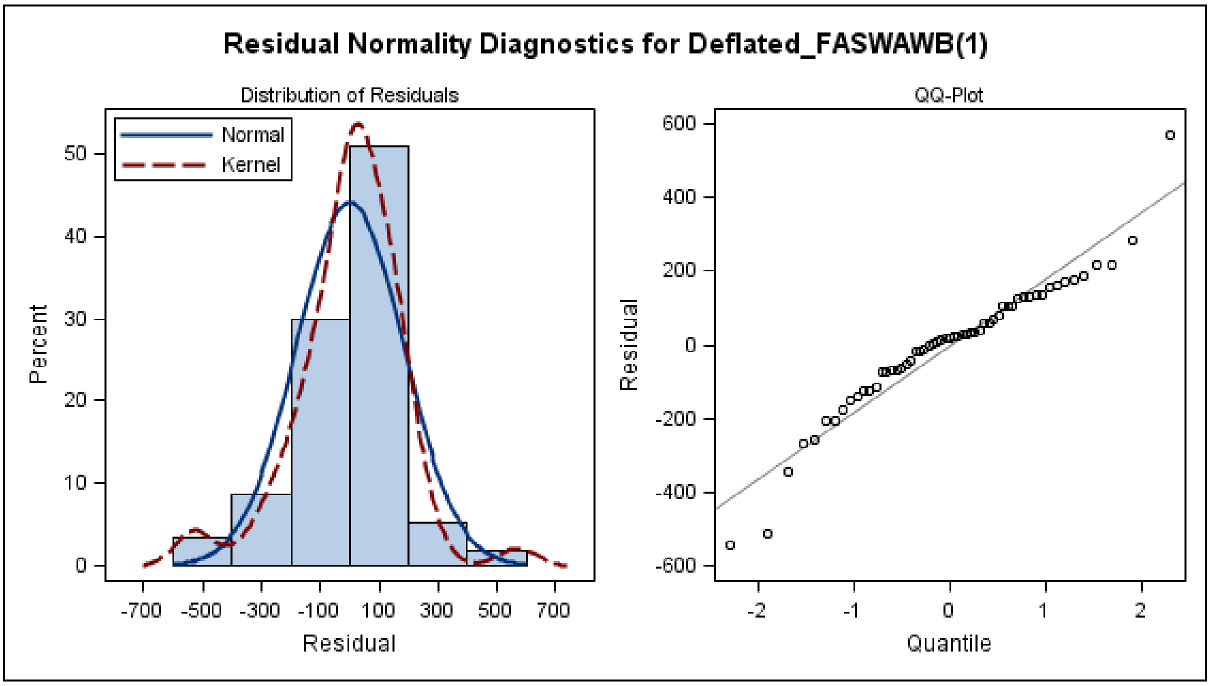
Source: SAS 9.2(25/03/2014)

Figure 340: Residual correlation diagnostics for the average freight rates of the Asia – West Africa, West bound time series and a fitted ARIMA (0, 1, 0) model



Source: SAS 9.2(25/03/2014)

Figure 341: Residual normality diagnostics for the average freight rates of the Asia – West Africa, West bound time series and a fitted ARIMA (0, 1, 0) model



Source: SAS 9.2(25/03/2014)

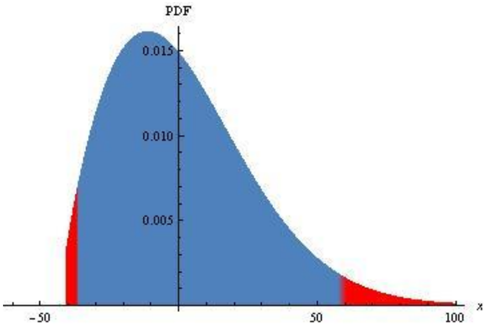
Model

Estimated Mean	-12.531
Period(s) of Differencing	1

Weibull (1.6, 52, -44)

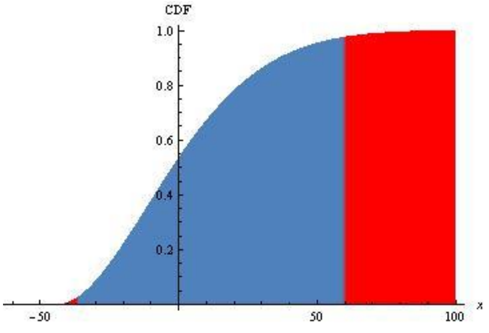
Probability density function

Figure 342: Probability density function Weibull (1.8, 50, -43)



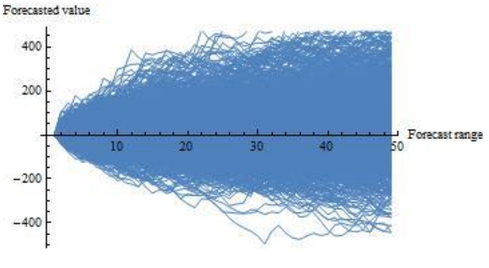
Cumulative density function

Figure 343: Cumulative density function Weibull (1.8, 50, -43)



Possible prediction paths

Figure 344: Possible prediction paths 48 steps ahead Weibull (1.8, 50, -43)

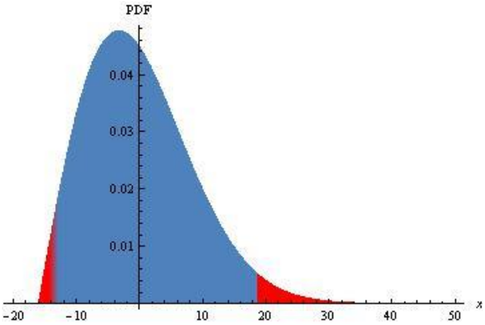


R.3.13 Average net freight rates: Europe – West Africa, North bound: No econometric ARIMA model

Weibull (2, 18, -16)

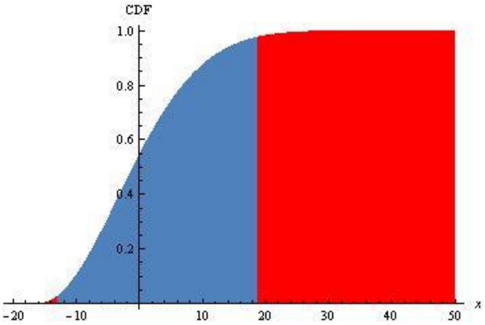
Probability density function

Figure 345: Probability density function Weibull (2, 18, -16)



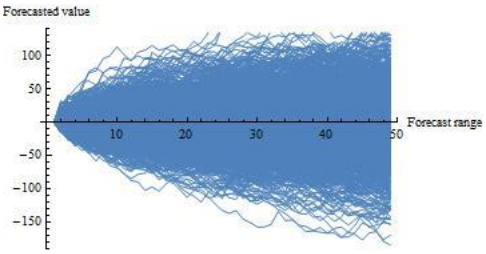
Cumulative density function

Figure 346: Cumulative density function Weibull (2, 18, -16)



Possible prediction paths

Figure 347: Possible prediction paths 48 steps ahead Weibull (2, 18, -16)

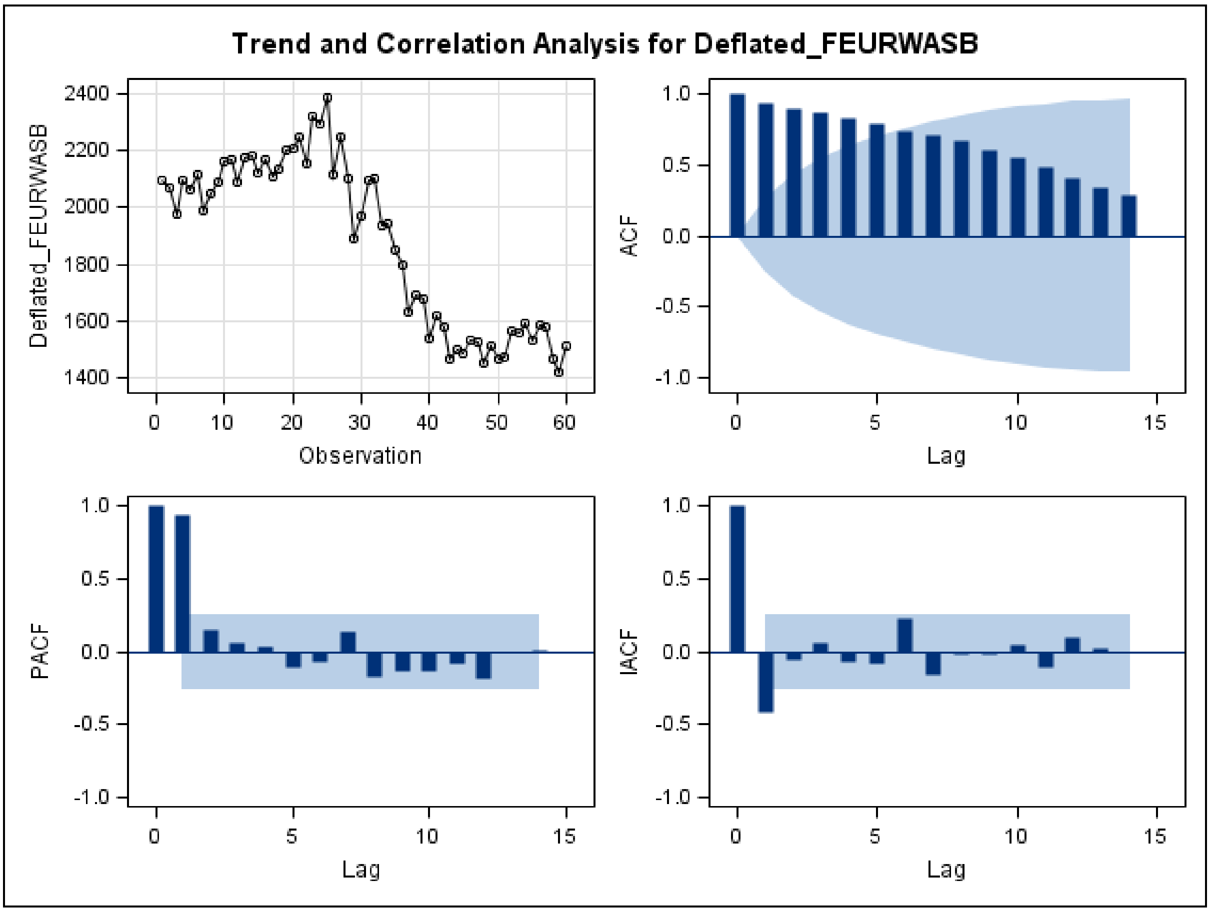


R.3.14 Average net freight rates: Europe – West Africa, South bound: ARIMA (0, 1, 1)

Descriptive statistics

Mean of Working Series	1.878,478
Standard Deviation	295,158
Number of Observations	60

Figure 348: Trend and correlation analysis for the average freight rates of the Europe – West Africa, South bound time series and a fitted ARIMA (0, 1, 1) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 303: Augmented Dickey-Fuller unit root tests for the average freight rates of the Europe – West Africa, South bound time series and a fitted ARIMA (0, 1, 1) model

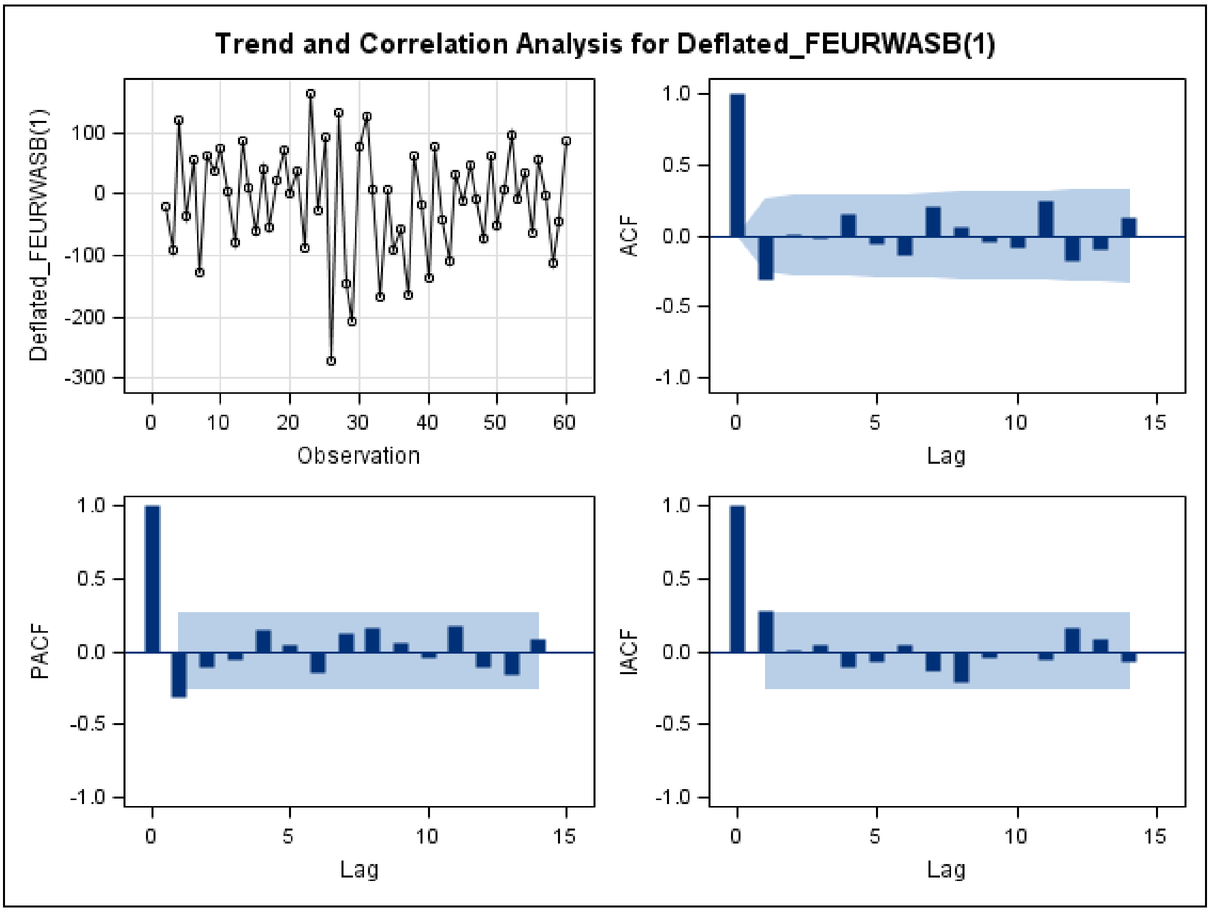
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-0,3526	0,5996	-0,98	0,2879		
	1	-0,3219	0,6065	-1,22	0,1999		
	2	-0,2791	0,6162	-1,17	0,219		
Single Mean	0	-2,1714	0,752	-0,93	0,773	0,79	0,8709
	1	-0,7691	0,903	-0,44	0,8949	0,77	0,8749
	2	-0,3293	0,9357	-0,21	0,9311	0,67	0,9003
Trend	0	-9,7023	0,4226	-2,35	0,4004	2,84	0,6137
	1	-6,2176	0,7097	-1,90	0,6432	2,03	0,7724
	2	-6,2853	0,7036	-2,07	0,5531	2,68	0,6454

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	-9,85273
Standard Deviation	88,74232
Number of Observations	59
Observation(s) eliminated by differencing	1

Figure 349: Trend and correlation analysis for the average freight rates of the Europe – West Africa, South bound time series and a fitted ARIMA (0, 1, 1) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 304: Augmented Dickey-Fuller unit root tests for the average freight rates of the Europe – West Africa, South bound time series and a fitted ARIMA (0, 1, 1) model

Type	Lags	Rho	Pr <0 Rho	Tau	Pr <0 Tau	F	Pr > F
Zero Mean	0	-75,5707	<0,0001	-10,24	<0,0001		
	1	-87,9778	<0,0001	-6,57	<0,0001		
	2	-91,3467	<0,0001	-4,87	<0,0001		
Single Mean	0	-76,6905	0,0005	-10,33	0,0001	53,40	0,0010
	1	-93,9224	0,0005	-6,69	0,0001	22,38	0,0010
	2	-109,6610	0,0001	-5,07	0,0002	12,86	0,0010
Trend	0	-77,1193	0,0001	-10,30	<0,0001	53,07	0,0010
	1	-97,7177	0,0001	-6,76	<0,0001	22,87	0,0010
	2	-118,7870	0,0001	-5,11	0,0006	13,07	0,0010

Source: SAS 9.2(25/03/2014)

ARIMA (0, 1, 1)

Conditional least squares estimation

Table 305: Conditional least squares estimation for the average freight rates of the Europe – West Africa, South bound time series and a fitted ARIMA (0, 1, 1) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-10,17788	7,35853	-1,38	0,172	0
MA1.1	0,34134	0,12473	3	0,0083	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	-10,1779
Variance Estimate	7.249,732
Std Error Estimate	85,14536
AIC	693,8345
SBC	697,9896
Number of Residuals	59

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 306: Correlations of parameter estimates for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

Parameter	MU	MA1.1
MU	1,000	-0,015
MA1.1	-0,015	1,000

Source: SAS 9.2(25/03/2014)

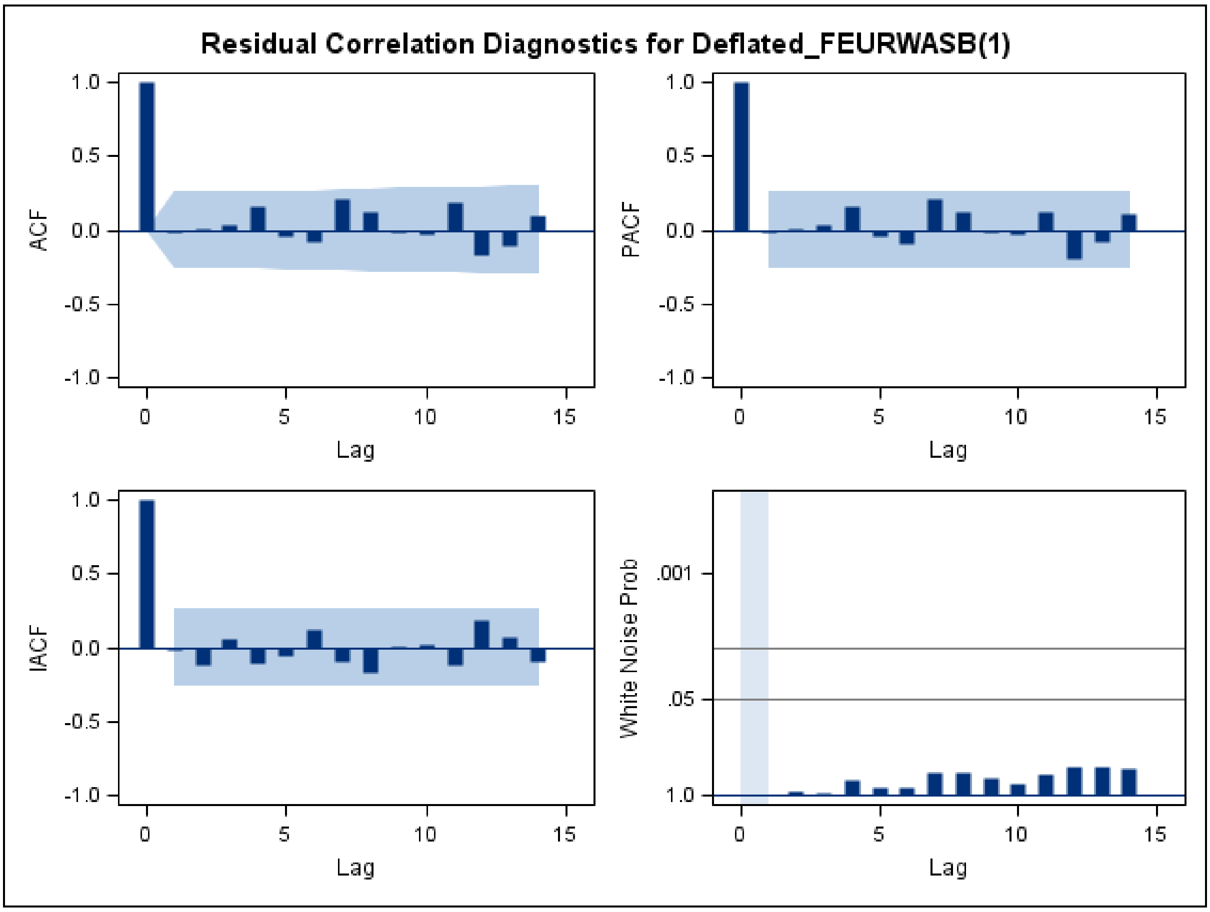
Autocorrelation check residuals

Table 307: Autocorrelation check residuals for the average freight rates of the Europe – West Africa, South bound time series and a fitted ARIMA (0, 1, 1) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	2,32	5	0,8039	-0,014	0,012	0,035	0,157	-0,042	-0,085
12	11,35	11	0,4143	0,211	0,125	-0,022	-0,034	0,188	-0,164
18	19,71	17	0,2893	-0,111	0,098	0,004	-0,222	-0,122	-0,117
24	32,2	23	0,096	-0,027	-0,247	0,093	0,081	-0,119	-0,195

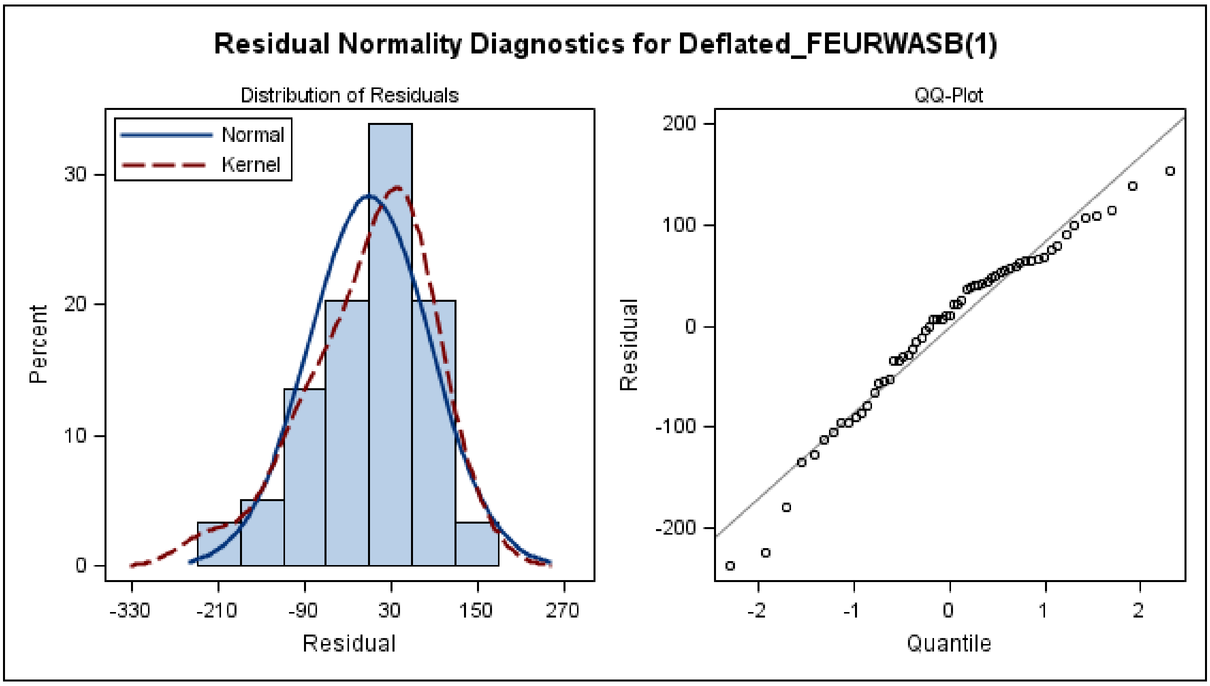
Source: SAS 9.2(25/03/2014)

Figure 350 : Residual correlation diagnostics for the average freight rates of the Europe – West Africa, South bound time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2(25/03/2014)

Figure 351: Residual normality diagnostics for the average freight rates of the Europe – West Africa, South bound time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2(25/03/2014)

Model

Estimated Mean -10,1779

Period(s) of Differencing 1

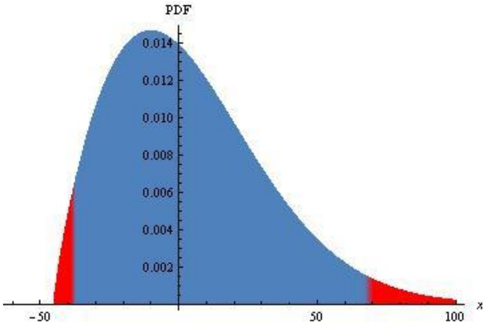
Moving Average Factors

Factor 1: 1 - 0.34134 B^(1)

Weibull (2, 47, -41)

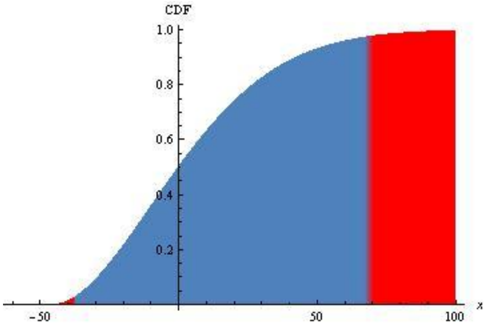
Probability density function

Figure 352: Probability density function Weibull (2, 47, -41)



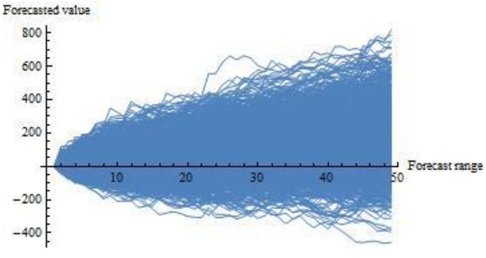
Cumulative density function

Figure 353: Cumulative density function Weibull (2, 47, -41)



Possible prediction paths

Figure 354: Possible prediction paths 48 steps ahead Weibull (2, 47, -41)

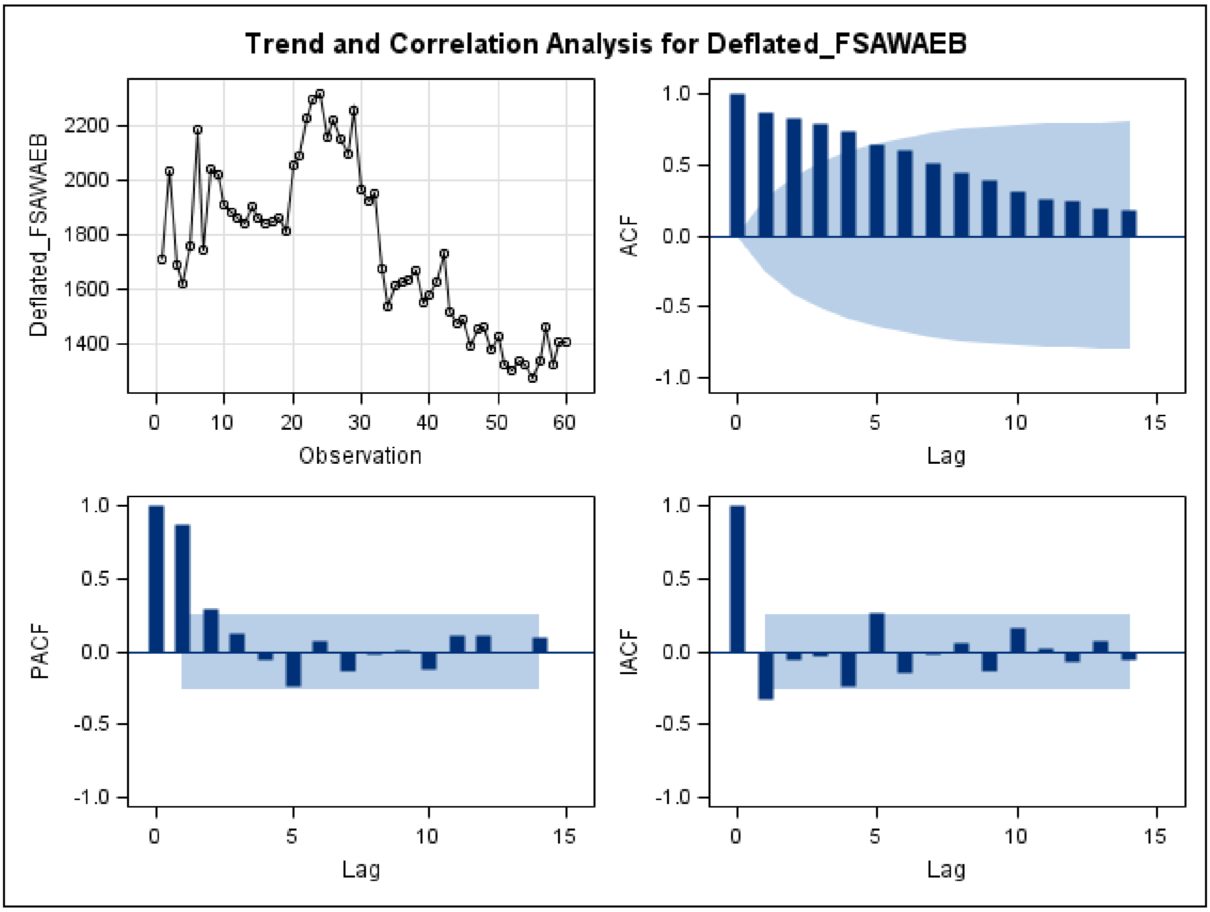


R.3.15 Average net freight rates: South America - West Africa, East bound: ARIMA (0, 1, 1)

Descriptive statistics

Mean of Working Series	1.741,952
Standard Deviation	296,4942
Number of Observations	60

Figure 355: Trend and correlation analysis for the average freight rates of the South America West Africa East bound time series and a fitted ARIMA (0, 1, 1) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 308: Augmented Dickey-Fuller unit root tests for the average freight rates of the South America - West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

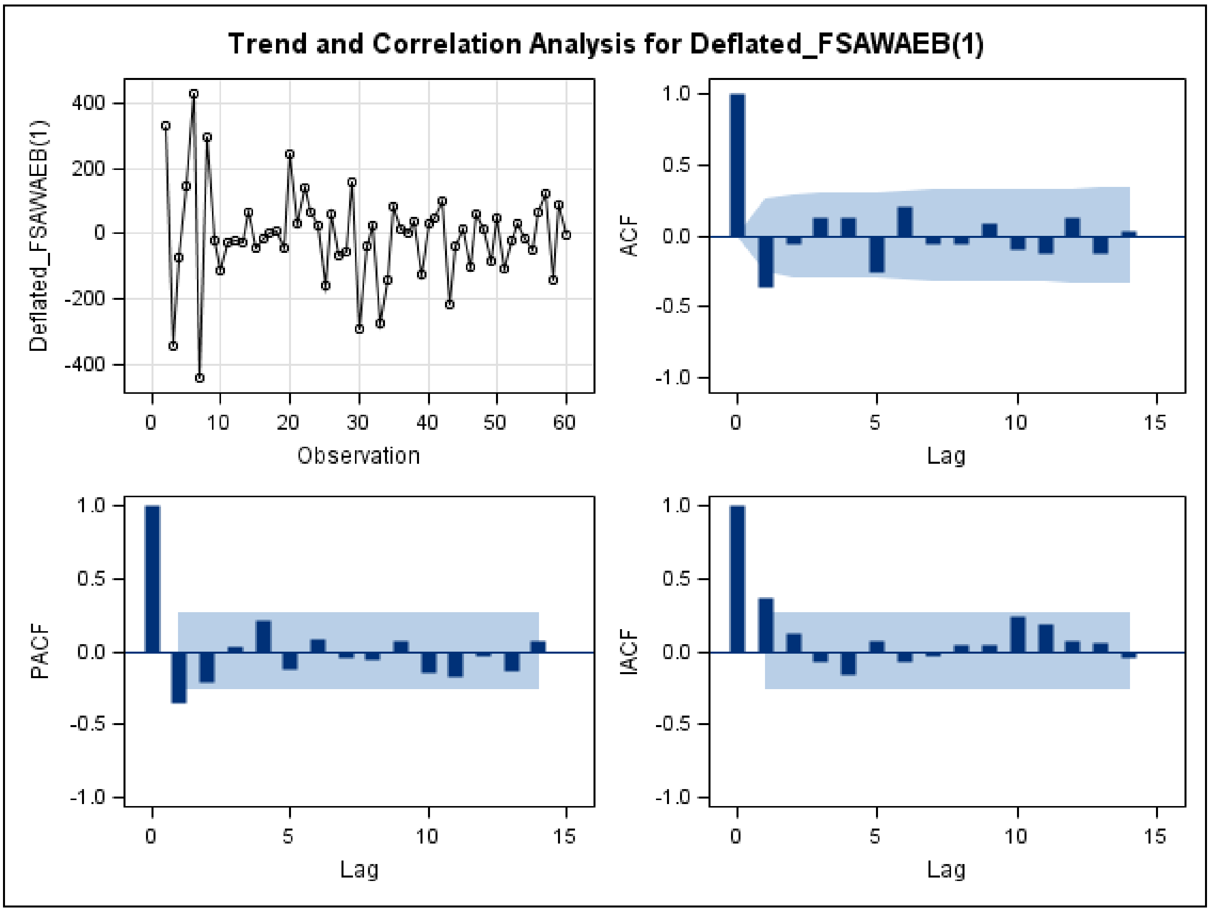
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-0,3467	0,6009	-0,55	0,4741		
	1	-0,3740	0,5947	-0,90	0,3221		
	2	-0,2498	0,6228	-0,72	0,4028		
Single Mean	0	-6,4176	0,2989	-1,72	0,416	1,52	0,6873
	1	-2,7953	0,6734	-1,06	0,7239	0,84	0,8578
	2	-1,5358	0,8272	-0,68	0,8432	0,42	0,9687
Trend	0	-15,3629	0,1369	-3,11	0,1134	5,03	0,1861
	1	-7,3414	0,6125	-1,91	0,6391	1,87	0,8043
	2	-6,8194	0,6572	-2,01	0,5838	2,45	0,6908

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	-5,12033
Standard Deviation	144,7516
Number of Observations	59
Observation(s) eliminated by differencing	1

Figure 356: Trend and correlation analysis for the average freight rates of the South America - West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 309: Augmented Dickey-Fuller unit root tests after differentiating for the average freight rates of the South America - West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

Type	Lags	Rho	Pr <0 Rho	Tau	Pr <0 Tau	F	Pr > F
Zero Mean	0	-78,6178	<0,0001	-11,53	<0,0001		
	1	-108,5020	0,0001	-7,44	<0,0001		
	2	-80,9921	<0,0001	-4,89	<0,0001		
Single Mean	0	-78,7956	0,0005	-11,51	0,0001	66,25	0,0010
	1	-110,3520	0,0001	-7,42	0,0001	27,53	0,0010
	2	-83,3362	0,0005	-4,87	0,0002	11,88	0,0010
Trend	0	-78,9682	0,0001	-11,40	<0,0001	65,18	0,0010
	1	-113,5180	0,0001	-7,46	<0,0001	27,81	0,0010
	2	-91,3365	0,0001	-5,00	0,0008	12,55	0,0010

Source: SAS 9.2(25/03/2014)

ARIMA (0, 1, 1)

Conditional least squares estimation

Table 310: Conditional least squares estimation for the average freight rates of the South America - West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-6,30898	10,7808	-0,59	0,5607	0
MA1.1	0,39582	0,12177	3	0,0019	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	-6,30898
Variance Estimate	18.416,02
Std Error Estimate	135,7056
AIC	748,8376
SBC	752,9927
Number of Residuals	59

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 311: Correlations of parameter estimates for the average freight rates of the Asia – West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

Parameter	MU	MA1.1
MU	1,000	0,003
MA1.1	0,003	1,000

Source: SAS 9.2(25/03/2014)

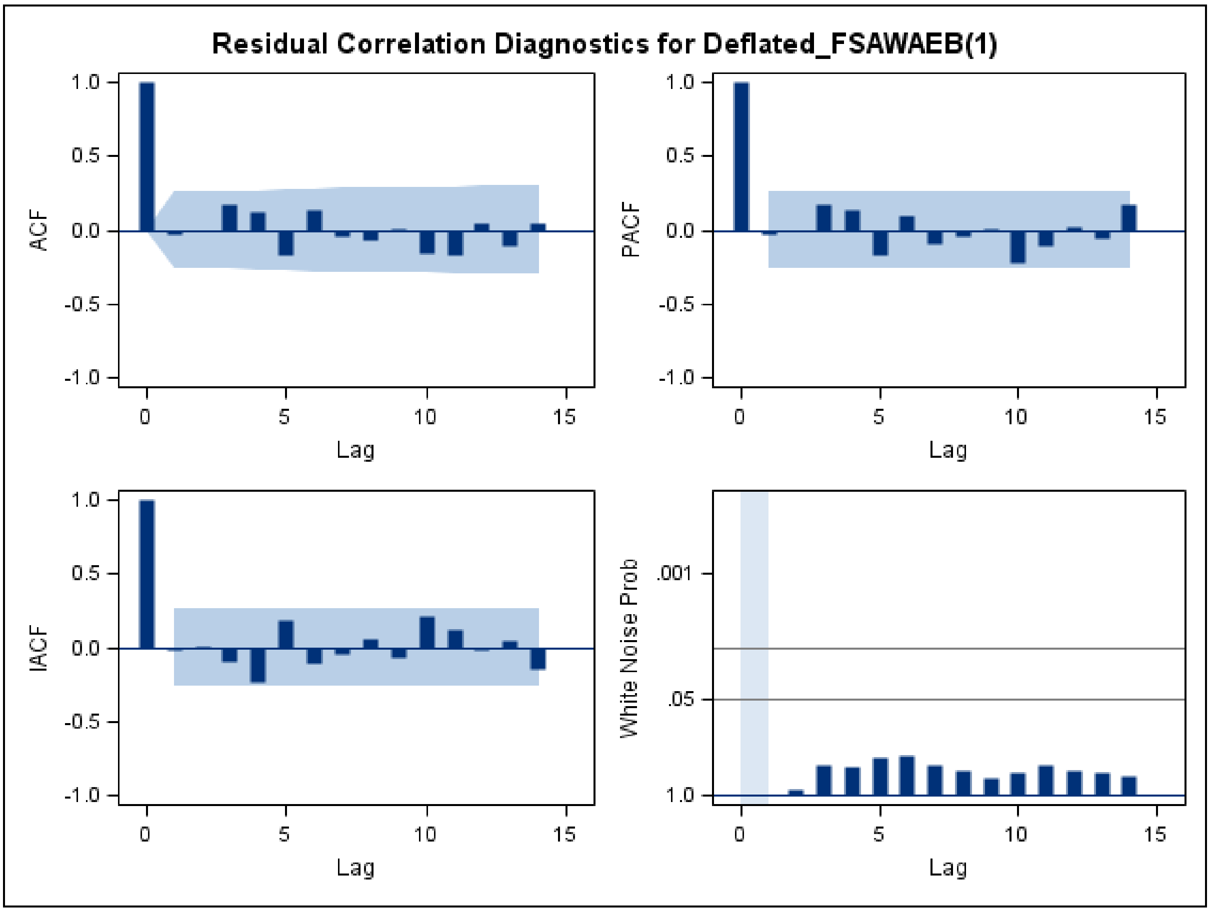
Autocorrelation check residuals

Table 312: Autocorrelation check residuals for the average freight rates of the South America - West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	6,13	5	0,2936	-0,027	-0,011	0,171	0,121	-0,174	0,134
12	10,86	11	0,4551	-0,046	-0,075	0,003	-0,162	-0,169	0,039
18	17,3	17	0,4339	-0,101	0,041	0,139	0,066	-0,054	0,194
24	19,97	23	0,6439	-0,040	0,032	0,116	-0,078	-0,037	-0,065

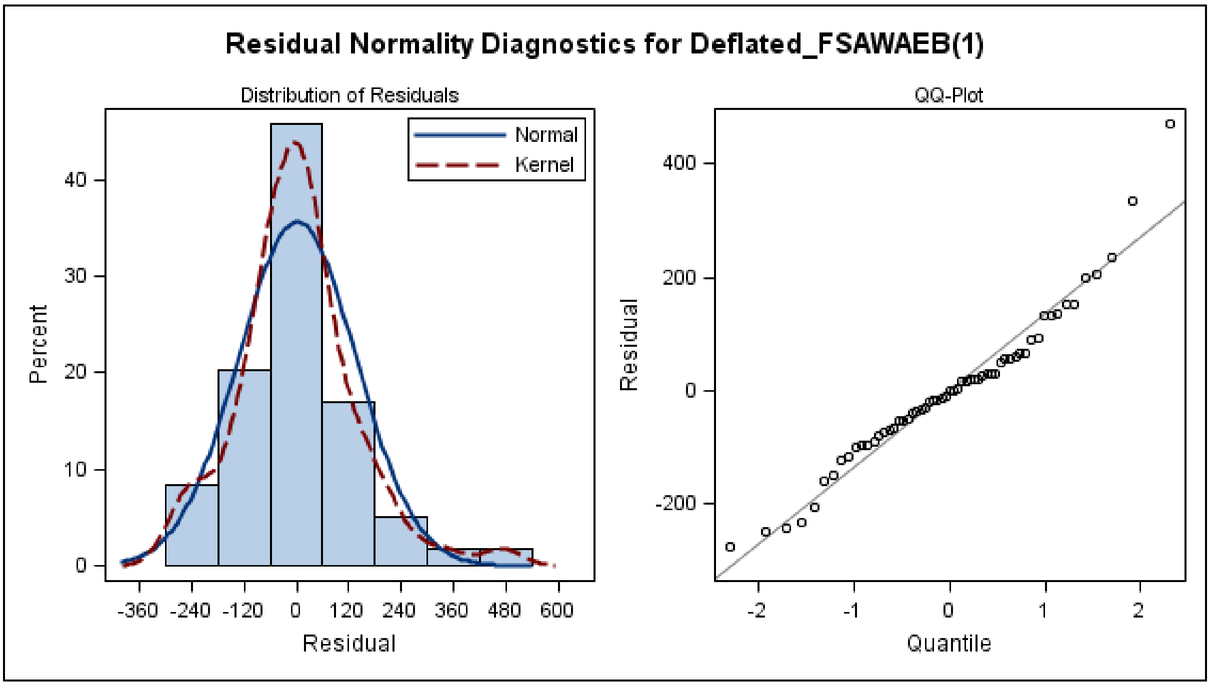
Source: SAS 9.2(25/03/2014)

Figure 357: Residual correlation diagnostics for the average freight rates of the South America - West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2(25/03/2014)

Figure 358: Residual normality diagnostics for the average freight rates of the South America - West Africa, East bound time series and a fitted ARIMA (0, 1, 1) model



Source: SAS 9.2(25/03/2014)

Model

Estimated Mean	-6.30898
Period(s) of Differencing	1

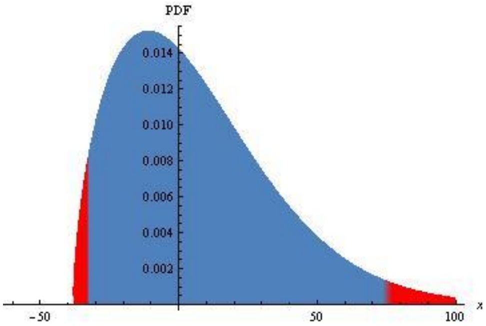
Moving Average Factors

Factor 1: 1 - 0.39582 B^(1)

Weibull (3, 55, -49)

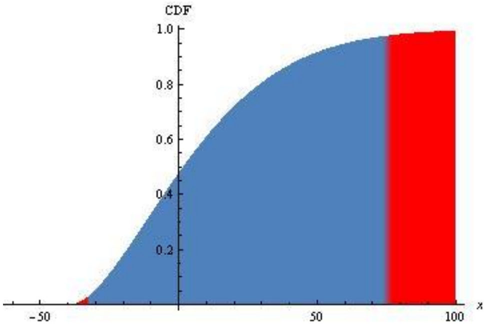
Probability density function

Figure 359: Probability density function Weibull (3, 55, -49)



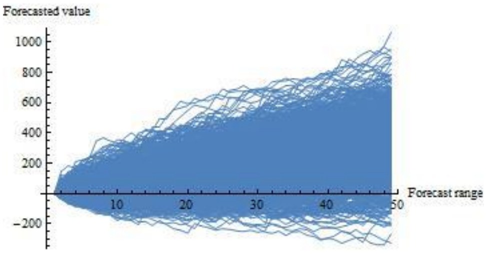
Cumulative density function

Figure 360: Cumulative density function Weibull (3, 55, -49)



Possible prediction paths

Figure 361: Possible prediction paths 48 steps ahead Weibull (3, 55, -49)

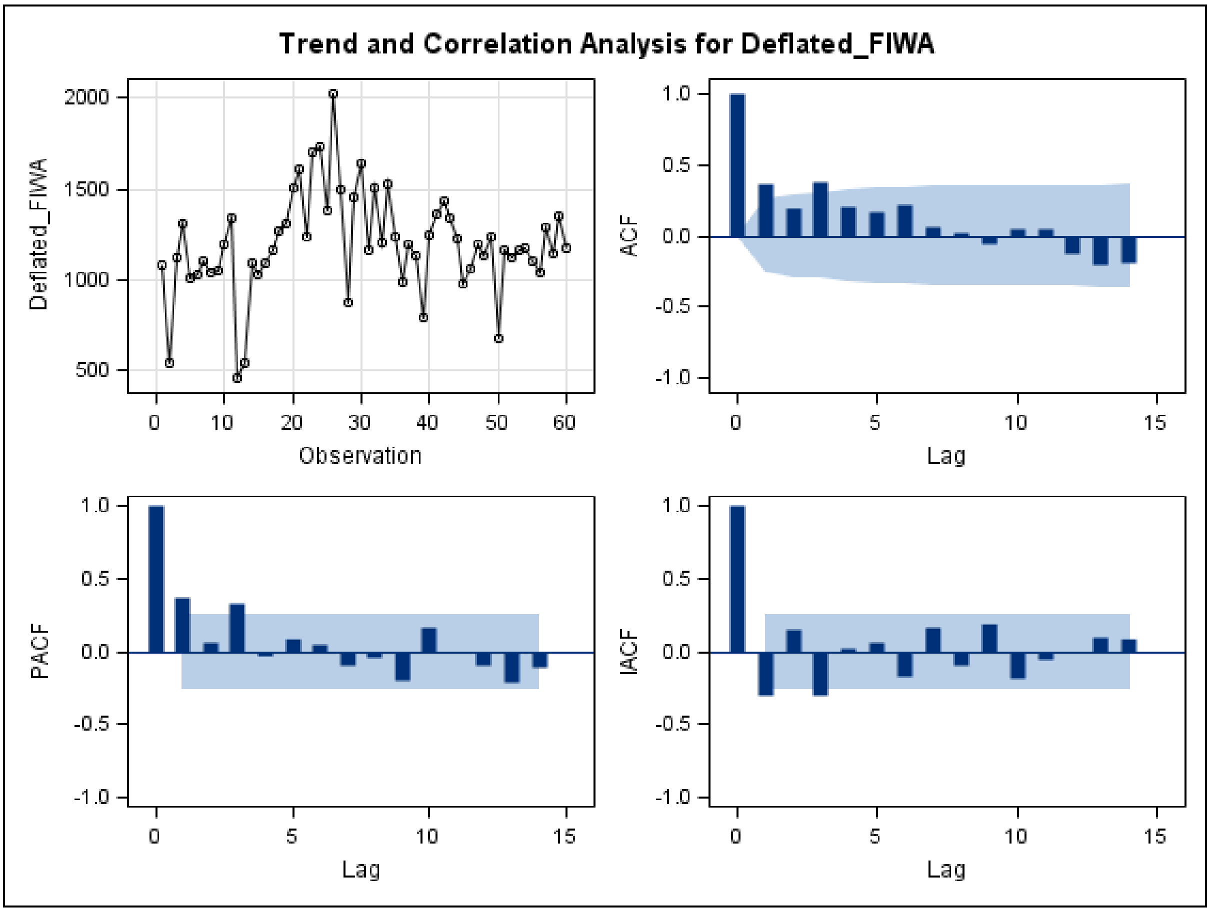


R.3.16 Average net freight rates: Inter West Africa: ARIMA (0, 1, 0)

Descriptive statistics

Mean of Working Series	1.196,066
Standard Deviation	276,7073
Number of Observations	60

Figure 362: Trend and correlation analysis for the average freight rates of the S Inter West Africa time series and a fitted ARIMA (0, 1, 0) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 313: Augmented Dickey-Fuller unit root tests for the average freight rates of the Inter West Africa bound time series and a fitted ARIMA (0, 1, 0) model

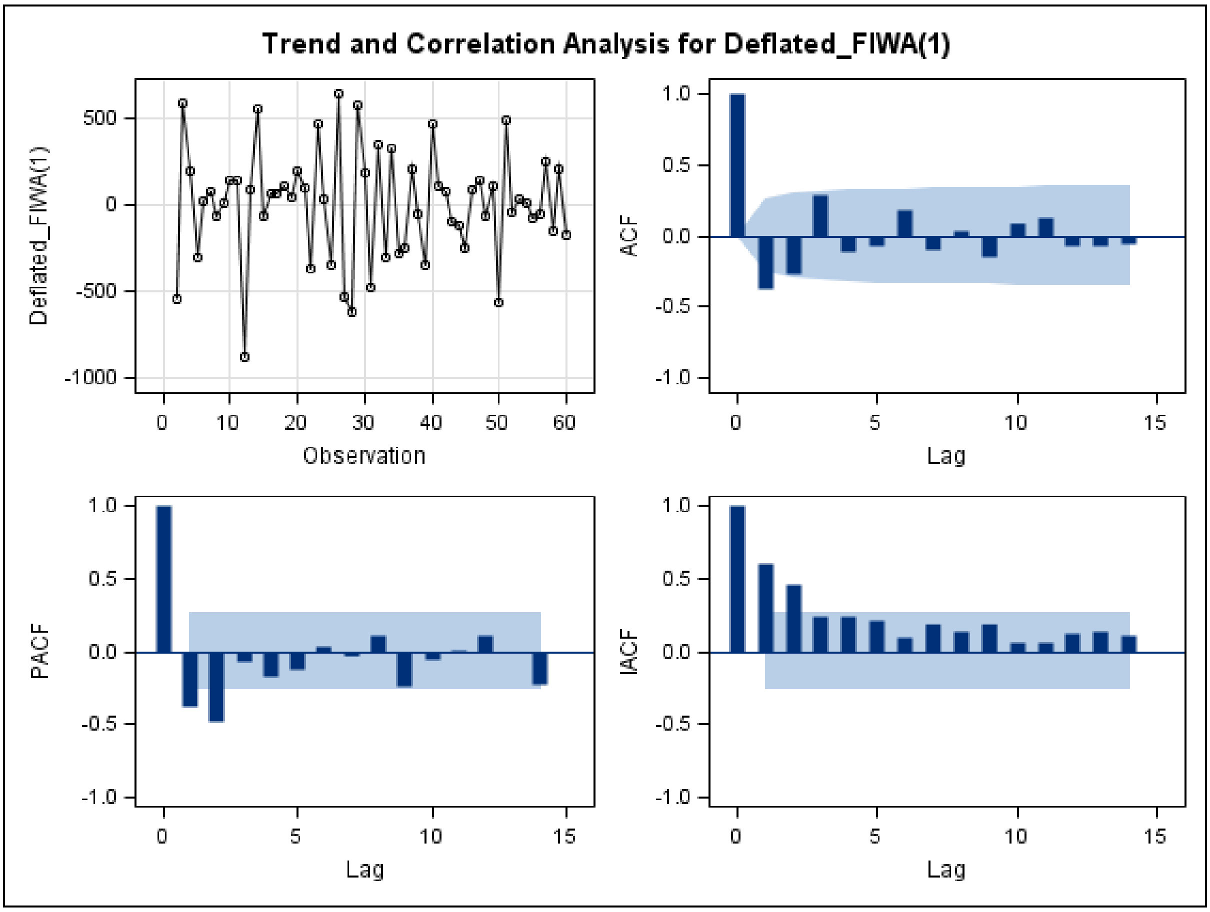
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-1,8649	0,3441	-0,95	0,3021		
	1	-0,4986	0,567	-0,38	0,5439		
	2	-0,1115	0,6541	-0,14	0,6315		
Single Mean	0	-37,5808	0,0005	-5,17	0,0001	13,36	0,0010
	1	-32,7868	0,0005	-4,21	0,0014	8,93	0,0010
	2	-13,9251	0,0401	-2,51	0,119	3,18	0,2704
Trend	0	-37,8909	0,0002	-5,15	0,0005	13,25	0,0010
	1	-32,6291	0,0013	-4,13	0,0098	8,71	0,0014
	2	-13,7651	0,1918	-2,45	0,3483	3,11	0,5612

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating after differentiating

Period(s) of Differencing	1
Mean of Working Series	1,577754
Standard Deviation	314,6003
Number of Observations	59
Observation(s) eliminated by differencing	1

Figure 363: Trend and correlation analysis for the average freight rates of the Inter West Africa time series and a fitted ARIMA (0, 1, 0) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 314: Augmented Dickey-Fuller unit root tests after differentiating for the average freight rates of the Inter West Africa time series and a fitted ARIMA (0, 1, 0) model

Type	Lags	Rho	Pr <0 Rho	Tau	Pr <0 Tau	F	Pr > F
Zero Mean	0	-79,7920	<0,0001	-11,52	<0,0001		
	1	-213,7750	0,0001	-10,44	<0,0001		
	2	-279,9570	0,0001	-6,31	<0,0001		
Single Mean	0	-79,8253	0,0005	-11,43	0,0001	65,39	0,0010
	1	-214,2860	0,0001	-10,36	0,0001	53,66	0,0010
	2	-282,4770	0,0001	-6,25	0,0001	19,58	0,0010
Trend	0	-79,8123	0,0001	-11,36	<0,0001	64,67	0,0010
	1	-215,5790	0,0001	-10,29	<0,0001	52,92	0,0010
	2	-287,2150	0,0001	-6,20	<0,0001	19,22	0,0010

Source: SAS 9.2(25/03/2014)

ARIMA (0, 1, 0)

Conditional least squares estimation

Table 315: Conditional least squares estimation for the average freight rates of the Inter West Africa time series and a fitted ARIMA (0, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	3,0101	9,82449	0,31	0,7604	0
MA1.1	0,72548	0,09136	8	<0,0001	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	3,010104
Variance Estimate	69.955,29
Std Error Estimate	264,4906
AIC	827,5811
SBC	831,7362
Number of Residuals	59

* AIC and SBC do not include log determinant.

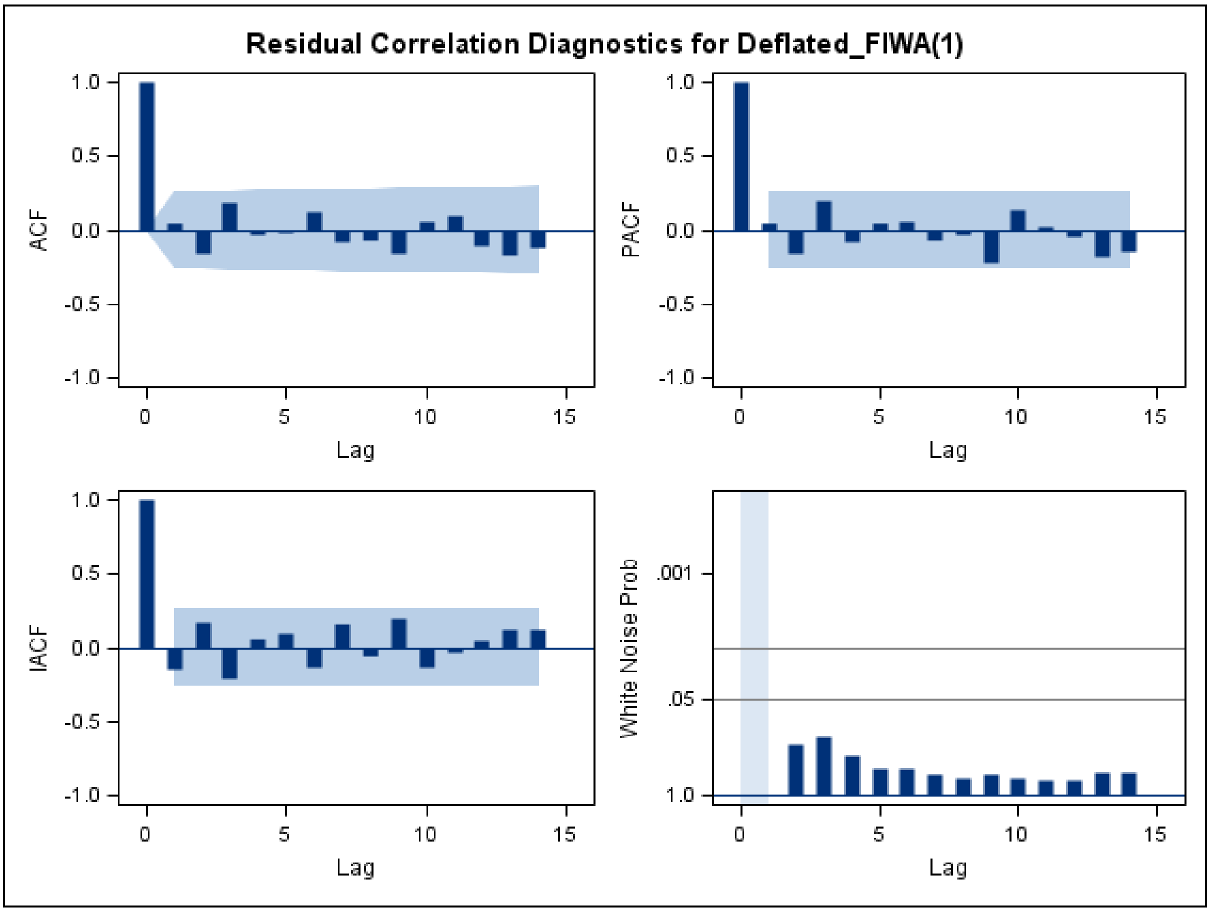
Autocorrelation check residuals

Table 316: Autocorrelation check residuals for the average freight rates of the Inter West Africa time series and a fitted ARIMA (0, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	4,79	5	0,4427	0,042	-0,154	0,181	-0,033	-0,023	0,119
12	9,11	11	0,6113	-0,076	-0,072	-0,155	0,060	0,097	-0,107
18	14,76	17	0,6124	-0,171	-0,114	0,038	0,065	0,032	-0,142
24	21,17	23	0,5709	0,007	-0,014	-0,106	0,022	0,133	-0,184

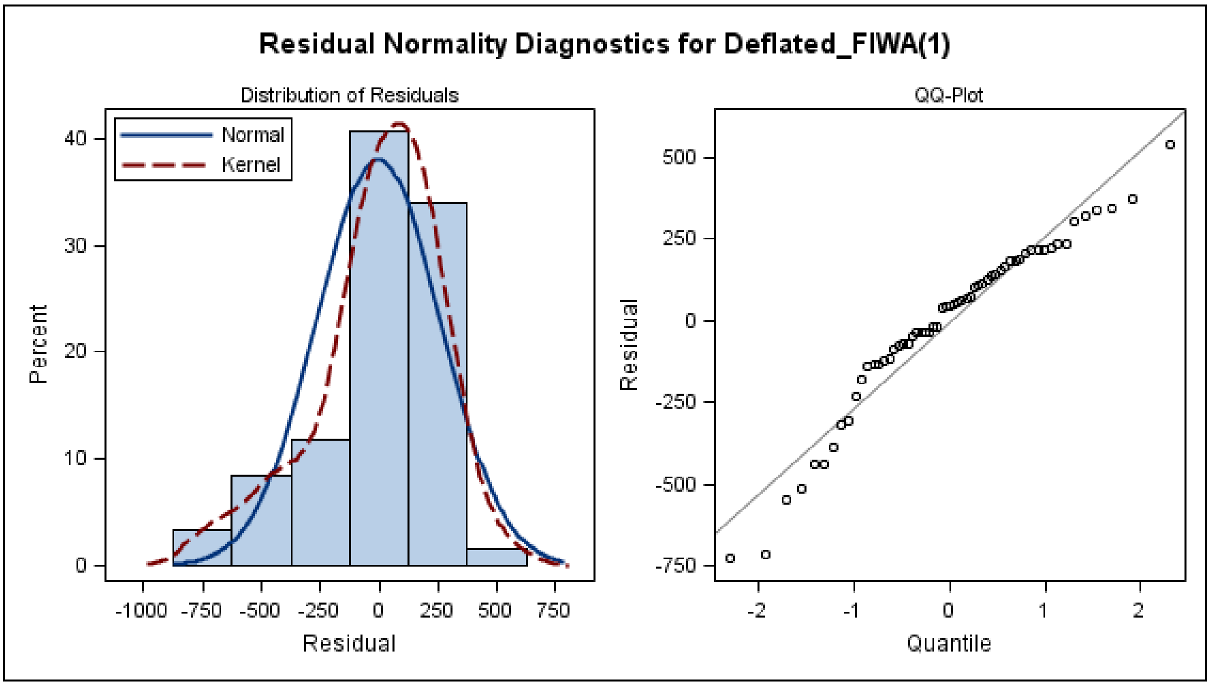
Source: SAS 9.2(25/03/2014)

Figure 364: Residual correlation diagnostics for the average freight rates of the Inter West Africa time series and a fitted ARIMA (0, 1, 0) model



Source: SAS 9.2(25/03/2014)

Figure 365: Residual normality diagnostics for the average freight rates of the Inter West Africa bound time series and a fitted ARIMA (0, 1, 0) model



Source: SAS 9.2(25/03/2014)

Model
Estimated Mean 3,010104
Period(s) of Differencing 1

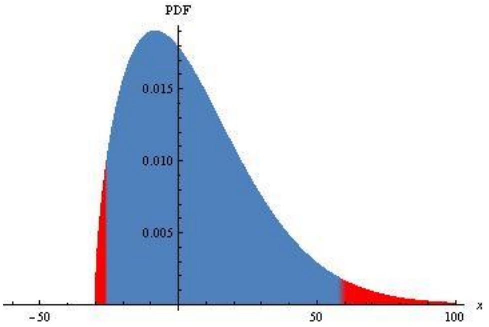
Moving Average Factors

Factor 1: 1 - 0.72548 B^(1)

Weibull (1.6, 37, 27)

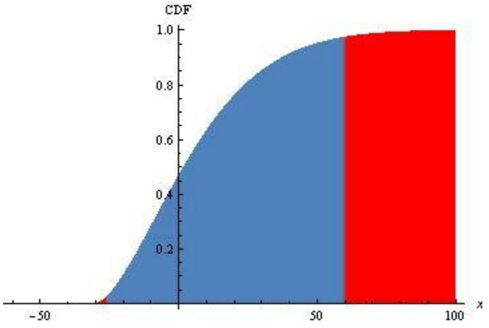
Probability density function

Figure 366: Probability density function Weibull (1.6, 37, 27)



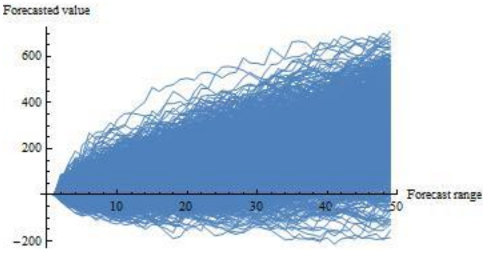
Cumulative density function

Figure 367: Cumulative density function Weibull (1.6, 37, 27)



Possible prediction paths

Figure 368: Possible prediction paths 48 steps ahead Weibull (1.6, 37, 27)

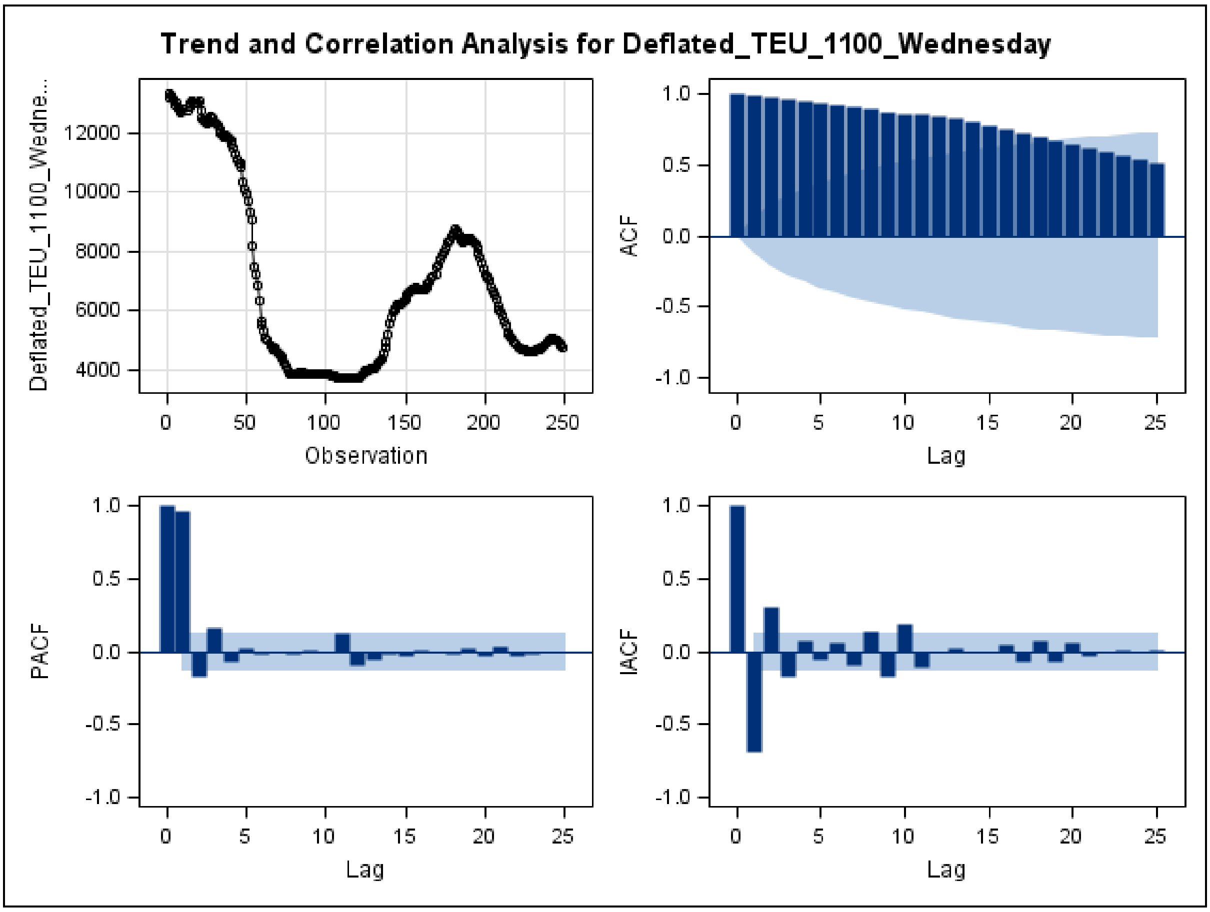


R.3.17 Average charter prices: 1.100TEU container vessel (data: Wednesday): ARIMA (3, 1, 0)

Descriptive statistics

Mean of Working Series	6.875,173
Standard Deviation	3.064,796
Number of Observations	249
Embedded missing values in working series	7

Figure 369: Trend and correlation analysis for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 317: Augmented Dickey-Fuller unit root tests for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model

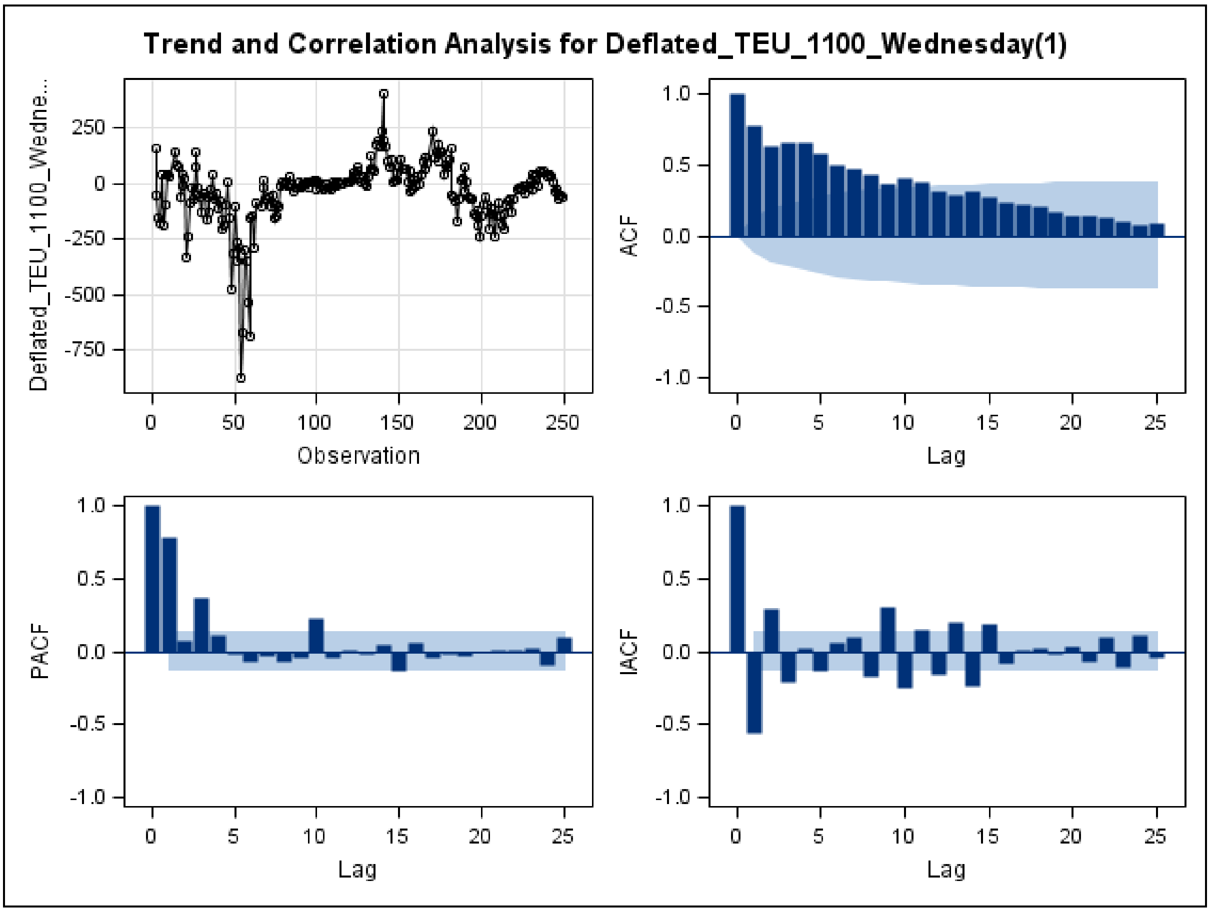
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	**0**	-1,3571	0,4152	-4,77	<0,0001		
	1	-1,9638	0,3345	-2,66	0,008		
	2	-1,8809	0,3444	-2,30	0,0211		
Single Mean	**0**	-2,1410	0,7606	-3,06	0,0312	12,17	0,0010
	1	-4,4316	0,4896	-2,53	0,1089	4,78	0,0455
	2	-4,2500	0,5089	-2,20	0,2076	3,58	0,1587
Trend	**0**	-1,3113	0,9837	-1,63	0,7793	6,82	0,0368
	1	-4,0443	0,8824	-2,05	0,5732	3,27	0,5248
	2	-3,9563	0,8876	-1,83	0,6896	2,44	0,6907

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	-35,278
Standard Deviation	142,0392
Number of Observations	248
Observation(s) eliminated by differencing	1
Embedded missing values in working series	13

Figure 370: Trend and correlation analysis for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 318: Augmented Dickey-Fuller unit root tests after differentiating for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-51,0855	<0,0001	-5,47	<0,0001		
	1	-41,6281	<0,0001	-4,53	<0,0001		
	2	-18,3891	0,0024	-2,96	0,0033		
Single Mean	0	-55,1867	0,0014	-5,76	<0,0001	16,62	0,0010
	1	-45,7725	0,0014	-4,79	0,0001	11,48	0,0010
	2	-20,9884	0,008	-3,21	0,0211	5,23	0,0317
Trend	0	-58,4021	0,0006	-5,96	<0,0001	17,81	0,0010
	1	-48,9368	0,0006	-4,95	0,0004	12,24	0,0010
	2	-22,7308	0,0351	-3,34	0,0627	5,58	0,0899

Source: SAS 9.2(25/03/2014)

ARIMA (3, 1, 0)

Conditional least squares estimation

Table 319: Conditional least squares estimation for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-1,15202	36,91176	-0,03	0,9751	0
AR1.1	0,69645	0,06212	11	<0,0001	1
AR1.2	-0,17755	0,07696	-2	0,0219	2
AR1.3	0,3509	0,06233	6	<0,0001	3

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	-0,14999
Variance Estimate	7.520,712
Std Error Estimate	86,72204
AIC	2.768,339
SBC	2.782,178
Number of Residuals	235

* AIC and SBC do not include log determinant.

Correlations of Parameter Estimates

Table 320: Correlations of Parameter Estimates for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model

Parameter	MU	MA1.1	AR1.1	AR1.3
MU	1,000	0,073	-0,012	0,088
AR1.1	0,073	1,000	-0,588	-0,060
AR1.2	-0,012	-0,588	1,000	-0,593
AR1.3	0,088	-0,060	-0,593	1,000

Source: SAS 9.2(25/03/2014)

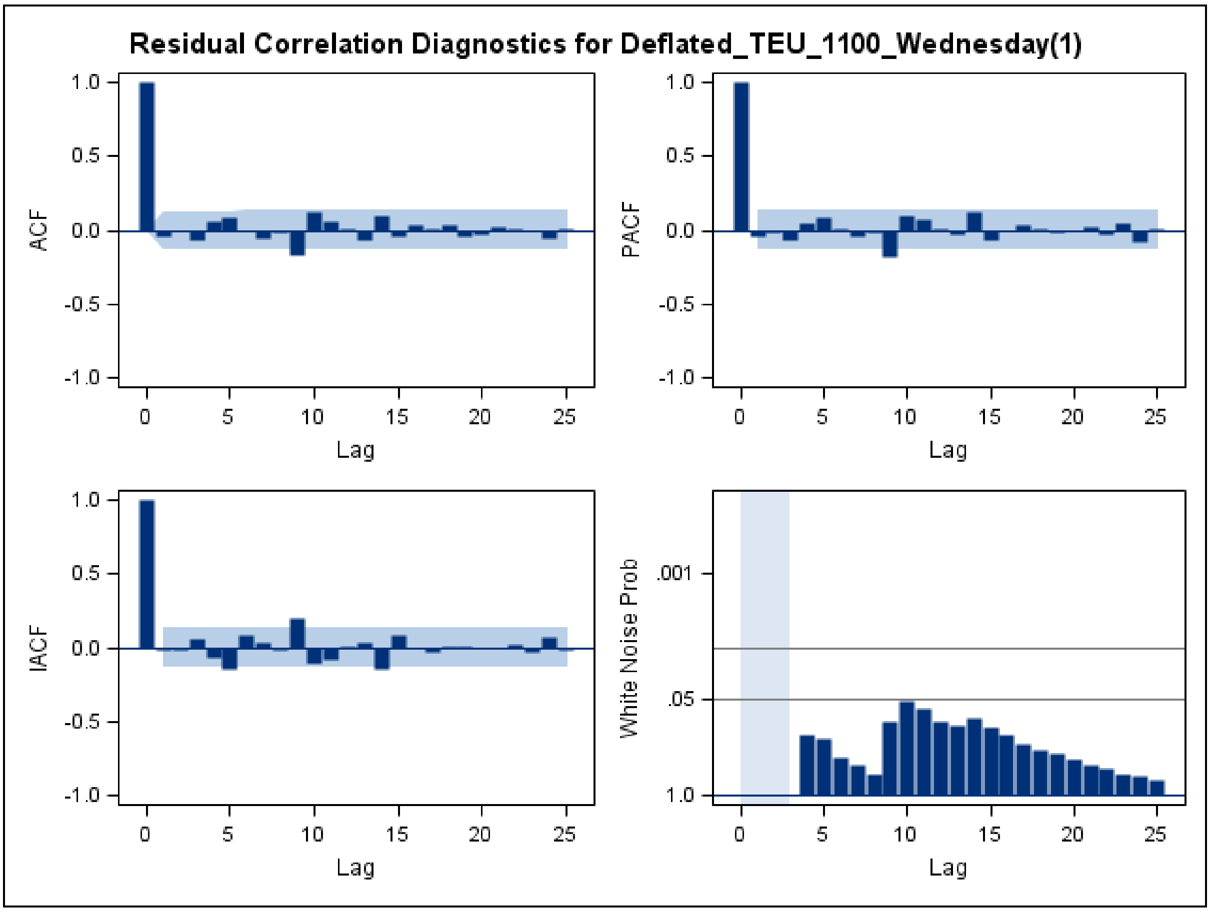
Autocorrelation check residuals

Table 321: Autocorrelation check residuals for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	3,57	3	0,3115	-0,037	-0,005	-0,059	0,060	0,087	-0,003
12	14,64	9	0,1014	-0,047	-0,017	-0,172	0,124	0,060	0,013
18	18,44	15	0,2403	-0,062	0,102	-0,032	0,036	0,006	0,041
24	19,68	21	0,5418	-0,039	-0,026	0,028	0,006	-0,003	-0,046
30	22,01	27	0,7369	0,013	0,072	-0,001	-0,062	-0,045	-0,002
36	27,72	33	0,7273	0,036	-0,048	0,125	-0,050	-0,045	0,078
42	33,25	39	0,7289	0,108	0,014	-0,094	-0,064	0,055	-0,032
48	39,89	45	0,6878	-0,053	0,034	-0,097	-0,102	0,098	-0,047

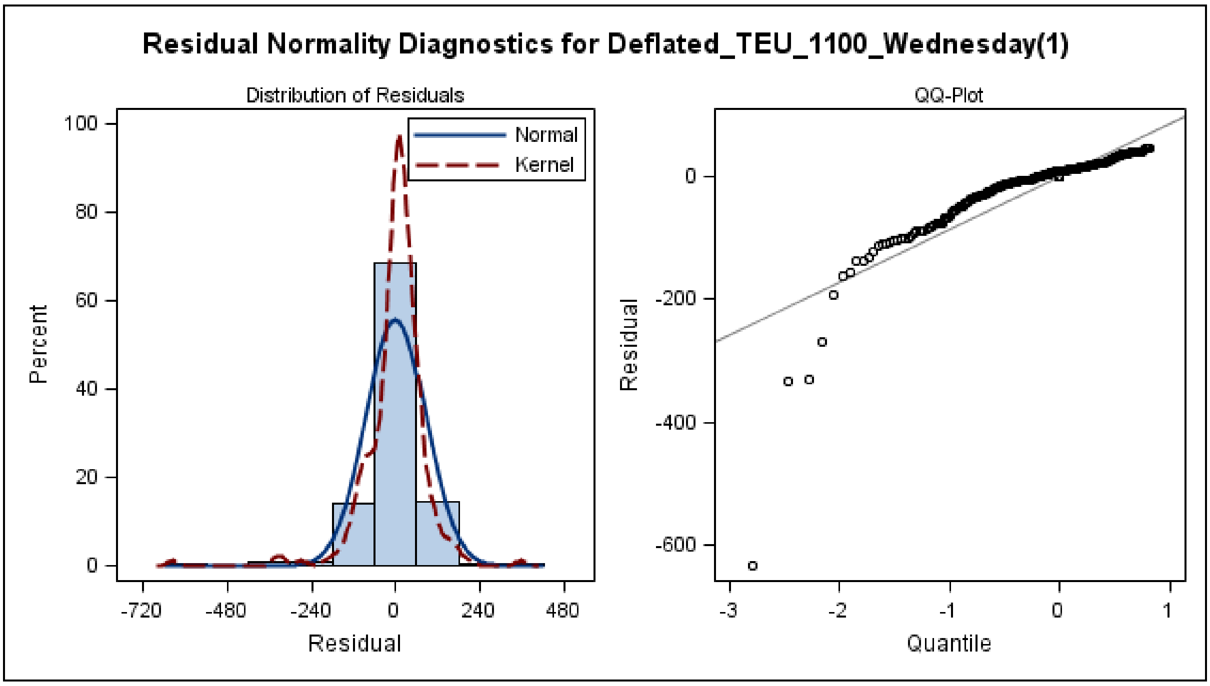
Source: SAS 9.2(25/03/2014)

Figure 371: Residual correlation diagnostics for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model



Source: SAS 9.2(25/03/2014)

Figure 372: Residual normality diagnostics for the charter prices of a 1.100TEU container vessel time series and a fitted ARIMA (3, 1, 0) model



Source: SAS 9.2(25/03/2014)

Model

Estimated Mean -1,15202

Period(s) of Differencing 1

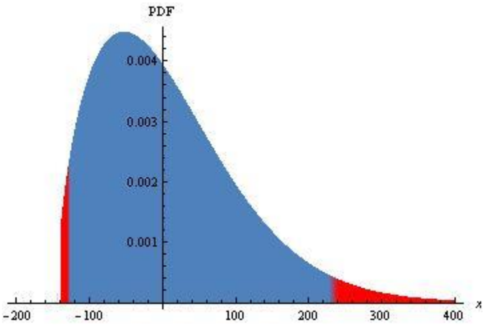
Autoregressive Factors

Factor 1: 1 - 0.69645 B^(1) + 0.17755 B^(2) - 0.3509 B^(3)

Weibull (1.6, 170, -145)

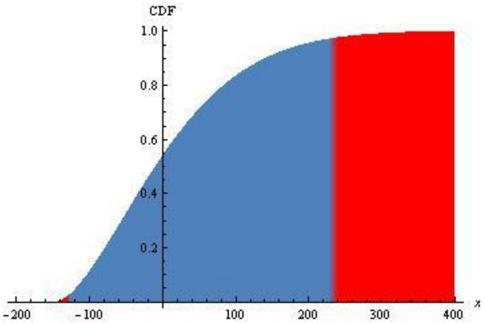
Probability density function

Figure 373: Probability density function Weibull (1.6, 170, -145)



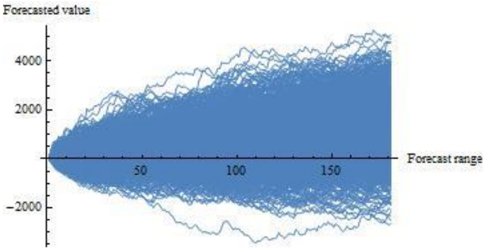
Cumulative density function

Figure 374: Cumulative density function Weibull (1.6, 170, -145)



Possible prediction paths

Figure 375: Possible prediction paths 48 steps ahead Weibull (1.6, 170, -145)

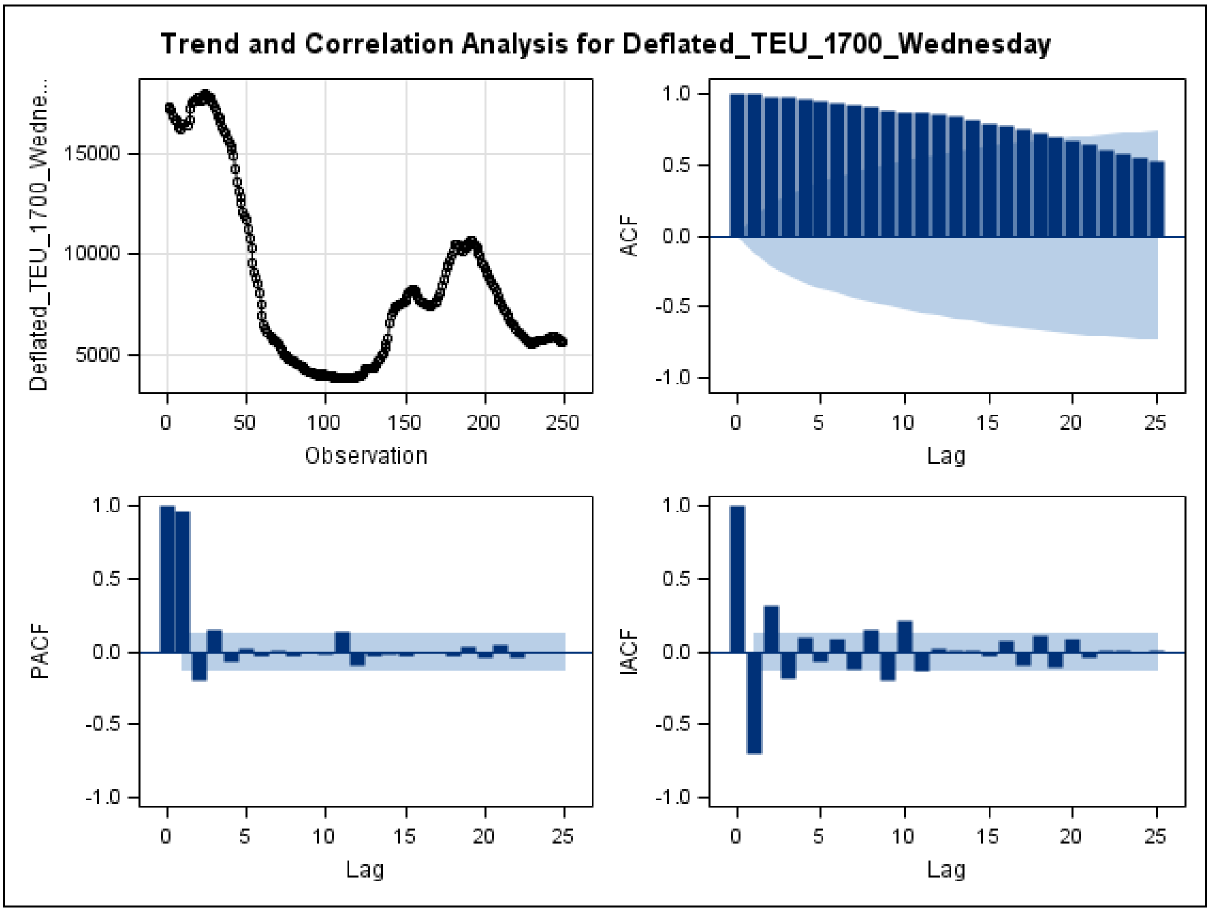


R.3.18 Average charter prices: 1.700TEU container vessel (data: Wednesday ARIMA(1, 1, 2))

Descriptive statistics

Mean of Working Series	8.66,274
Standard Deviation	4.373,658
Number of Observations	249
Embedded missing values in working series	7

Figure 376: Trend and correlation analysis for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model (1)



Source: SAS 9.2 (20/11/2013)

Augmented Dickey-Fuller unit root tests

Table 322: Augmented Dickey-Fuller unit root tests for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model

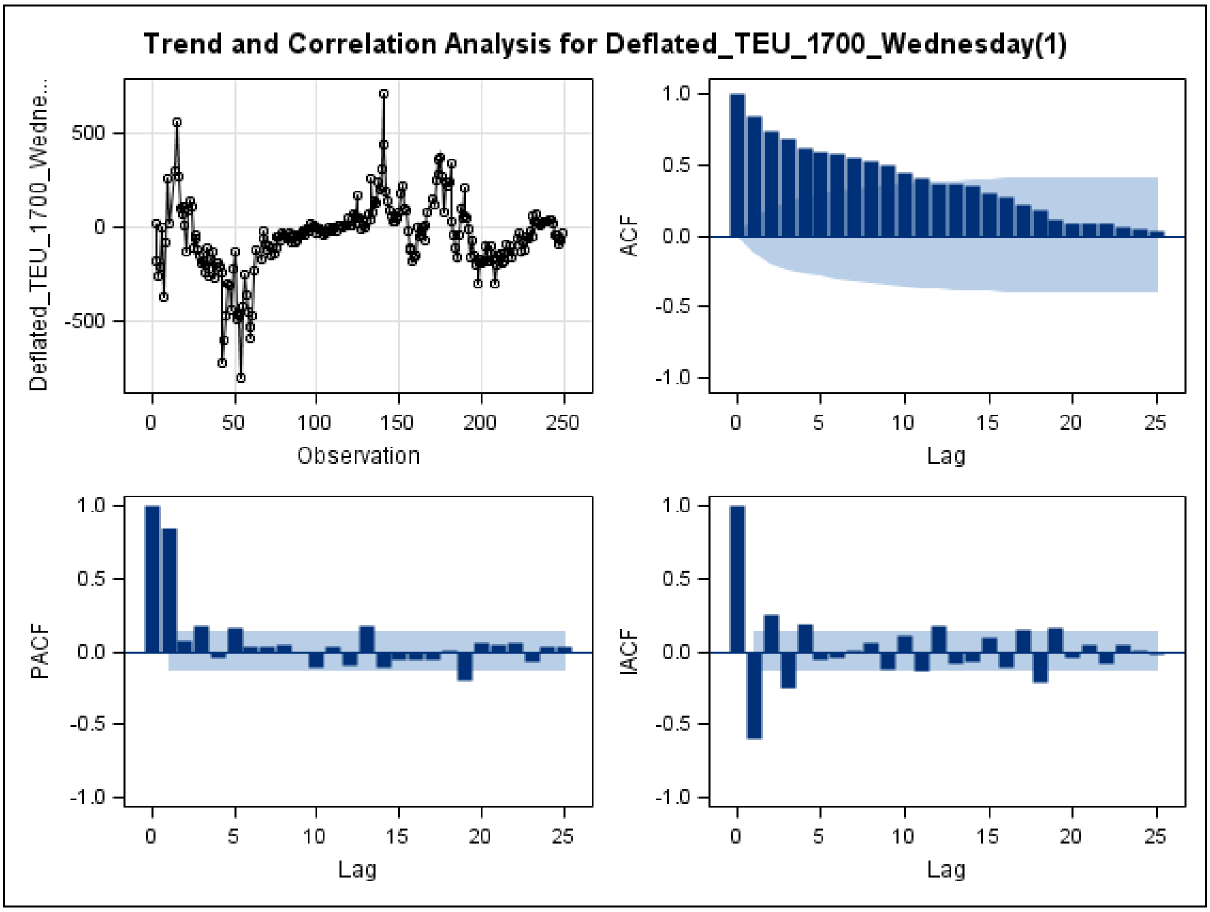
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-1,4767	0,3978	-4,89	<0,0001		
	1	-2,2444	0,3029	-2,42	0,0154		
	2	-2,4942	0,2775	-2,73	0,0064		
Single Mean	0	-2,0174	0,7755	-3,06	0,0312	12,39	0,0010
	1	-4,7217	0,4596	-2,42	0,1366	3,99	0,0888
	2	-5,1382	0,4188	-2,69	0,0782	5,01	0,0383
Trend	0	-1,1181	0,9865	-1,47	0,8361	7,46	0,0206
	1	-4,3618	0,8625	-1,98	0,612	2,97	0,5848
	2	-4,6862	0,8406	-2,19	0,4907	3,67	0,4450

Source: SAS 9.2 (20/11/2013)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	-48,2028
Standard Deviation	191,2294
Number of Observations	248
Observation(s) eliminated by differencing	1
Embedded missing values in working series	13

Figure 377: Trend and correlation analysis for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model (2)



Source: SAS 9.2 (20/11/2013)

Augmented Dickey-Fuller unit root tests after differentiating

Table 323: Augmented Dickey-Fuller unit root tests after differentiating for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-37,4690	<0,0001	-4,60	<0,0001		
	1	-31,3340	<0,0001	-4,23	<0,0001		
	2	-20,4679	0,0013	-3,30	0,0011		
Single Mean	0	-40,4312	0,0014	-4,82	0,0001	11,66	0,0010
	1	-34,8580	0,0014	-4,53	0,0003	10,39	0,0010
	2	-23,1605	0,0046	-3,58	0,0071	6,51	0,0012
Trend	0	-43,2583	0,0006	-5,03	0,0003	12,68	0,0010
	1	-38,3934	0,0009	-4,80	0,0006	11,59	0,0010
	2	-25,6162	0,0184	-3,77	0,02	7,11	0,0288

Source: SAS 9.2 (20/11/2013)

ARIMA (1, 1, 3)

Conditional least squares estimation

Table 324: Conditional least squares estimation for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-21,33694	51,1873	-0,42	0,6772	0
MA1.1	0,16588	0,07354	2	0,025	1
MA1.2	0,2309	0,07192	3	0,0015	2
AR1.1	0,93362	0,03102	30	<0,0001	1

Source: SAS 9.2 (20/11/2013)

Fit statistics

Constant Estimate	-1,4164
Variance Estimate	11.344,35
Std Error Estimate	106,5098
AIC	2.864,938
SBC	2.878,777
Number of Residuals	235

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 325: Correlations of parameter estimates for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model

Parameter	MU	MA1.1	MA1.2	AR1.1
MU	1,000	0,044	0,059	0,148
MA1.1	0,044	1,000	0,039	0,482
MA1.2	0,059	0,039	1,000	0,445
AR1.1	0,148	0,482	0,445	1,000

Source: SAS 9.2 (20/11/2013)

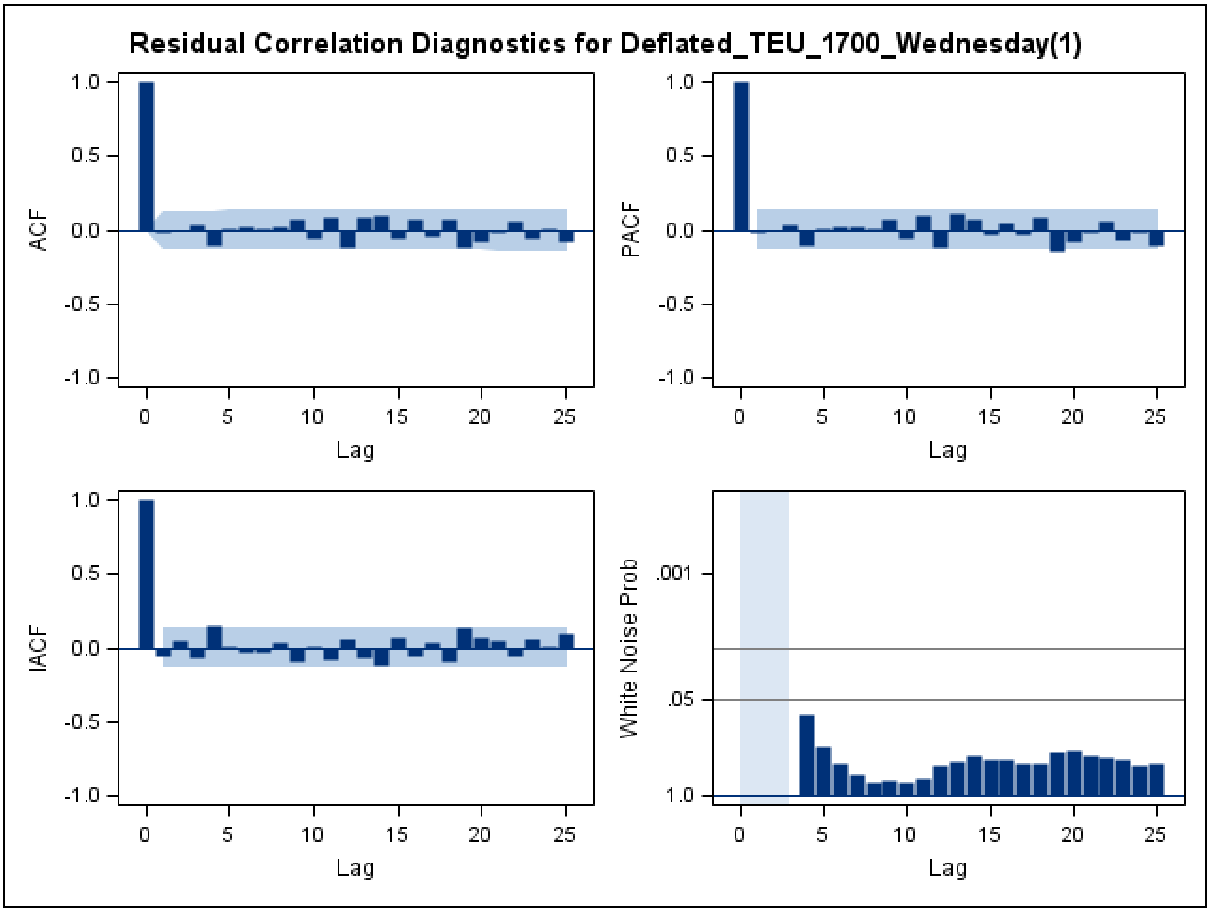
Autocorrelation check residuals

Table 326: Autocorrelation check residuals for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	3,17	3	0,3662	-0,010	-0,007	0,037	-0,111	0,010	0,019
12	9,58	9	0,3852	0,012	0,020	0,072	-0,054	0,087	-0,118
18	16,19	15	0,3697	0,085	0,094	-0,052	0,079	-0,042	0,068
24	22,18	21	0,3889	-0,118	-0,086	-0,019	0,063	-0,048	0,013
30	28,9	27	0,3656	-0,083	0,058	0,097	-0,058	-0,099	-0,014
36	32,73	33	0,4804	0,042	-0,075	0,085	-0,056	0,026	0,035
42	44,74	39	0,2436	-0,110	0,065	-0,081	0,142	0,136	-0,039
48	59,18	45	0,0763	-0,115	-0,008	-0,182	-0,108	0,141	0,029

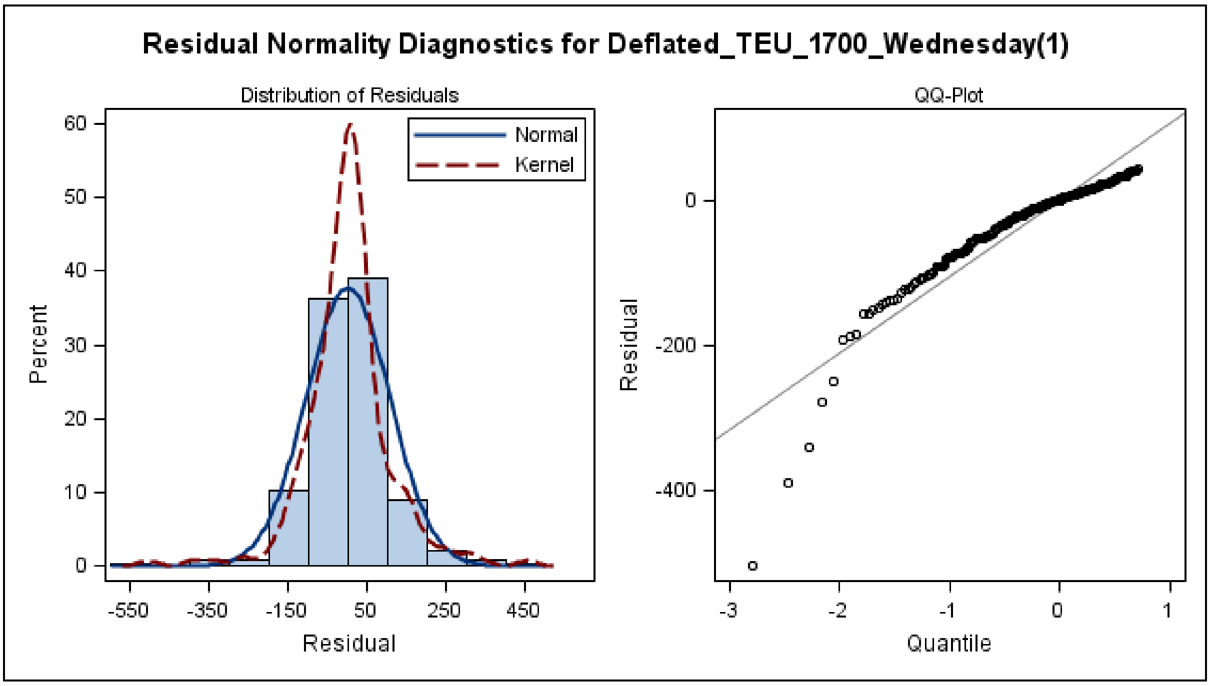
Source: SAS 9.2 (20/11/2013)

Figure 378: Residual correlation diagnostics for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model



Source: SAS 9.2 (20/11/2013)

Figure 379: Residual normality diagnostics for the charter prices of a 1.700TEU container vessel time series and a fitted ARIMA(1, 1, 2)) model



Source: SAS 9.2 (20/11/2013)

Model

Estimated Mean -21.3369

Period(s) of Differencing 1

Autoregressive Factors

Factor 1: 1 - 0.93362 B^(1)

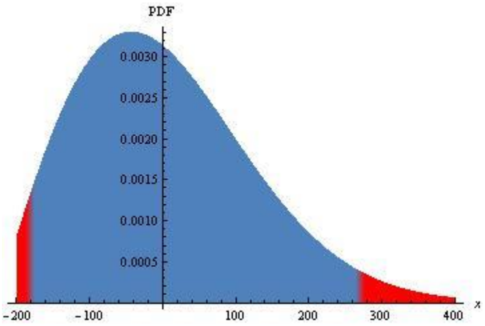
Moving Average Factors

Factor 1: 1 - 0.16588 B^(1) - 0.2309 B^(2)

Weibull (2, 260, -227)

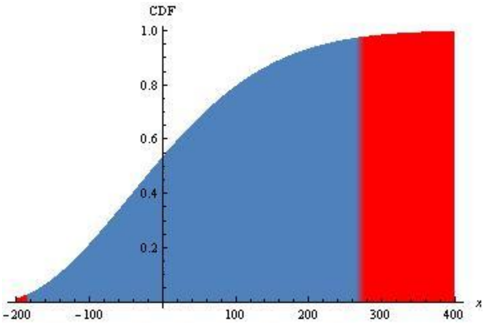
Probability density function

Figure 380: Probability density function Weibull (2, 260, -227)



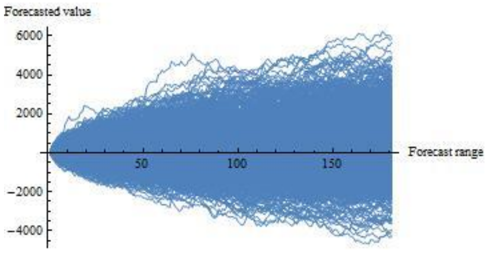
Cumulative density function

Figure 381: Cumulative density function Weibull (2, 260, -227)



Possible prediction paths

Figure 382: Possible prediction paths 48 steps ahead Weibull (2, 260, -227)

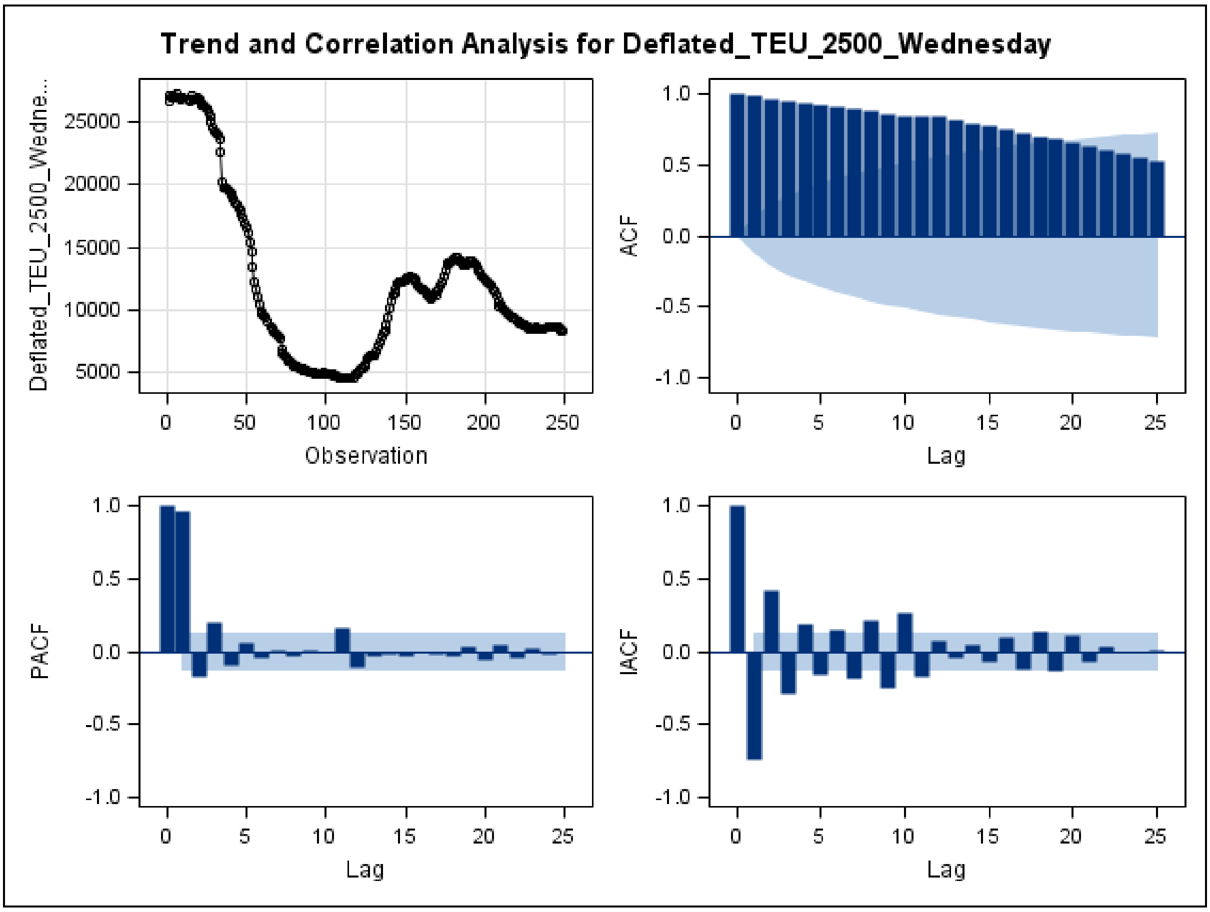


R.3.19 Average charter prices: 2.500TEU container vessel (data: Wednesday): ARIMA(1, 1, 2)

Descriptive statistics

Mean of Working Series	12.021,94
Standard Deviation	6.641,992
Number of Observations	249
Embedded missing values in working series	7

Figure 383: Trend and correlation analysis for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 327: Augmented Dickey-Fuller unit root tests for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model

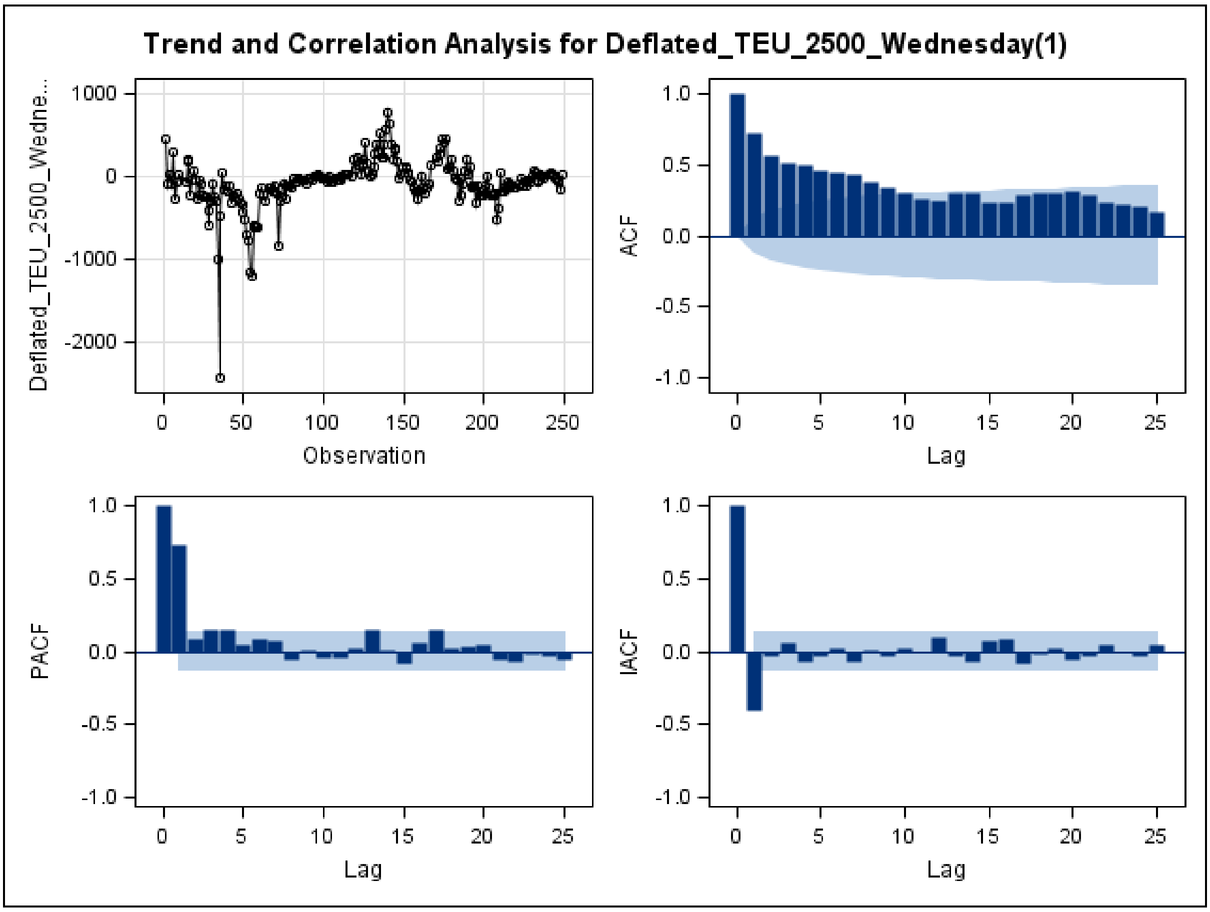
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-1,7200	0,3648	-5,30	<0,0001		
	1	-2,2067	0,3069	-2,85	0,0045		
	2	-2,2514	0,3021	-2,69	0,0073		
Single Mean	0	-2,5103	0,7153	-3,74	0,0043	14,98	0,0010
	1	-4,0640	0,5295	-2,64	0,0876	5,08	0,0363
	2	-4,0863	0,5269	-2,44	0,1309	4,44	0,0615
Trend	0	-1,4852	0,9807	-1,94	0,6294	10,80	0,0010
	1	-3,2036	0,9272	-1,90	0,6518	3,94	0,3899
	2	-3,2844	0,9234	-1,83	0,689	3,34	0,5103

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	-75,901
Standard Deviation	298,2188
Number of Observations	248
Observation(s) eliminated by differencing	1
Embedded missing values in working series	13

Figure 384: Trend and correlation analysis for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 328: Augmented Dickey-Fuller unit root tests after differentiating for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-62,2925	<0,0001	-6,04	<0,0001		
	1	-50,6373	<0,0001	-5,01	<0,0001		
	2	-35,3144	<0,0001	-4,05	<0,0001		
Single Mean	0	-66,9343	0,0014	-6,31	<0,0001	19,96	0,0010
	1	-55,8667	0,0014	-5,30	<0,0001	14,08	0,0010
	2	-40,1668	0,0014	-4,35	0,0005	9,53	0,0010
Trend	0	-72,9486	0,0006	-6,68	<0,0001	22,33	0,0010
	1	-62,6993	0,0006	-5,63	<0,0001	15,85	0,0010
	2	-47,0059	0,0006	-4,71	0,0009	11,12	0,0010

Source: SAS 9.2(25/03/2014)

ARIMA(1, 1, 2)

Conditional least squares estimation

Table 329: Conditional least squares estimation for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	-6,05567	80,6409	-0,08	0,9402	0
MA1.1	0,34444	0,07475	5	<0,0001	1
MA1.2	0,23947	0,07198	3	0,001	2
AR1.1	0,93901	0,03354	28	<0,0001	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	-0,36932
Variance Estimate	43.061,3
Std Error Estimate	207,5122
AIC	3.178,406
SBC	3.192,244
Number of Residuals	235

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 330: Correlations of parameter estimates for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model

Parameter	MU	MA1.1	MA1.2	AR1.1
MU	1,000	0,091	0,082	0,259
MA1.1	0,091	1,000	-0,116	0,514
MA1.2	0,082	-0,116	1,000	0,450
AR1.1	0,259	0,514	0,450	1,000

Source: SAS 9.2(25/03/2014)

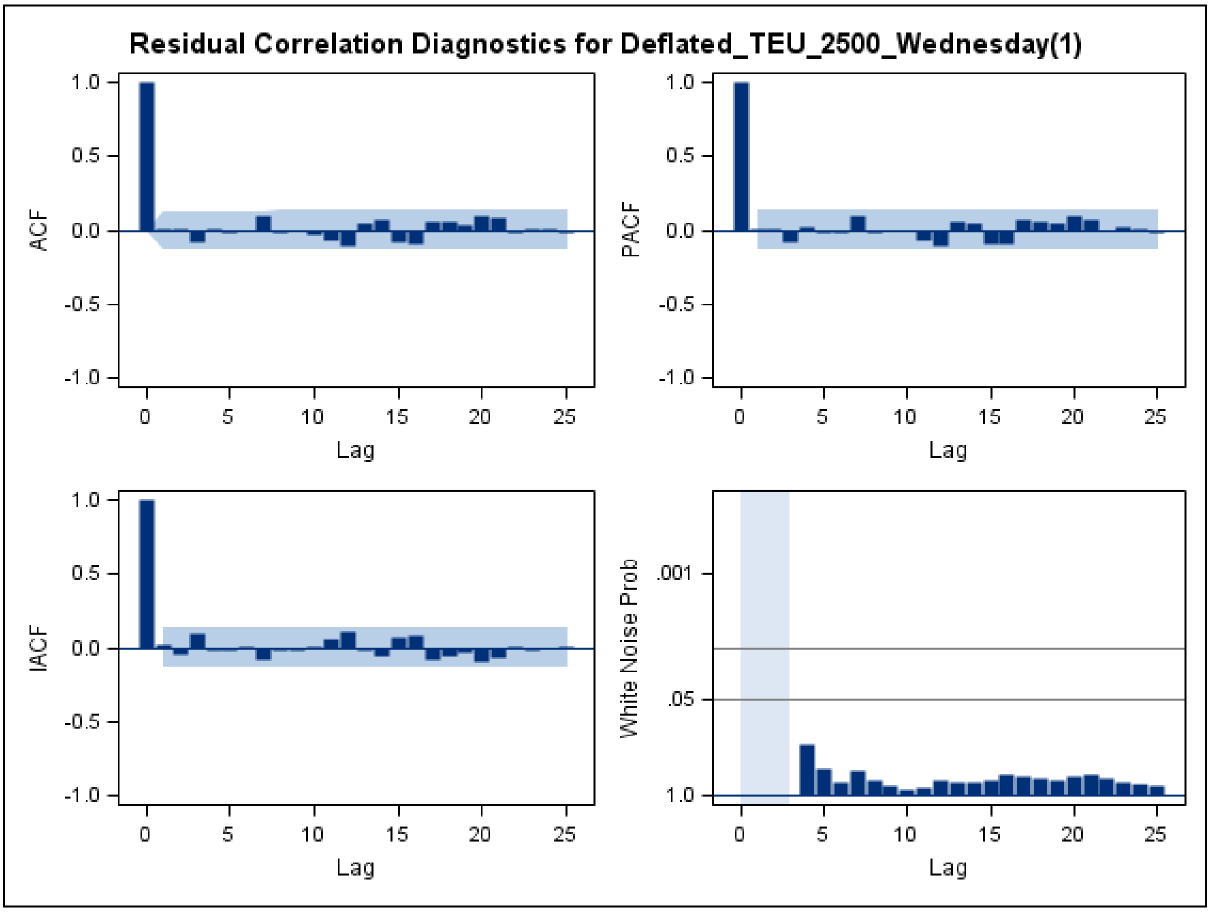
Autocorrelation check residuals

Table 331: Autocorrelation check residuals for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	1,69	3	0,6386	0,013	0,014	-0,079	0,017	-0,014	-0,006
12	7,27	9	0,6093	0,095	-0,014	0,000	-0,025	-0,062	-0,109
18	13,43	15	0,5694	0,052	0,068	-0,074	-0,094	0,063	0,061
24	17,19	21	0,6994	0,043	0,104	0,081	-0,018	0,003	0,014
30	21,49	27	0,7629	-0,012	-0,042	0,020	0,062	-0,067	0,103
36	29,16	33	0,6589	-0,047	0,015	-0,173	0,035	0,031	-0,058
42	37,95	39	0,5177	0,212	0,010	-0,014	-0,017	0,020	-0,003
48	38,82	45	0,7301	-0,038	0,023	-0,001	0,000	-0,018	0,051

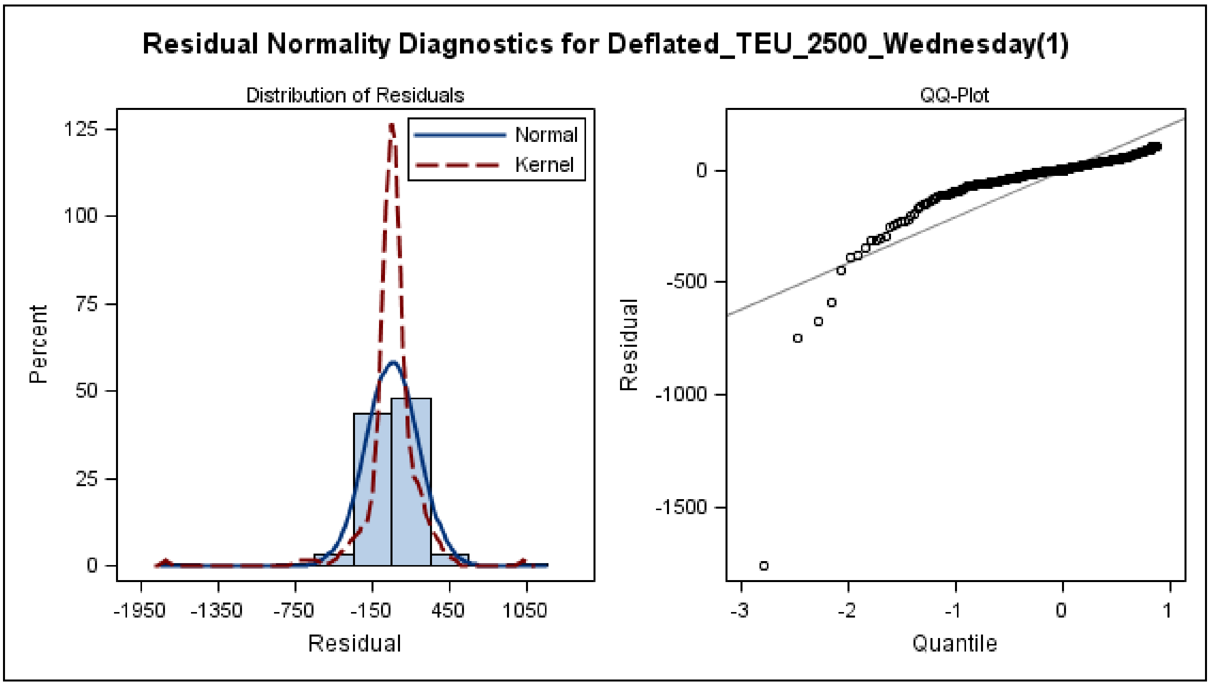
Source: SAS 9.2(25/03/2014)

Figure 385: Residual correlation diagnostics for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model



Source: SAS 9.2(25/03/2014)

Figure 386: Residual normality diagnostics for the charter prices of a 2.500TEU container vessel time series and a fitted ARIMA(1, 1, 2) model



Source: SAS 9.2(25/03/2014)

Model

Estimated Mean -6.05567
Period(s) of Differencing 1

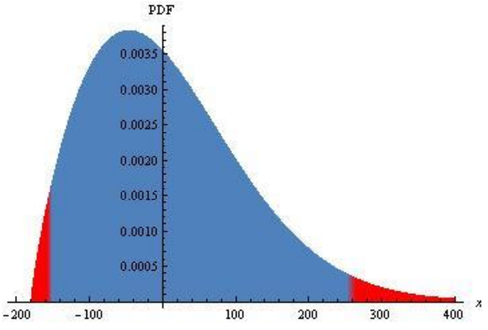
Autoregressive Factors
Factor 1: 1 - 0.93901 B^(1)

Moving Average Factors
Factor 1: 1 - 0.34444 B^(1) - 0.23947 B^(2)

Weibull (1.8, 210, -180)

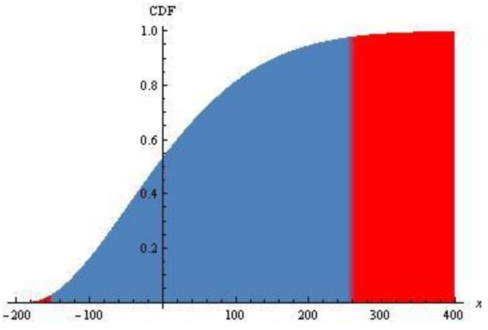
Probability density function

Figure 387: Probability density function Weibull (1.8, 210, -180)



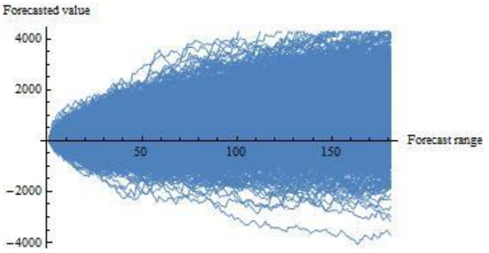
Cumulative density function

Figure 388: Cumulative density function Weibull (1.8, 210, -180)



Possible prediction paths

Figure 389: Possible prediction paths 48 steps ahead Weibull (1.8, 210, -180)

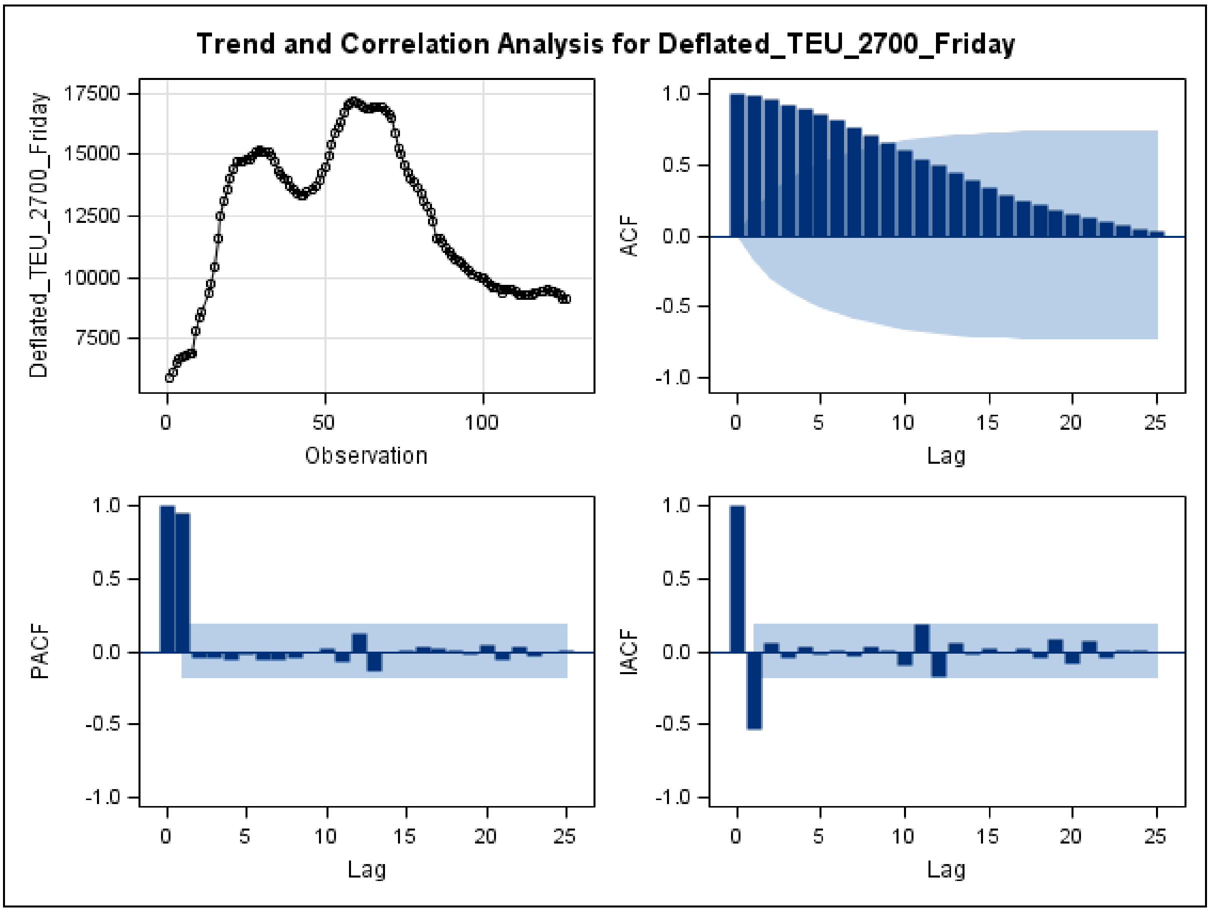


R.3.20 Average charter prices: 2.700TEU container vessel (data: Wednesday): ARIMA(1, 1, 0)

Descriptive statistics

Mean of Working Series	12.369,55
Standard Deviation	3.083,176
Number of Observations	126

Figure 390: Trend and correlation analysis for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 332: Augmented Dickey-Fuller unit root tests for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

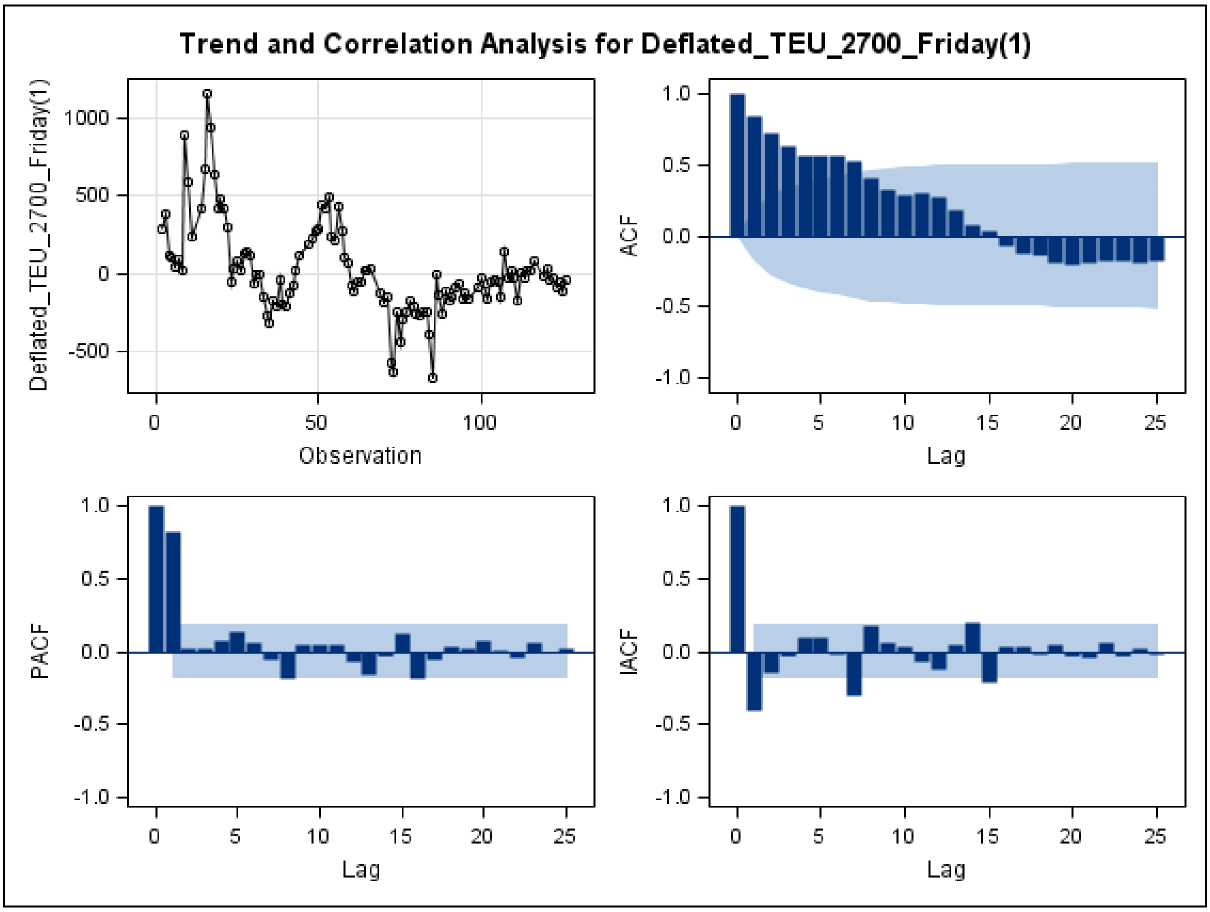
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	0,0795	0,6995	0,33	0,7783		
	1	-0,2545	0,6234	-0,35	0,5562		
	2	-0,4144	0,5872	-0,61	0,4521		
Single Mean	0	-1,9286	0,7845	-1,93	0,316	2,20	0,5090
	1	-4,6044	0,4674	-1,56	0,4979	1,22	0,7591
	2	-3,6911	0,5682	-1,26	0,648	0,84	0,8560
Trend	0	-2,9417	0,9375	-3,41	0,0554	24,48	0,0010
	1	-4,8333	0,8274	-2,13	0,5229	3,37	0,5046
	2	-4,0975	0,8769	-1,72	0,7345	2,13	0,7524

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	21,89362
Standard Deviation	288,4204
Number of Observations	125
Observation(s) eliminated by differencing	1
Embedded missing values in working series	10

Figure 391: Trend and correlation analysis for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 333: Augmented Dickey-Fuller unit root tests after differentiating for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-20,6932	0,001	-3,48	0,0006		
	1	-18,6274	0,002	-3,36	0,001		
	2	-14,8737	0,0061	-3,50	0,0006		
Single Mean	0	-20,6993	0,0073	-3,46	0,0111	6,00	0,0126
	1	-18,5021	0,0131	-3,32	0,0164	5,66	0,0202
	2	-14,7333	0,0361	-3,47	0,011	6,30	0,0095
Trend	0	-25,5156	0,0158	-3,75	0,0233	7,10	0,0291
	1	-22,4830	0,0317	-3,45	0,0509	6,17	0,0590
	2	-16,9082	0,1092	-3,37	0,0616	6,26	0,0612

Source: SAS 9.2(25/03/2014)

ARIMA(1, 1, 0)

Conditional least squares estimation

Table 334: Conditional least squares estimation for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	72,70248	75,99369	0,96	0,3408	0
AR1.1	0,83008	0,05374	15	<0,0001	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	12,35337
Variance Estimate	28.652,28
Std Error Estimate	169,2698
AIC	1.508,582
SBC	1.514,072
Number of Residuals	115

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 335: Correlations of parameter estimates for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

Parameter	MU	MA1.1
MU	1,000	0,143
AR1.1	0,143	1,000

Source: SAS 9.2(25/03/2014)

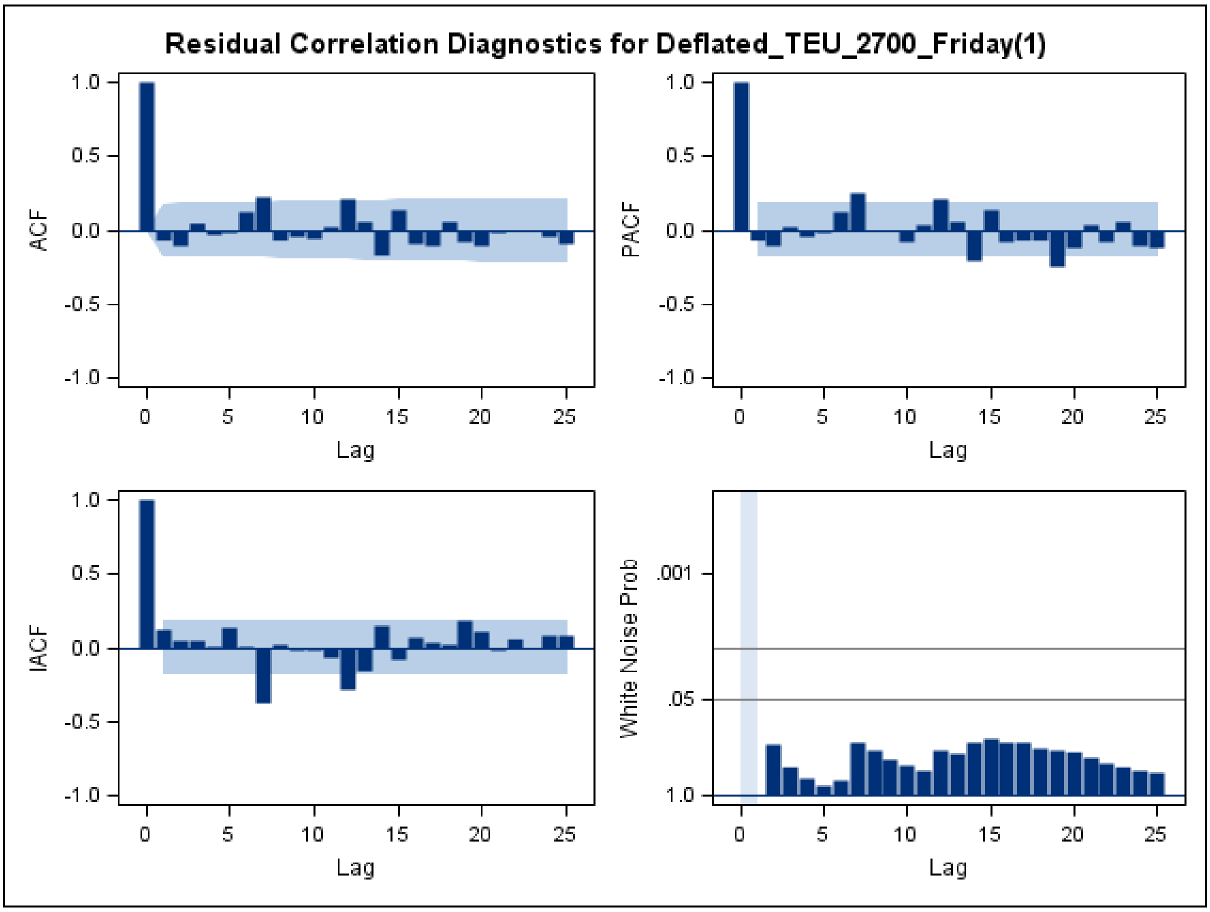
Autocorrelation check residuals

Table 336: Autocorrelation check residuals for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	3,51	5	0,6214	-0,061	-0,100	0,050	-0,029	-0,015	0,129
12	13,94	11	0,2366	0,231	-0,066	-0,034	-0,049	0,032	0,214
18	21,04	17	0,2247	0,065	-0,167	0,139	-0,088	-0,100	0,072
24	22,82	23	0,4714	-0,073	-0,094	-0,006	-0,001	0,005	-0,034

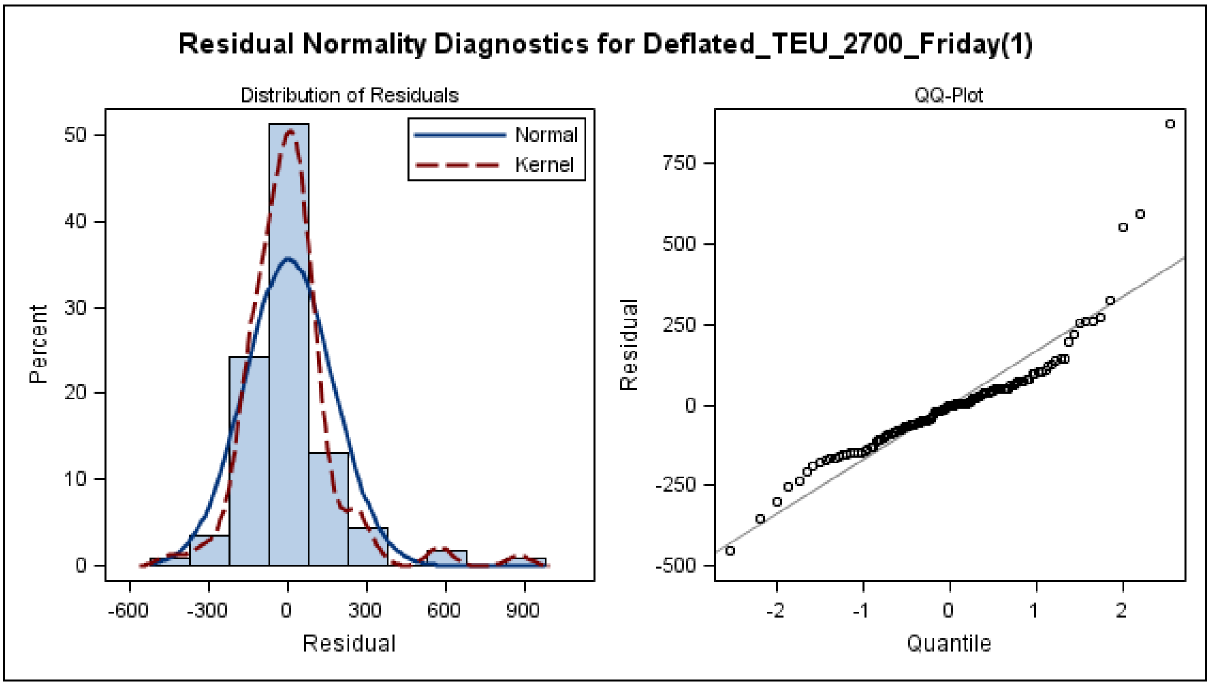
Source: SAS 9.2(25/03/2014)

Figure 392: Residual correlation diagnostics for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model



Source: SAS 9.2(25/03/2014)

Figure 393: Residual normality diagnostics for the charter prices of a 2.700TEU container vessel time series and a fitted ARIMA(1, 1, 0) model



Source: SAS 9.2(25/03/2014)

Model

Estimated Mean 72,70248

Period(s) of Differencing 1

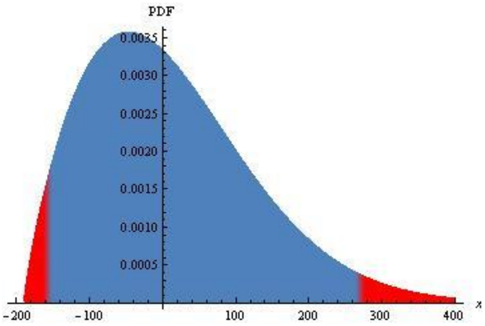
Autoregressive Factors

Factor 1: 1 - 0.83008 B^(1)

Weibull (1.8, 225, -190)

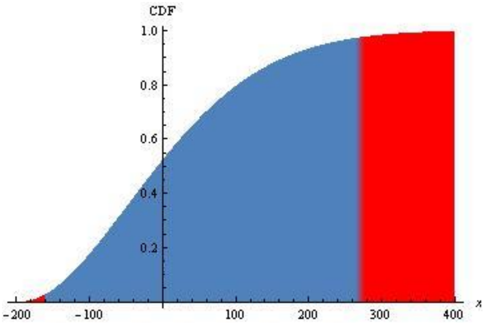
Probability density function

Figure 394: Probability density function Weibull (1.8, 225, -190)



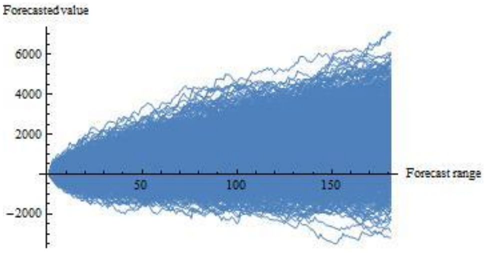
Cumulative density function

Figure 395: Cumulative density function Weibull (1.8, 225, -190)



Possible prediction paths

Figure 396: Possible prediction paths 48 steps ahead Weibull (1.8, 225, -190)

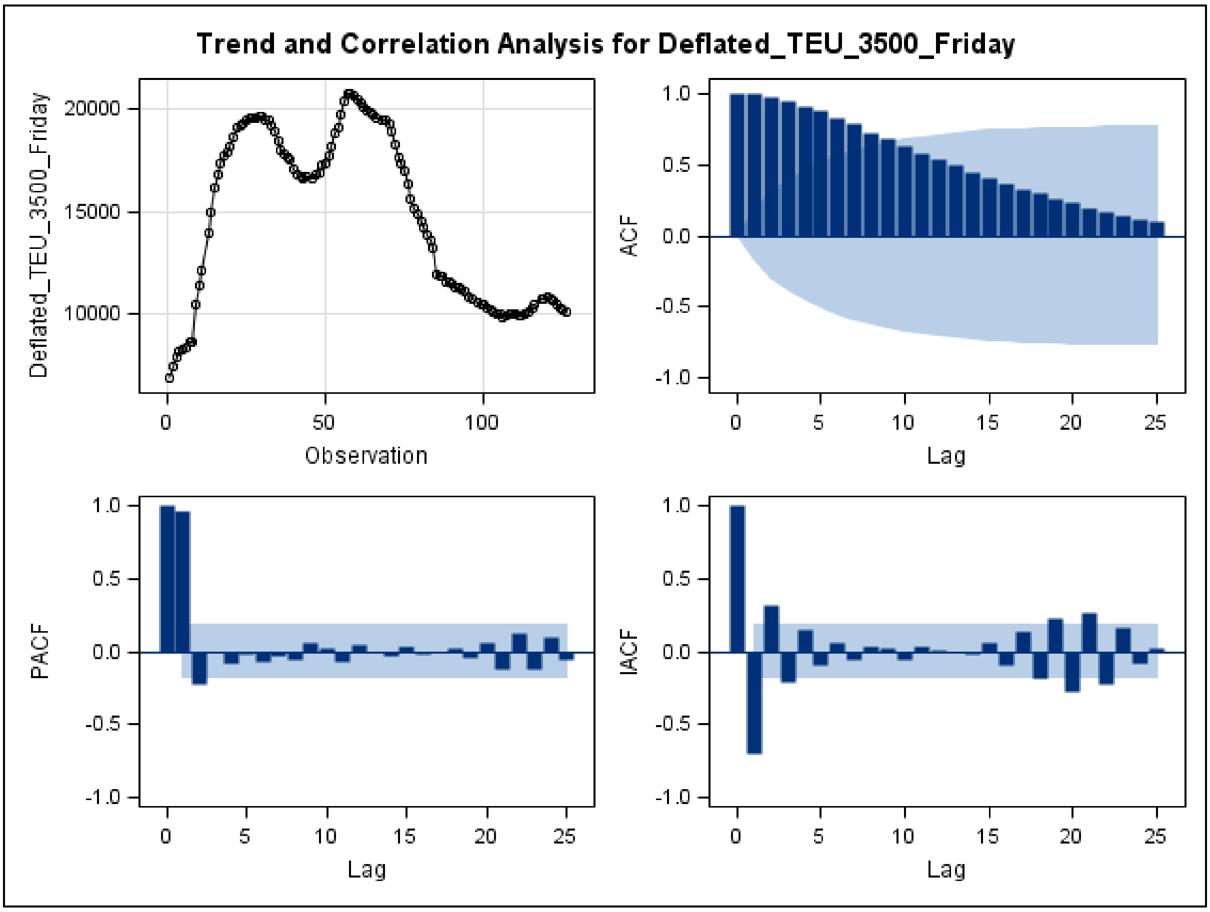


R.3.21 Average charter prices: 3.500TEU container vessel (data: Wednesday): ARIMA(1, 1, 1))

Descriptive statistics

Mean of Working Series	14.715,83
Standard Deviation	4.131,173
Number of Observations	126
Embedded missing values in working series	5

Figure 397: Trend and correlation analysis for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 337: Augmented Dickey-Fuller unit root tests for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model

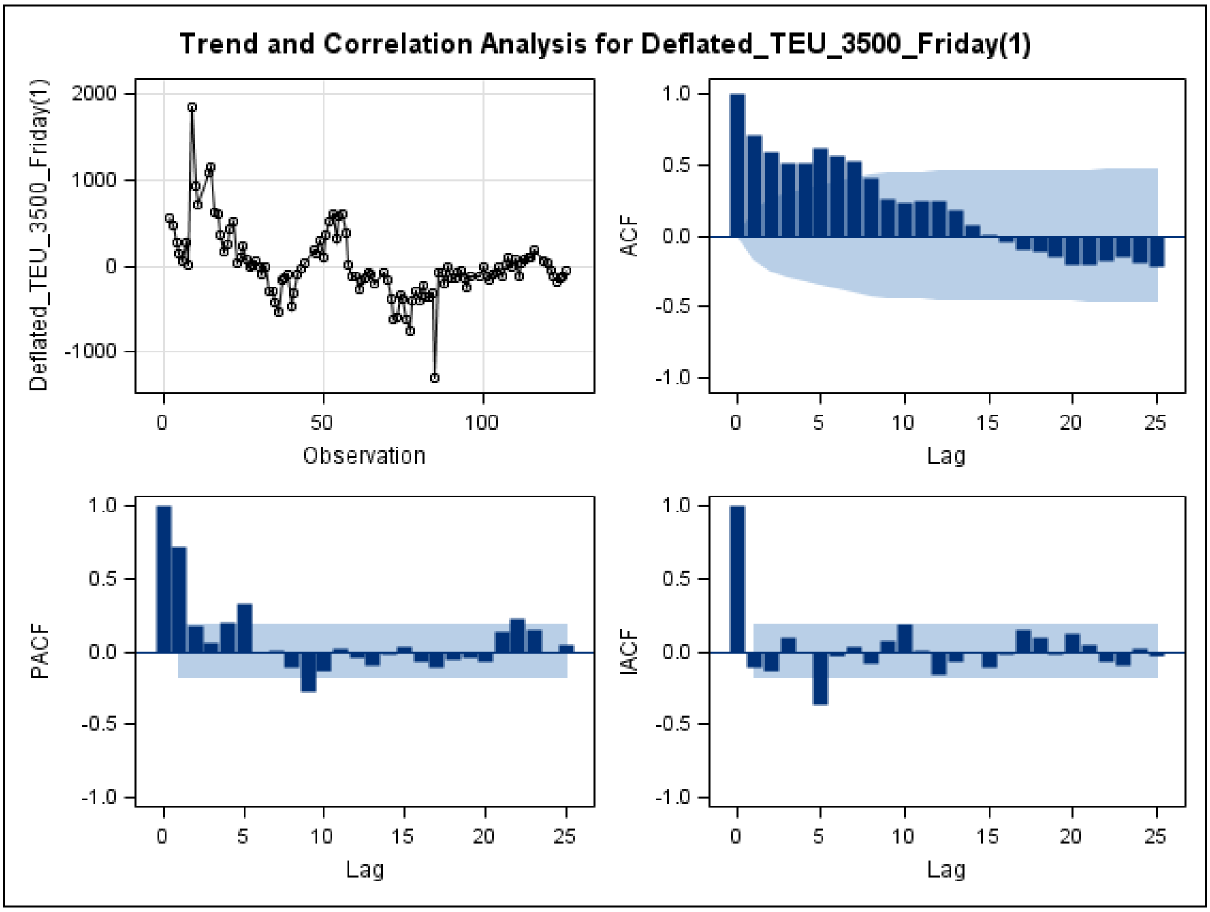
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-0,0110	0,6787	-0,04	0,668		
	1	-0,4012	0,5902	-0,67	0,427		
	2	-0,6236	0,5421	-0,95	0,3028		
Single Mean	0	-1,4602	0,838	-1,44	0,5605	1,10	0,7897
	1	-3,2463	0,6219	-1,45	0,5538	1,10	0,7908
	2	-4,0177	0,5306	-1,61	0,476	1,44	0,7034
Trend	0	-3,9738	0,8849	-4,23	0,0056	23,72	0,0010
	1	-5,0526	0,8112	-2,67	0,2503	4,90	0,1971
	2	-5,5053	0,7758	-2,60	0,2822	3,99	0,3793

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	13,22101
Standard Deviation	391,9063
Number of Observations	125
Observation(s) eliminated by differencing	1
Embedded missing values in working series	10

Figure 398: Trend and correlation analysis for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 338: Augmented Dickey-Fuller unit root tests after differentiating for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-33,0582	<0,0001	-4,65	<0,0001		
	1	-22,1807	0,0006	-3,66	0,0003		
	2	-14,9003	0,0061	-2,58	0,0101		
Single Mean	0	-33,0142	0,001	-4,63	0,0003	10,77	0,0010
	1	-22,1716	0,0048	-3,65	0,0062	6,81	0,0010
	2	-14,9947	0,0336	-2,59	0,0993	3,37	0,2232
Trend	0	-38,4022	0,0006	-4,89	0,0006	12,11	0,0010
	1	-25,9054	0,014	-3,75	0,0231	7,27	0,0246
	2	-18,0796	0,0848	-2,69	0,2414	3,71	0,4446

Source: SAS 9.2(25/03/2014)

ARIMA(1, 1, 1))

Conditional least squares estimation

Table 339: Conditional least squares estimation for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	280,55308	190,1381	1,48	0,1429	0
MA1.1	0,46528	0,09503	5	<0,0001	1
AR1.1	0,95876	0,03364	29	<0,0001	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	11,57137
Variance Estimate	69.380,73
Std Error Estimate	263,4022
AIC	1.611,263
SBC	1.619,498
Number of Residuals	115

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 340: Correlations of parameter estimates for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model

Parameter	MU	MA1.1	AR1.1
MU	1,000	0,110	0,342
MA1.1	0,110	1,000	0,471
AR1.1	0,342	0,471	1,000

Source: SAS 9.2(25/03/2014)

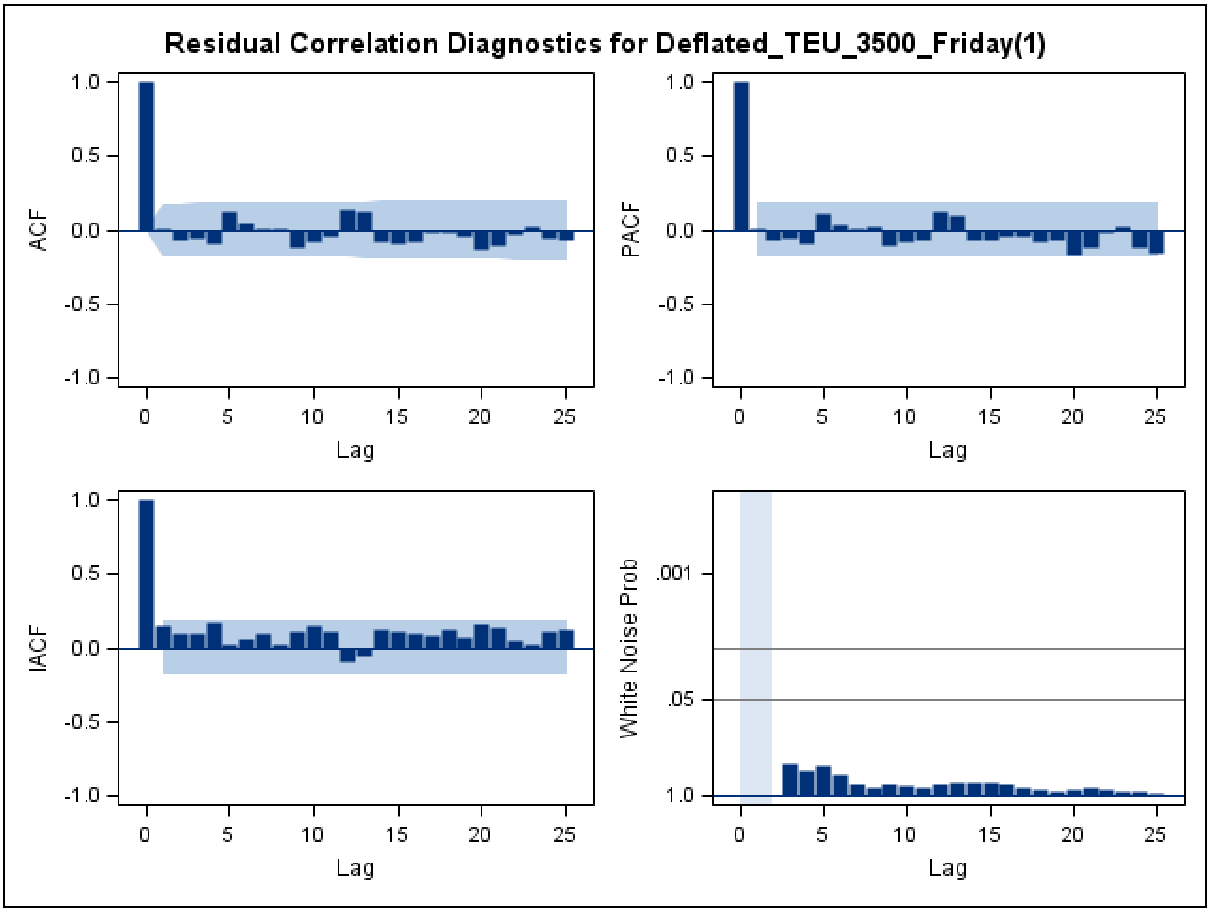
Autocorrelation check residuals

Table 341: Autocorrelation check residuals for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	3,15	4	0,5328	0,023	-0,052	-0,034	-0,075	0,120	0,051
12	7,28	10	0,6984	0,010	0,026	-0,110	-0,063	-0,025	0,147
18	10,85	16	0,8188	0,130	-0,066	-0,079	-0,057	-0,009	0,001
24	14,19	22	0,8946	-0,019	-0,118	-0,098	-0,018	0,034	-0,035

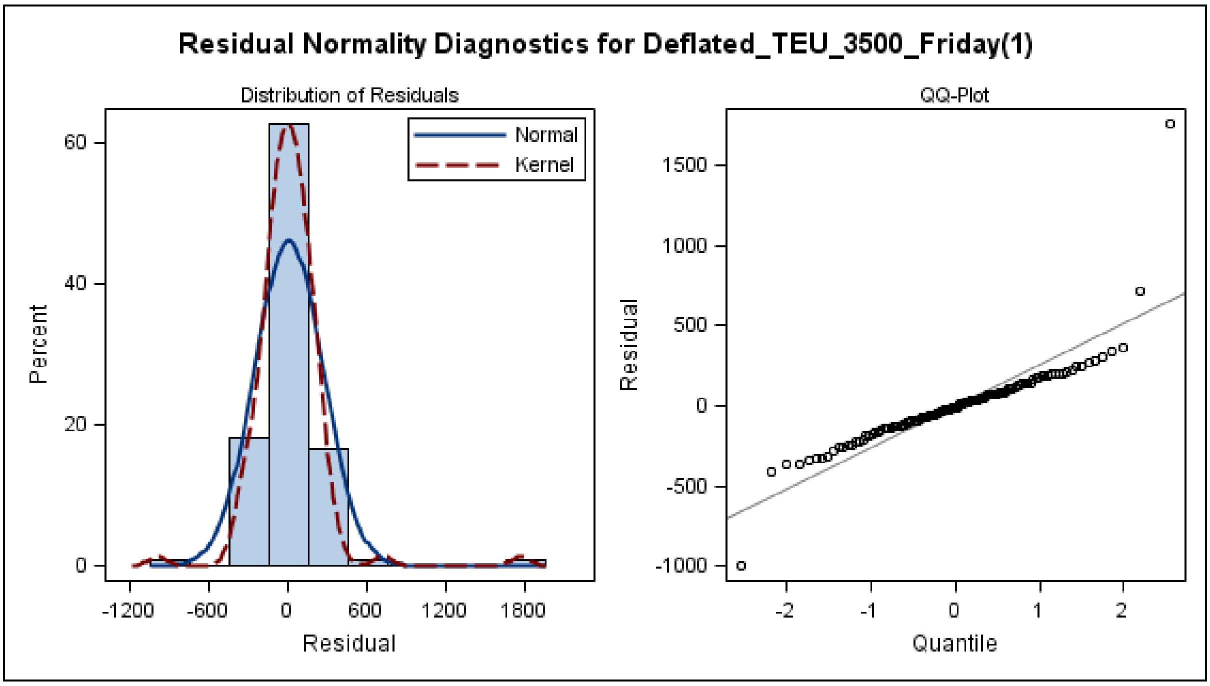
Source: SAS 9.2(25/03/2014)

Figure 399: Residual correlation diagnostics for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model



Source: SAS 9.2(25/03/2014)

Figure 400: Residual normality diagnostics for the charter prices of a 3.500TEU container vessel time series and a fitted ARIMA(1, 1, 1)) model



Source: SAS 9.2(25/03/2014)

Model
Estimated Mean 280.5531
Period(s) of Differencing 1

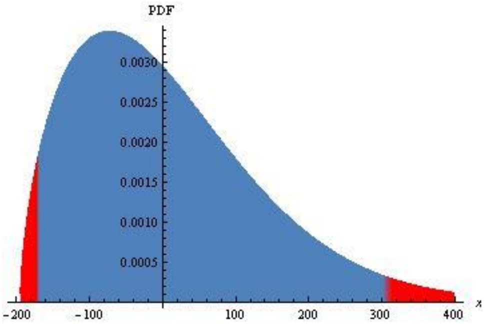
Autoregressive Factors
Factor 1: 1 - 0.95876 B^(1)

Moving Average Factors
Factor 1: 1 - 0.46528 B^(1)

Weibull (1.6, 225, -195)

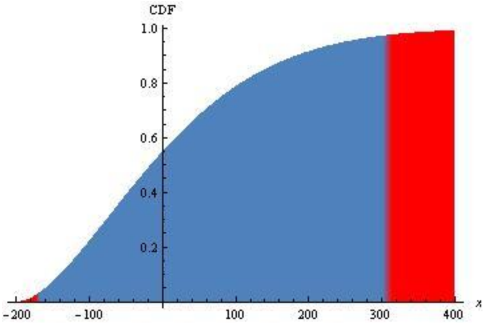
Probability density function

Figure 401: Probability density function Weibull (1.6, 225, -195)



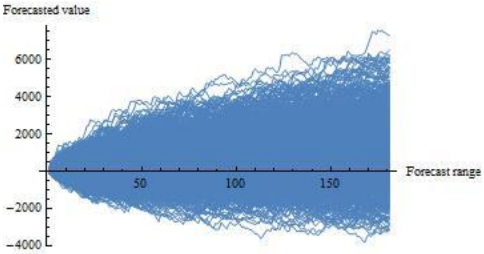
Cumulative density function

Figure 402: Cumulative density function Weibull (1.6, 225, -195)



Possible prediction paths

Figure 403: Possible prediction paths 48 steps ahead Weibull (1.6, 225, -195)

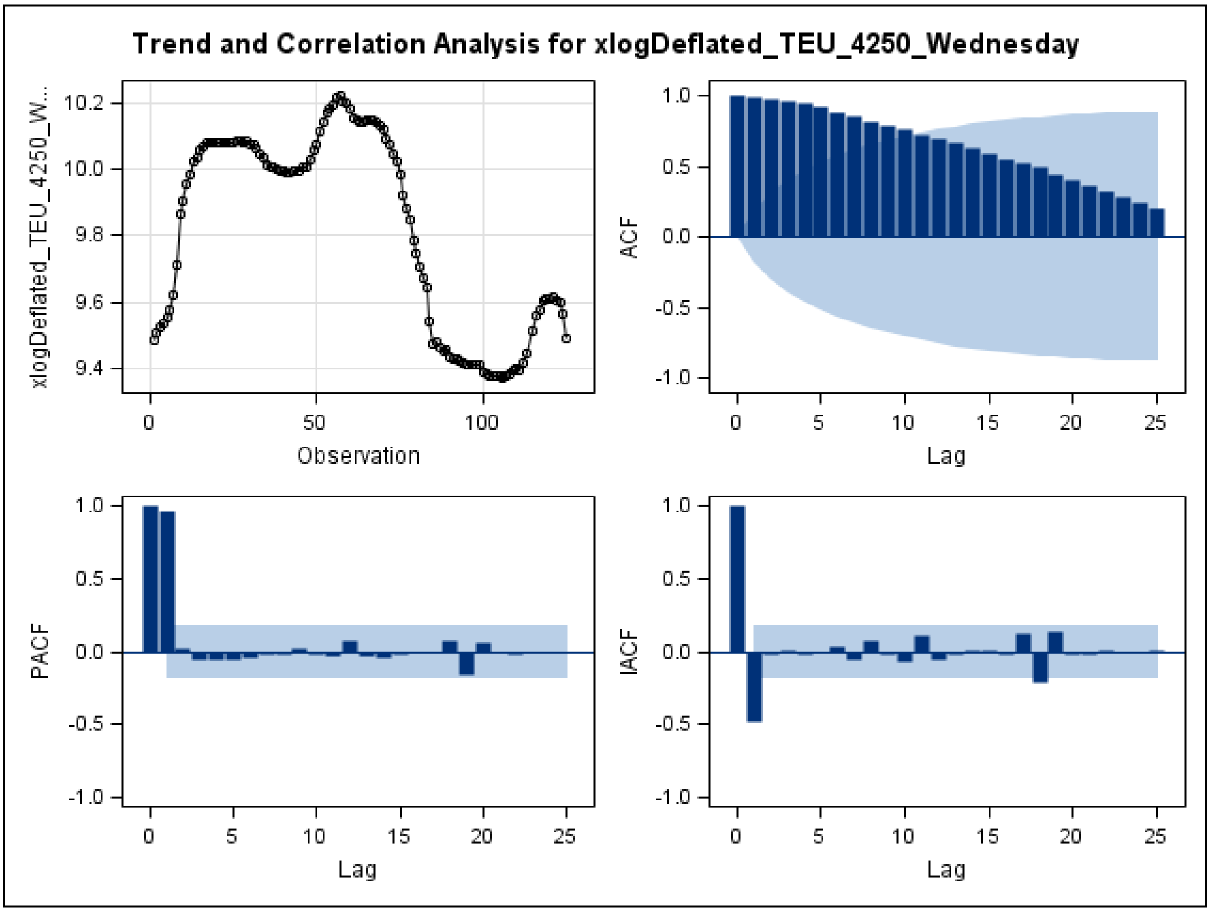


R.3.22 Average charter prices: 4.250TEU container vessel (data: Wednesday): ARIMA(1, 1, 0)

Descriptive statistics

Mean of Working Series	9,820391
Standard Deviation	0,296144
Number of Observations	125
Embedded missing values in working series	3

Figure 404: Trend and correlation analysis for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 342: Augmented Dickey-Fuller unit root tests for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

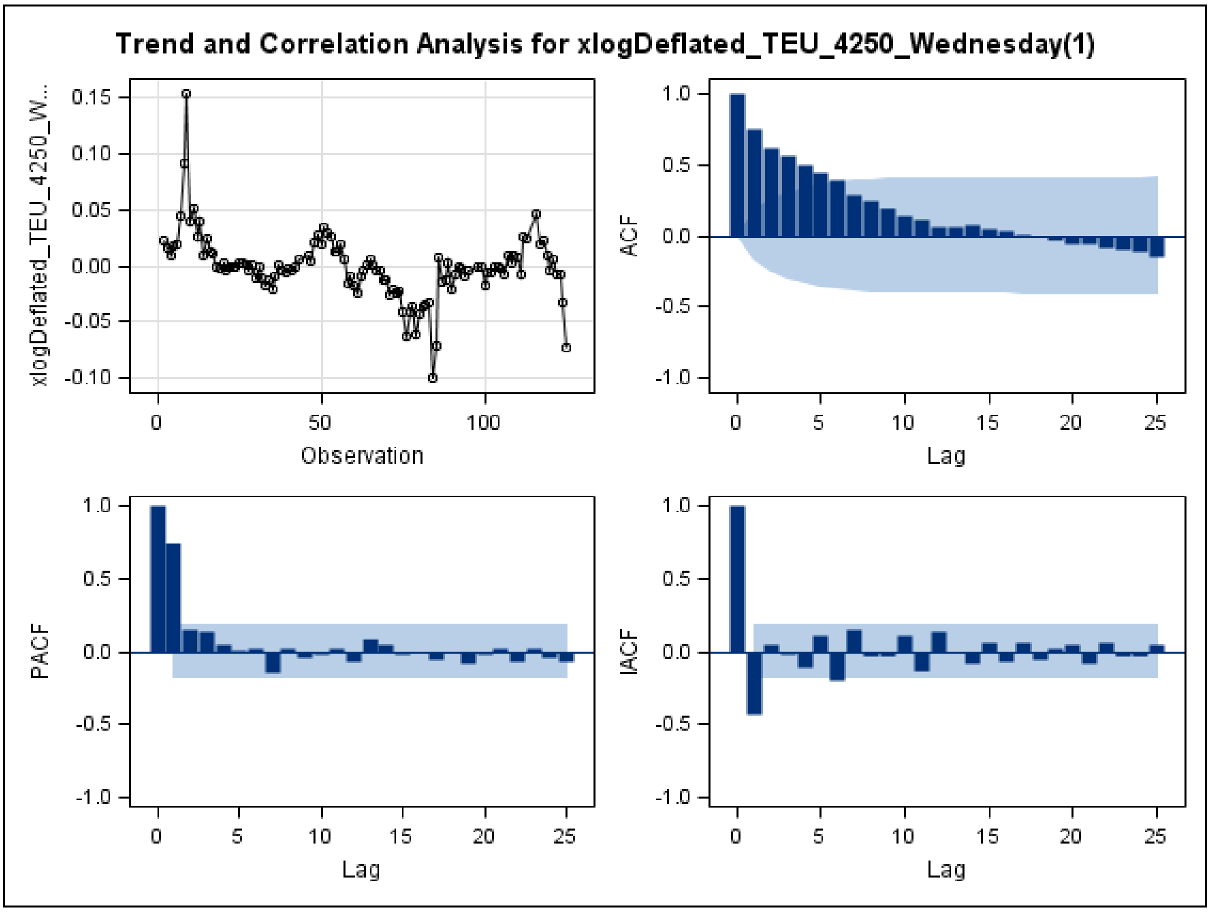
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-0,0063	0,6798	-0,20	0,6142		
	1	-0,0567	0,6683	-0,64	0,4399		
	2	-0,0606	0,6674	-0,58	0,4641		
Single Mean	0	-0,3338	0,9371	-0,31	0,919	0,07	0,9900
	1	-2,4177	0,7248	-0,80	0,8165	0,50	0,9515
	2	-3,6884	0,569	-1,00	0,7521	0,65	0,9065
Trend	0	-4,0572	0,8799	-3,46	0,0481	15,51	0,0010
	1	-7,1639	0,6396	-2,69	0,2434	5,90	0,0732
	2	-8,4295	0,5356	-2,84	0,1879	5,84	0,0762

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	-0,0005
Standard Deviation	0,028989
Number of Observations	124
Observation(s) eliminated by differencing	1
Embedded missing values in working series	6

Figure 405: Trend and correlation analysis for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 343: Augmented Dickey-Fuller unit root tests for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-26,6977	0,0001	-3,72	0,0003		
	1	-19,6990	0,0014	-2,87	0,0044		
	2	-15,5245	0,0051	-2,47	0,0136		
Single Mean	0	-26,7168	0,0015	-3,71	0,0051	7,06	0,0010
	1	-19,7250	0,0095	-2,87	0,0521	4,25	0,0729
	2	-15,5535	0,0294	-2,48	0,1235	3,22	0,2496
Trend	0	-32,2822	0,003	-4,26	0,0051	9,25	0,0010
	1	-25,5964	0,0155	-3,40	0,0569	5,93	0,0717
	2	-21,5179	0,04	-3,02	0,1329	4,69	0,2400

Source: SAS 9.2(25/03/2014)

ARIMA(1, 1, 0)

Conditional least squares estimation

Table 344: Conditional least squares estimation for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	0,0024382	0,0073189	0,33	0,7396	0
AR1.1	0,78607	0,06261	13	<0,0001	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	0,000522
Variance Estimate	0,000375
Std Error Estimate	0,019364
AIC	-594,006
SBC	-588,465
Number of Residuals	118

* AIC and SBC do not include log determinant.

Correlations of parameter estimates

Table 345: Correlations of parameter estimates for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

Parameter	MU	AR1.1
MU	1,000	0,051
AR1.1	0,051	1,000

Source: SAS 9.2(25/03/2014)

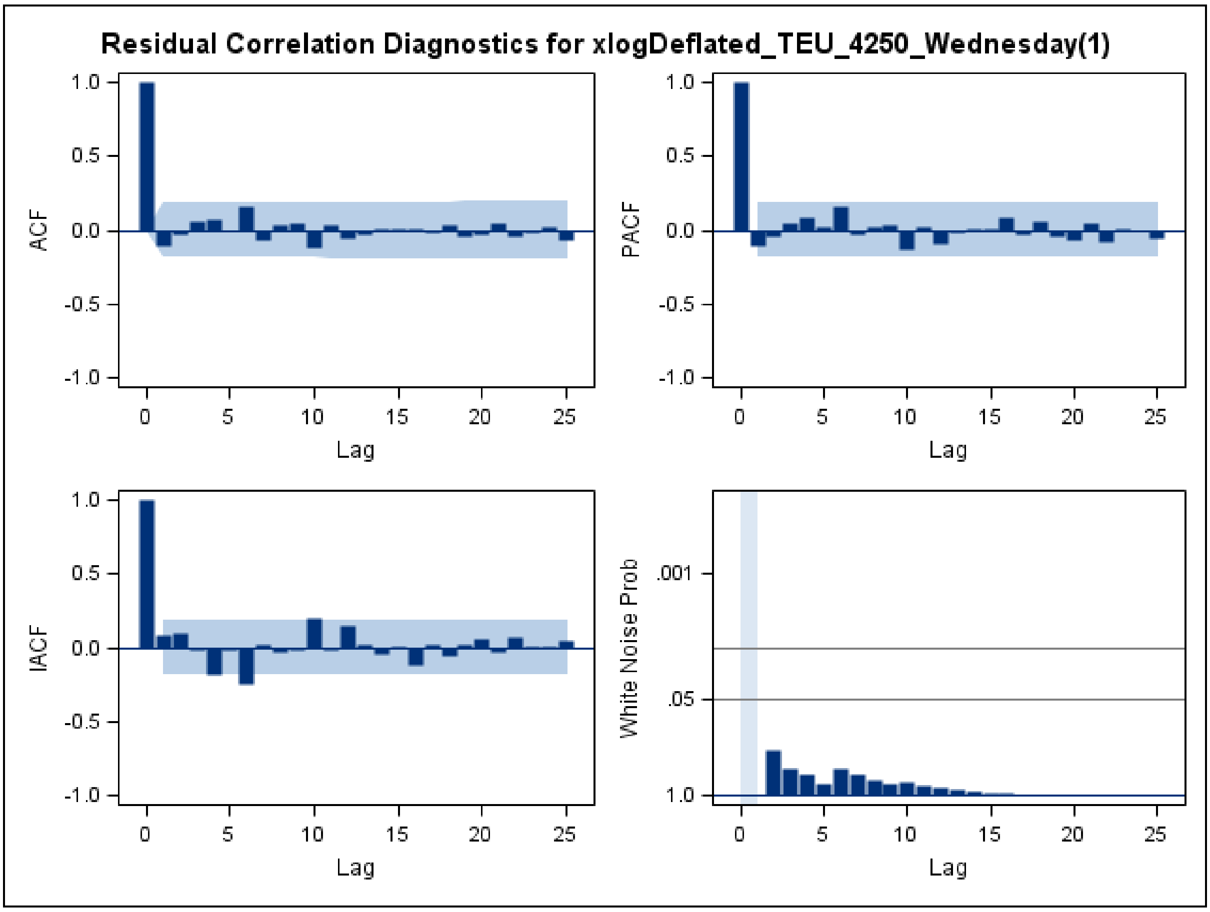
Autocorrelation check residuals

Table 346; for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	4,82	5	0,4382	-0,103	-0,025	0,055	0,073	0,003	0,158
12	7,35	11	0,7702	-0,059	0,040	0,044	-0,112	0,044	-0,048
18	7,6	17	0,9743	-0,026	0,018	0,017	0,020	-0,017	0,034
24	8,26	23	0,9979	-0,040	-0,022	0,047	-0,032	-0,007	0,025

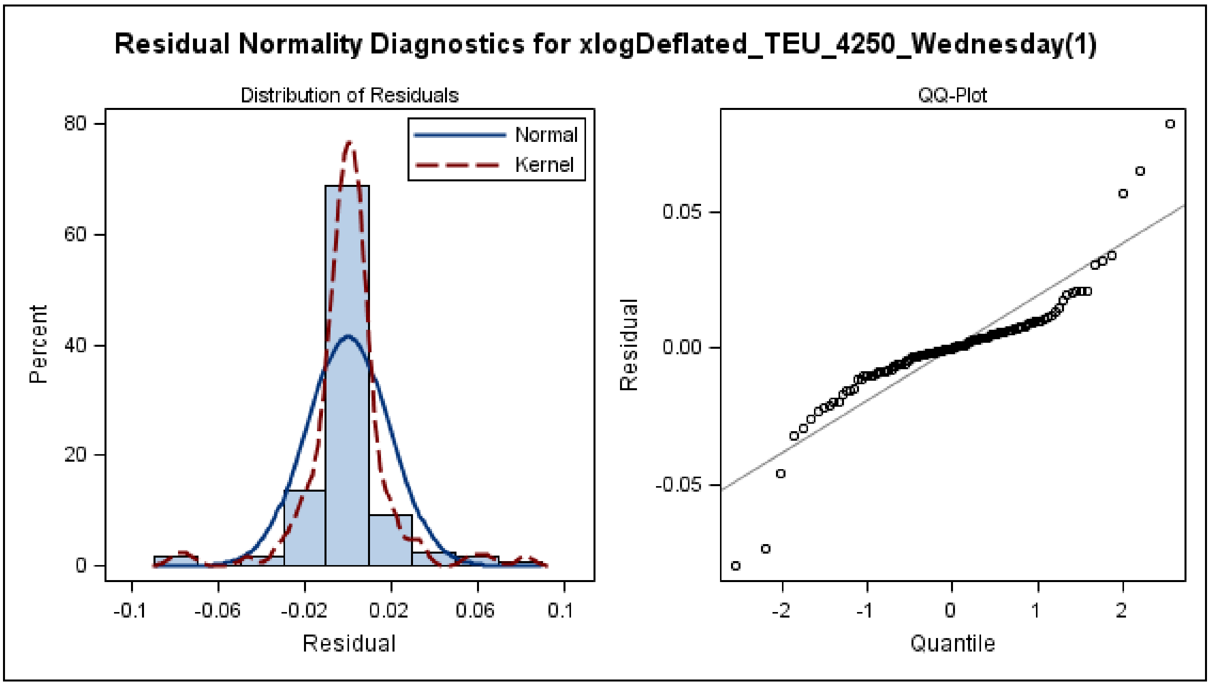
Source: SAS 9.2(25/03/2014)

Figure 406: Residual correlation diagnostics for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model



Source: SAS 9.2(25/03/2014)

Figure 407: residual normality diagnostics for the charter prices of a 4.250TEU container vessel time series and a fitted ARIMA(1, 1, 0) model



Source: SAS 9.2(25/03/2014)

Model

Estimated Mean	0,002438
Period(s) of Differencing	1

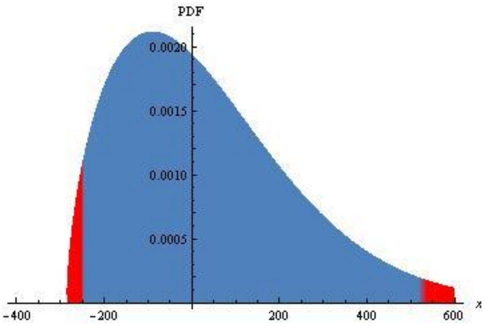
Autoregressive Factors

Factor 1: 1 – 0,78607 B^(1)

Weibull (1.6, 360, -285)

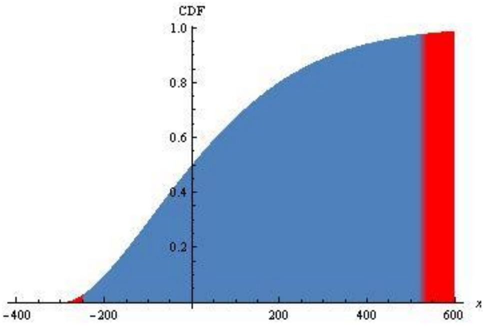
Probability density function

Figure 408: Probability density function Weibull (1.6, 360, -285)



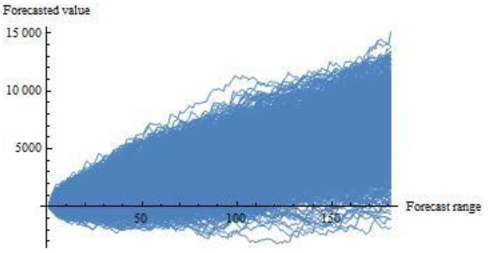
Cumulative density function

Figure 409: Cumulative density function Weibull (1.6, 360, -285)



Possible prediction paths

Figure 410: Possible prediction paths 48 steps ahead Weibull (1.6, 360, -285)

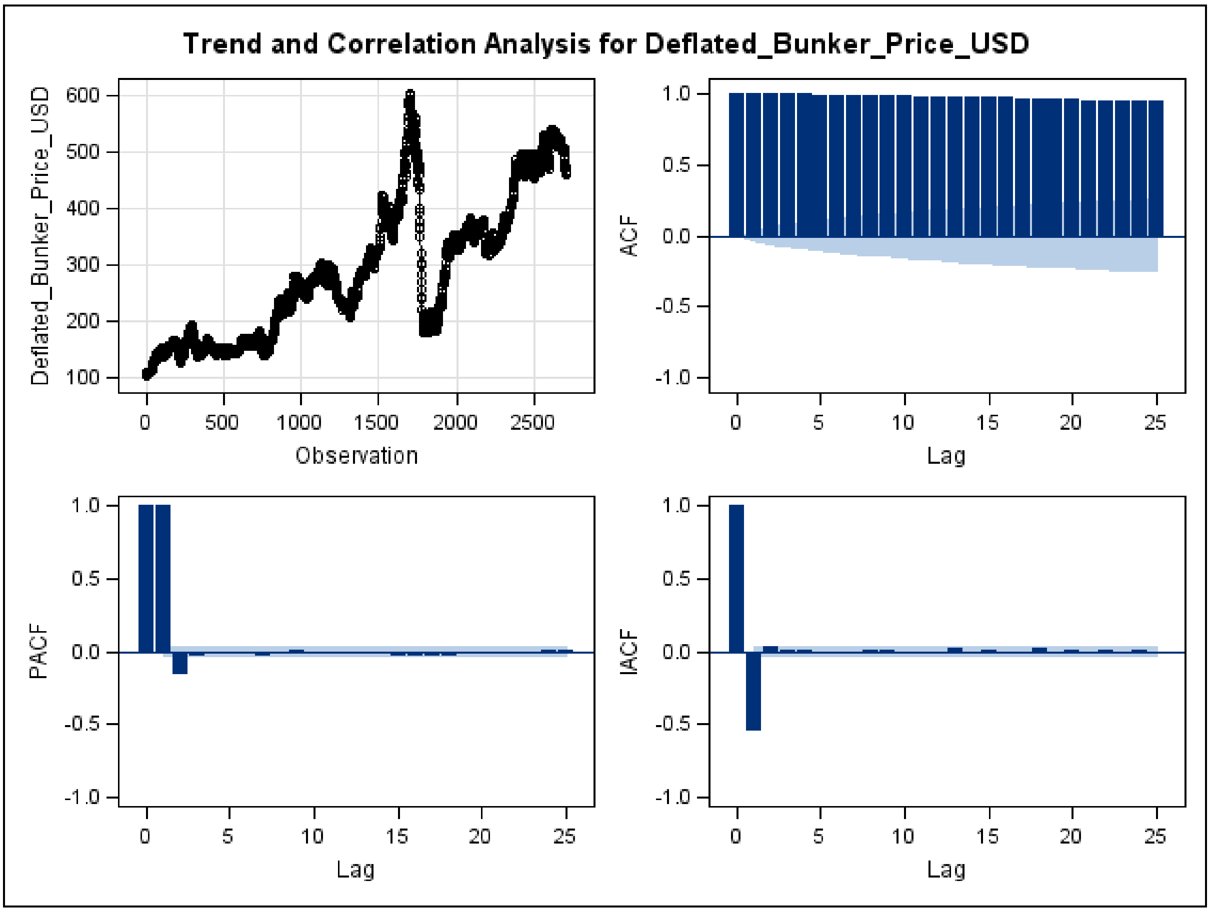


R.3.23 Average bunker prices: ARIMA (1, 1, 3)

Descriptive statistics

Mean of Working Series	287.4817
Standard Deviation	123.6319
Number of Observations	2.710

Figure 411: Trend and correlation analysis for the average bunker prices time series and a fitted ARIMA (1, 1, 3) model (1)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests

Table 347: Augmented Dickey-Fuller unit root tests for the average bunker prices time series and a fitted ARIMA (1, 1, 3) model

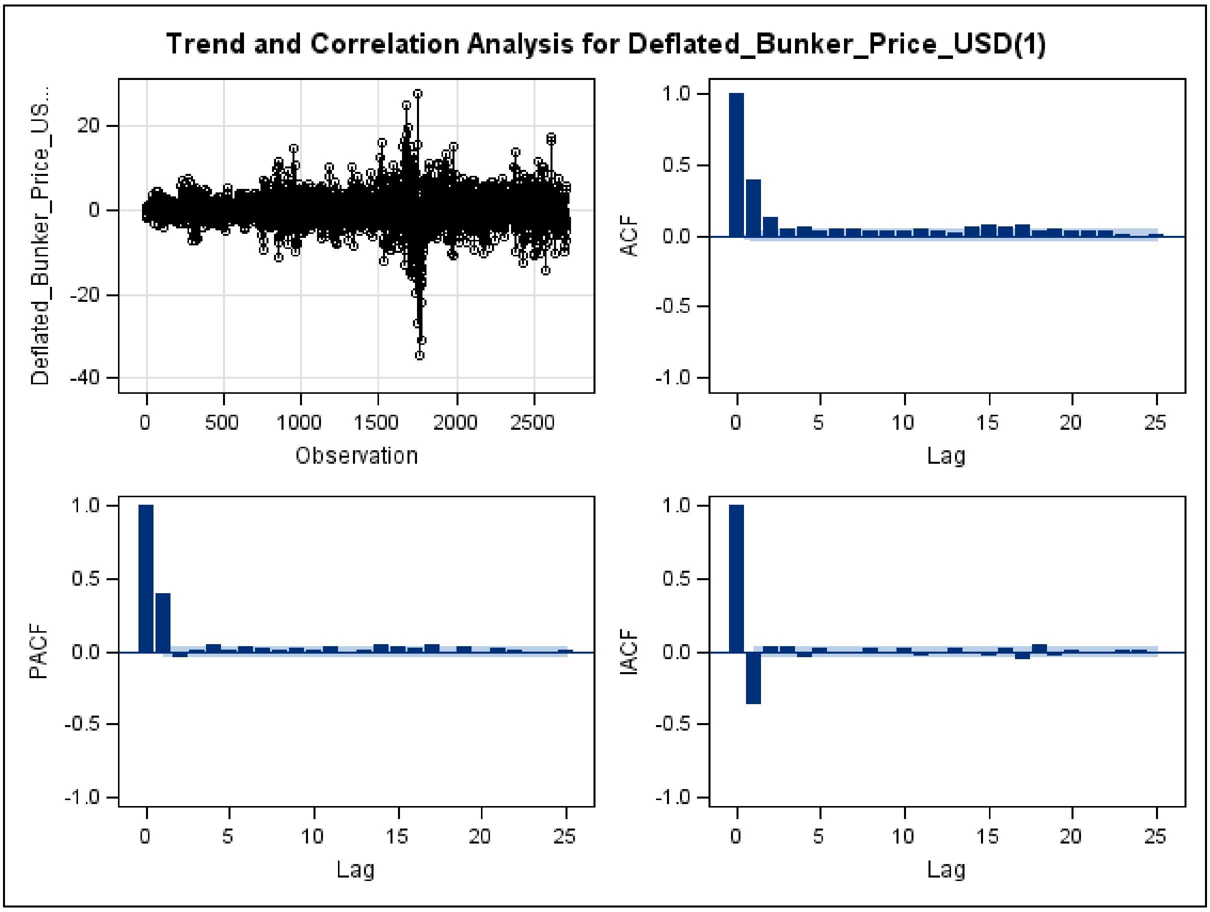
Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	0,8228	0,8814	1,24	0,9455		
	1	0,5510	0,8202	0,54	0,8332		
	2	0,5897	0,8297	0,60	0,8468		
Single Mean	0	-1,3962	0,8471	-0,83	0,8104	1,79	0,6110
	1	-3,2606	0,6255	-1,27	0,6467	1,45	0,6988
	2	-3,0267	0,6538	-1,22	0,6667	1,45	0,6991
Trend	0	-5,4661	0,7864	-1,65	0,7717	1,37	0,9044
	1	-12,7262	0,2787	-2,52	0,3178	3,18	0,5379
	2	-11,8011	0,3265	-2,42	0,3666	2,94	0,5863

Source: SAS 9.2(25/03/2014)

Descriptive statistics after differentiating

Period(s) of Differencing	1
Mean of Working Series	0,130845
Standard Deviation	3,998586
Number of Observations	2.709
Observation(s) eliminated by differencing	1

Figure 412: Trend and correlation analysis for the average bunker prices time series and a fitted ARIMA (1, 1, 3) model (2)



Source: SAS 9.2(25/03/2014)

Augmented Dickey-Fuller unit root tests after differentiating

Table 348: Augmented Dickey-Fuller unit root tests after differentiating for the average bunker prices time series and a fitted ARIMA (1, 1, 3) model

Type	Lags	Rho	Pr < Rho	Tau	Pr < Tau	F	Pr > F
Zero Mean	0	-1628,6300	0,0001	-34,10	<0,0001		
	1	-1760,7500	0,0001	-29,65	<0,0001		
	2	-1711,5000	0,0001	-25,48	<0,0001		
Single Mean	0	-1630,3700	0,0001	-34,12	<0,0001	582,21	0,0010
	1	-1764,3600	0,0001	-29,68	<0,0001	440,31	0,0010
	2	-1717,3000	0,0001	-25,51	<0,0001	325,29	0,0010
Trend	0	-1630,3700	0,0001	-34,12	<0,0001	582,00	0,0010
	1	-1764,3600	0,0001	-29,67	<0,0001	440,15	0,0010
	2	-1717,3000	0,0001	-25,50	<0,0001	325,17	0,0010

Source: SAS 9.2(25/03/2014)

ARIMA (1, 1, 3)

Conditional least squares estimation

Table 349: Conditional least squares estimation for the average bunker prices time series and a fitted ARIMA (1, 1, 3) model

Parameter	Estimate	Standard error	T value	Approx, Pr > |t|	Lag
MU	0,12558	0,17364	0,72	0,4696	0
MA1.1	0,55499	0,02869	19	<0,0001	1
MA1.2	0,26887	0,02371	11	<0,0001	2
MA1.3	0,09038	0,02047	4	<0,0001	3
AR1.1	0,96544	0,02091	46	<0,0001	1

Source: SAS 9.2(25/03/2014)

Fit statistics

Constant Estimate	0,00434
Variance Estimate	13,37375
Std Error Estimate	3,657014
AIC	14.718,04
SBC	14.747,56
Number of Residuals	2.709

* AIC and SBC do not include log determinant.

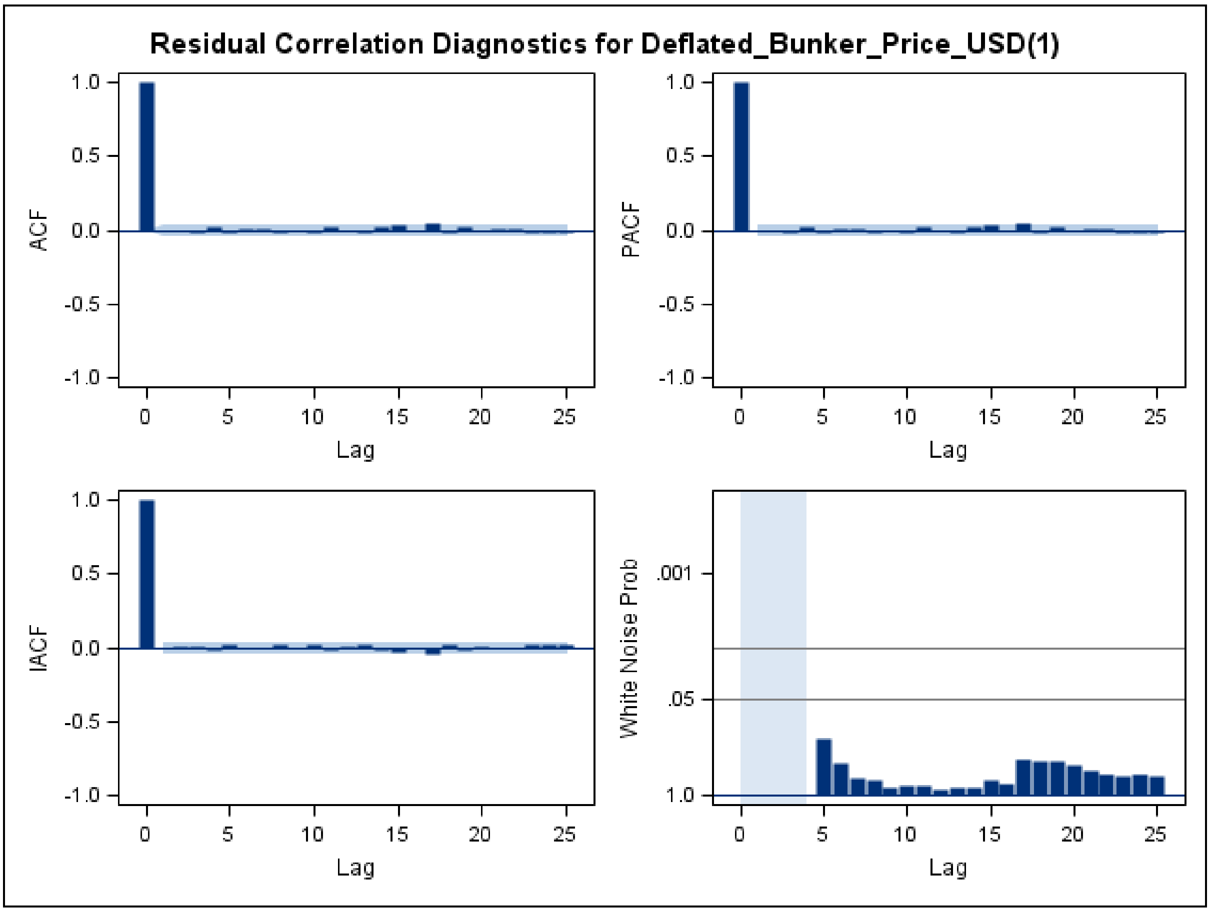
Autocorrelation check residuals

Table 350: Autocorrelation check residuals for the average bunker prices time series and a fitted ARIMA (1, 1, 3) model

To lag	Chi-Square	DF	Pr>ChiSq	Autocorrelations					
6	2,00	2	0,3680	-0,002	-0,005	-0,012	0,016	-0,017	0,005
12	4,5	8	0,8092	0,002	-0,014	-0,002	-0,018	0,018	-0,009
18	15,6	14	0,3384	-0,019	0,017	0,032	-0,001	0,045	-0,018
24	18,93	20	0,5262	0,020	-0,009	0,005	0,008	-0,013	-0,022
30	26,79	26	0,4203	-0,017	0,032	-0,024	0,027	-0,011	-0,009
36	40,43	32	0,1457	-0,021	0,014	-0,009	0,027	0,051	-0,031
42	51,46	38	0,0713	-0,008	-0,007	0,032	0,043	0,028	-0,014
48	68,63	44	0,0102	0,024	-0,005	-0,015	-0,071	-0,017	0,010

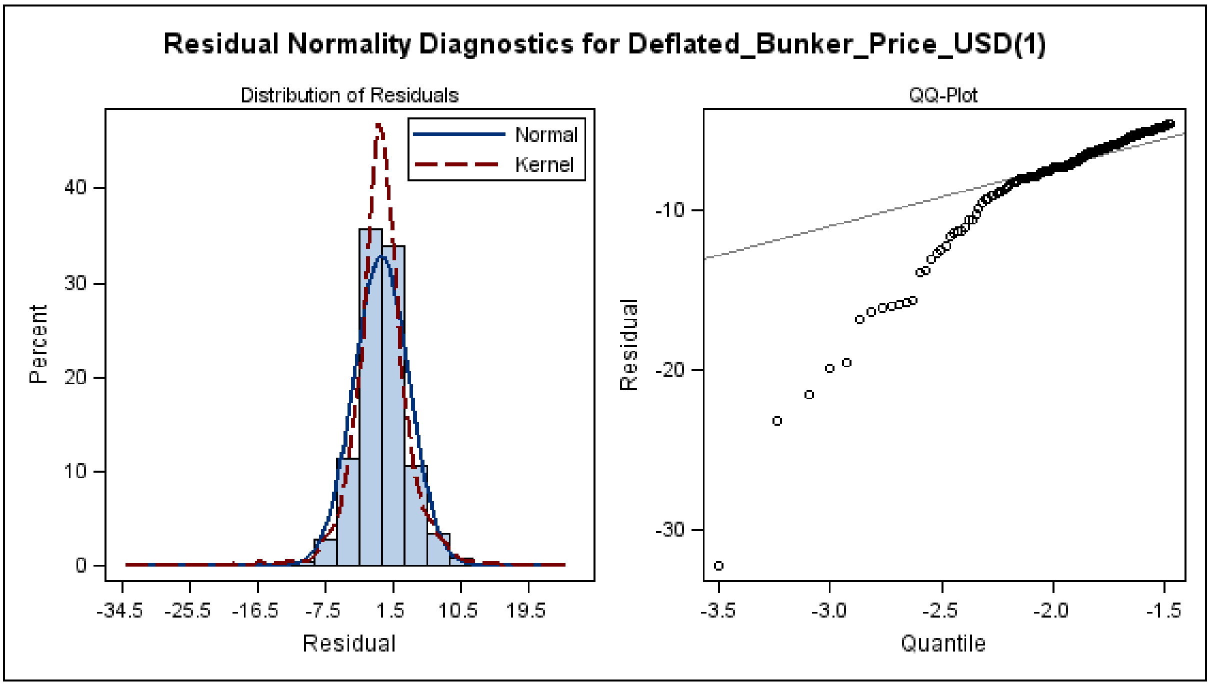
Source: SAS 9.2(25/03/2014)

Figure 413: residual correlation diagnostics for the average bunker prices time series and a fitted ARIMA (1, 1, 3) model



Source: SAS 9.2(25/03/2014)

Figure 414: Residual normality diagnostics for the average bunker prices time series and a fitted ARIMA (1, 1, 3) model



Source: SAS 9.2(25/03/2014)

Model
Estimated Mean 0,125575
Period(s) of Differencing 1

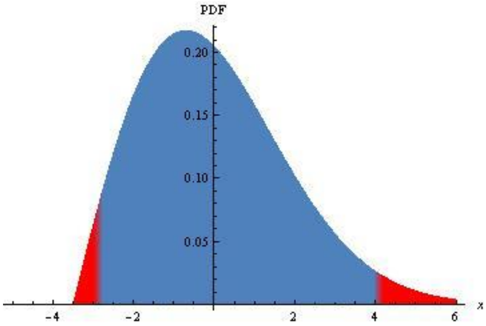
Autoregressive Factors
Factor 1: 1 - 0.96544 B^(1)

Moving Average Factors
Factor 1: 1 - 0.55499 B^(1) - 0.26887 B^(2) - 0.09038 B^(3)

Weibull (2, 4, 3,49)

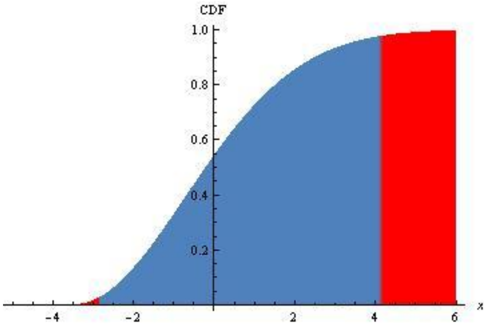
Probability density function

Figure 415: Probability density function Weibull (2, 4, 3,49)



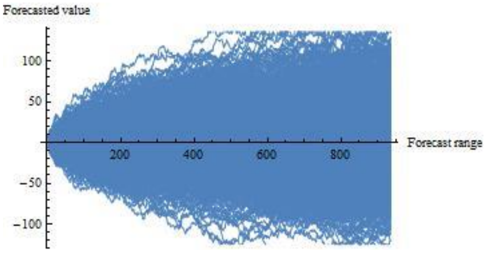
Cumulative density function

Figure 416: Cumulative density function Weibull (2, 4, 3,49)



Possible prediction paths

Figure 417: Possible prediction paths 48 steps ahead Weibull (2, 4, 3,49)



Appendix S : Presentation container types

Containers need to be transported by container vessels, trucks and trains. They need to be able to withstand all the forces which they are subjected to during their transport, during container handling operations, and in heavy weather conditions. Therefore, the International Organization of Standardization defined the dimensions and weight capacity for each container size in the ISO 668 and ISO 1496-1 codes. The minimum weight capacity, external dimensions, minimum internal dimensions, and minimum door dimensions can be found in Table 351. An example of what an ISO container may look like per container type can be found in Table 352. All the container types in this table are the container types that can be found in the NileDutch's container fleet.

Table 351: Weight capacity and minimum dimensions per container size

		External dimensions (mm)[a]			Minimum internal dimensions (mm)[a]			Minimum door dimestions (mm)[b]	
Container type	Max. gross weight a	Length	Width	Height	Length	Width	Height	Width	Height
20'	24.000	6.058	2.438	2.591	5.867	2.330	2.350	2.286	2.261
40'	30.480	12.192	2.438	2.591	11.998	2.330	2.350	2.286	2.261
40' high cube	30.480	12.192	2.438	2.896	11.998	2.330	2.655	2.286	2.566

Source:

a: International organization for standardization (ISO), ISO 668:2005: Classification, dimensions, and ratings

b: International organization for standardization (ISO), ISO 1496-1:1990 amendment 5:2006: Series 1 freight containers – Specifications and testing Part 1: Door and security

The tolerances for the external dimensions are 10mm. The internal dimensions, the door dimensions, and the gross weight may be above the minimum indications values due to the design specifications of the manufacture.

Table 352: Example of how the container dimensions may look like for the containers present in the NileDutch container fleet

		Weight (kg)			Internal dimensions (mm)			Door dimensions (mm)	
Container type	Abbreviation	Max. gross weight	Tare weight	Max. net weight	Length	Width	Height	Width	Height
20 ft dry cargo	20DC	30.480	2.230	28.250	5.900	2.352	2.395	2.340	2.280
40 ft dry cargo	40DC	30.480	3.740	26.740	12.034	2.352	2.395	2.340	2.280
40 ft high cube	40HC	30.480	3.900	26.580	12.034	2.352	2.700	2.340	2.585
45 ft high cube	45HC	30.480	4.700	25.780	13.556	2.352	2.700	2.340	2.585
20 ft reefer	20RF	30.480	3.010	27.470	5.456	2.294	2.273	2.290	2.264
40 ft high cube reefer	40HR	34.000	4.700	29.300	11.584	2.294	2.557	2.284	2.437
20 ft open top	20OT	30.480	2.200	28.280	5.898	2.352	2.348	/	/
40 ft open top	40OT	30.480	3.880	26.600	12.032	2.352	2.348	/	/
20 ft flat rack folding ends	20FF	34.000	2.750	31.250	5.718	2.208	2.213	/	/
40 ft flat rack folding ends	40FF	50.000	5.100	44.900	11.888	2.374	1.959	/	/
20 ft flat rack fixed ends	20FR	34.000	2.750	31.250	5.718	2.208	2.213	/	/
40 ft flat rack fixed ends	40FR	50.000	5.100	44.900	11.888	2.374	1.959	/	/
20ft platform	20PF	24.000	1.890	22.110	6.058	2.438	/	/	/
40ft platform	40PF	45.000	4.400	40.600	13.192	2.438	/	/	/

Source: CMA CGM (01/08/2012)

In the NileDutch container fleet twelve container types are represented. These container types are described and illustrated below.

Figure 418: 20 feet dry cargo container (20DC)

Figure 419: 40 feet dry cargo container (40DC)

Figure 420: 40 feet high cube dry cargo container (40HC)

Figure 421: 20 feet reefer container (20RF)

20, 40 feet dry cargo container, and 40 feet high cube cargo container

A dry cargo container is closed on all sides. The container may have doors on both end(s) or on one of both sides alongside the container. The container is used for all types of dry cargo. High cube dry cargo containers are often used to transport larger volumes of dry cargo or cargo that is higher than the 20 and 40 feet dry cargo container. Figure 418 to Figure 420 illustrate a 20DC, 40 DC, and 40HC.

20 feet reefer container and 40 feet high cube reefer

A reefer container is closed on all sides. The walls are isolated and a refrigerating unit is integrated in one of the ends. The container has a door at one end. The containers are used to transport cargo that needs to be cooled down or frozen. A high cube reefer container is used to transport larger volumes or higher cargo. Figure 421 and Figure 422 are illustrations of respectively a 20RF and 40HR.

20 and 40 feet open top container

An open top container is closed on all sides except for the roof. It has a door on one end and the roof consists of removable bows and a canvas. The container is used for the transport of dry cargo. The stuffing and stripping of the container can be done by a crane or crab. The container is often used to transport taller cargo. Figure 423 and Figure 424 are illustrations of respectively a 20OT and 40OT.

Figure 422: 40 feet high cube reefer container (40HC)

Figure 423: 20 feet open top container (20OT)

Figure 424: 40 feet open top container (40OT)

Figure 425: 20 feet flat rack container (20FR)

20 and 40 feet flat rack with fixed ends and collapsible ends.

Flat rack containers have a reinforced floor and two end walls. These two end walls may be fixed or collapsible. These end walls are strong enough to secure safe lashing of the cargo and allow safe stacking of other container on top of it. Flat racks are often used to transport heavy-lifts, over height or over width cargoes. Figure 425 and Figure 426 are illustrations of respectively a 20 and 40 feet flat rack.

40 feet platform container

Platform containers have a reinforced floor and no walls or roof. Platforms are used to transport heavy and oversized cargoes. Figure 427 is an illustration of a 40PF.

Figure 426: 40 feet flat rack (40FR)

Figure 427: 40 feet platform container (40PF)

Appendix T : Results computer model

T.1 Scenario 1

Table 353: Results computer model scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$0,00
	FEWA voyage owned container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$1.489.141,86
	Total FEWA [Annual]	**2.092**	**1.551**	**108.784**	**80.627**	**15**	**11**	**124,78**	**1.101.880**	**18**	**9**	**9**	**22.834**	**31.920**	**54.754**	**86.476**	**86.476**	**0**	**86.476**	**0**	**86.476**	**172.952**	**86.476**	**86.476**	**$135.884.346,25**	**$0,00**	**$135.884.346,25**	**$29.053.450,83**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**148.564**	**109.645**				**2.223.208**	**34**	**17**	**17**	**39.892**	**49.431**	**89.323**	**117.676**	**117.572**	**104**	**117.676**	**104**	**117.572**	**235.352**	**117.676**	**117.676**	**$191.628.944,18**	**$52.114,15**	**$191.681.058,33**	**$42.236.286,35**
Europe - West Africa	WEWA voyage chartered container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$0,00
	WEWA voyage owned container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$1.091.206,24
Total Europe - West Africa [Annual]		**2.537**	**1.883**	**131.924**	**97.933**	**9**	**11**	**81,13**	**561.652**	**12**	**6**	**6**	**12.996**	**18.594**	**31.591**	**92.664**	**88.504**	**4.160**	**92.664**	**4.160**	**88.504**	**185.328**	**92.664**	**92.664**	**$156.148.243,93**	**$2.311.783,09**	**$158.460.027,02**	**$22.116.834,82**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**402.480**	**296.618**				**3.341.884**	**62**	**32**	**30**	**66.394**	**78.247**	**144.641**	**283.764**	**278.616**	**5.148**	**283.764**	**5.148**	**278.616**	**567.528**	**283.764**	**283.764**	**$426.084.658,71**	**$2.642.622,85**	**$428.727.281,56**	**$80.469.174,19**

Table 354: Results computer model scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.120.123,02	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$3.967.132,65	-$1.353.972,14	$2.385,53	$0,11
	FEWA voyage owned container vessel	$0,00	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$4.336.151,49	-$1.722.990,98	$2.607,43	$0,12
	Total FEWA [Annual]	**$29.488.927,28**	**$34.057.196,45**	**$16.008.617,04**	**$1.573.000,00**	**$32.398.072,74**	**$19.756.720,18**	**$9.598.565,17**	**$5.145.111,82**	**$25.240.770,56**	**$4.266.446,77**	**$206.586.878,85**	**-$70.702.532,60**	**$2.388,95**	**$0,12**
	SWAX voyage chartered container vessel	$790.694,05	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$1.973.272,85	-$900.259,16	$3.288,79	$0,15
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$1.938.528,22	-$865.514,53	$3.230,88	$0,15
	Total SWAX [Annual]	**$20.895.324,36**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.275.836,35**	**$1.539.307,31**	**$95.572.257,62**	**-$39.775.545,55**	**$3.063,21**	**$0,15**
Total Asia - West Africa [Annual]		**$50.384.251,64**	**$55.558.611,60**	**$25.942.503,86**	**$3.146.000,00**	**$38.574.495,02**	**$28.082.366,79**	**$9.709.919,56**	**$7.202.340,66**	**$35.516.606,91**	**$5.805.754,08**	**$302.159.136,48**	**-$110.478.078,15**	**$2.567,72**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$777.795,08	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.564.056,89	-$516.748,68	$2.000,03	$0,19
	WEWA voyage owned container vessel	$0,00	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.877.468,05	-$830.159,84	$2.175,91	$0,20
Total Europe - West Africa [Annual]		**$20.996.562,37**	**$19.649.438,30**	**$10.100.620,76**	**$1.573.000,00**	**$44.579.974,52**	**$24.603.082,09**	**$6.204.933,19**	**$6.339.408,46**	**$27.263.413,99**	**$4.571.742,72**	**$187.999.011,22**	**-$29.538.984,20**	**$2.028,82**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.357.910,46	-$719.360,93	$2.721,26	$0,30
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.400.802,20	-$762.252,66	$2.807,22	$0,31
Total South America - West Africa [Annual]		**$11.044.678,96**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.987.352,91**	**$1.280.190,58**	**$68.292.132,58**	**-$35.087.556,55**	**$2.631,88**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$449.986,01	-$249.194,87	$2.284,19	$1,79
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$403.998,43	-$203.207,30	$2.050,75	$1,61
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.373,86**	**$505.405,90**	**$21.314.534,21**	**-$10.873.395,08**	**$2.080,68**	**$1,67**
	Feeder 2 voyage chartered container vessel	$263.930,29	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.410.801,75	-$738.869,42	$1.970,39	$5,76
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.439.046,07	-$767.113,74	$2.009,84	$5,88
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.836.906,73**	**$71.417.748,11**	**-$36.477.267,06**	**$1.918,18**	**$5,83**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.226,14**	**$2.342.312,63**	**$92.732.282,32**	**-$47.350.662,13**	**$1.953,25**	**$4,27**
Grand Total [Annual]		**$90.292.292,49**	**$89.966.995,90**	**$48.892.227,12**	**$9.438.000,00**	**$126.878.243,09**	**$77.731.284,98**	**$19.079.275,37**	**$16.686.469,48**	**$77.748.599,96**	**$14.000.000,00**	**$651.182.562,59**	**-$222.455.281,03**	**$2.294,80**	**$0,70**

Table 355:Specifications container vessels scenario 1

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	2.092	765	2.537	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.551	558	1.883	781	142	789
Amount of reefer plugs	292	121	349	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	194,5	138,5	204,9	160,4	97,6	160,9
B [m]	32,4	25,2	34,1	26,7	17,7	26,8
T [m]	9,3	7,4	9,8	7,9	5,2	7,9
D [m]	17,0	12,4	18,1	13,8	8,2	13,8
LBD [m³]	97.271,3	39.852,4	115.419,4	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	38.885	17.214	45.460	22.471	6.018	22.659
Displacement Volume [m³]	37.937	16.795	44.351	21.923	5.871	22.106
DWT [t]	30.163	12.698	35.605	16.851	4.160	17.000
Gross Tonnage [m³]	22.494	9.199	26.700	12.324	2.904	12.437
Wsm [t]	11.770	5.445	13.645	7.006	2.014	7.061
Wst [t]	8.328	3.731	9.714	4.851	1.324	4.891
Vs (design) [kn]	20,2	17,2	20,7	18,5	14,6	18,5
Vs (Max)	20,3	17,3	20,8	18,6	14,6	18,6
LCB [m]	-1,22	-1,72	-1,16	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,3	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,8	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,8	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,3	7,2
Pb (MCR) [kW]	19.700	7.400	23.300	10.800	2.400	10.900
Cad [-]	487	466	492	474	429	473
Fuel consumption design condition [t/h]	3,74	1,41	4,43	2,05	0,46	2,07
Generator power [kW]	2.127	1.074	2.744	1.297	657	1.306
Operational costs [$/day]	$3.211,94	$2.418,33	$3.480,65	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$8.722,27	$4.423,16	$9.970,07	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$8.976,84	$7.155,93	$9.587,47	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	2.886	1.205	3.412	1.604	391	1.618
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	36.840	14.579	43.477	19.727	4.401	19.916
Displacement outbound [t]	30.891	15.053	36.202	18.610	5.957	18.741
Pb inbound [kW]	2.892	1.629	3.200	2.239	797	1.979
Pb outbound [kW]	2.572	1.664	2.832	2.153	975	1.900
Fuel consumption inbound [t/h]	0,549	0,309	0,608	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,489	0,316	0,538	0,409	0,185	0,361

T.2 Scenario 2

Table 356: Results computer model scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$0,00
	FEWA 2 voyage owned container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$1.521.991,24
	Total FEWA [Annual]	**2.219**	**1.645**	**115.388**	**85.566**	**16**	**12**	**122,86**	**1.103.596**	**18**	**9**	**9**	**26.017**	**35.711**	**61.728**	**90.012**	**89.492**	**520**	**90.012**	**520**	**89.492**	**180.024**	**90.012**	**90.012**	**$141.574.371,76**	**$286.609,91**	**$141.860.981,67**	**$30.272.549,93**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**155.168**	**114.584**				**2.224.924**		**17**	**17**	**43.074**	**53.222**	**96.297**	**121.212**	**120.588**	**624**	**121.212**	**624**	**120.588**	**242.424**	**121.212**	**121.212**	**$197.318.969,69**	**$338.724,05**	**$197.657.693,75**	**$43.455.385,45**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$0,00
	WEWA 2 voyage owned container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$1.147.946,27
Total Europe - West Africa [Annual]		**2.612**	**1.939**	**135.818**	**100.845**	**10**	**12**	**83,76**	**563.004**	**12**	**6**	**6**	**13.522**	**21.416**	**34.937**	**97.552**	**90.584**	**6.968**	**97.552**	**6.968**	**90.584**	**195.104**	**97.552**	**97.552**	**$160.317.375,54**	**$4.082.510,56**	**$164.399.886,10**	**$22.585.311,72**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**412.978**	**304.469**				**3.344.952**	**28**	**32**	**30**	**70.102**	**84.860**	**154.962**	**292.188**	**283.712**	**8.476**	**292.188**	**8.476**	**283.712**	**584.376**	**292.188**	**292.188**	**$435.943.815,83**	**$4.699.960,23**	**$440.643.776,06**	**$82.156.750,18**

Table 357: Results computer model scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$1.124.300,01	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$510.689,25	$82.939,75	$4.126.947,80	-$1.398.852,00	$2.384,14	$0,11
	FEWA 2 voyage owned container vessel	$0,00	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$510.689,25	$82.939,75	$4.524.639,03	-$1.796.543,23	$2.613,89	$0,12
	Total FEWA [Annual]	**$30.061.402,26**	**$38.395.094,93**	**$17.327.232,83**	**$1.573.000,00**	**$33.181.282,48**	**$19.839.508,08**	**$9.598.565,17**	**$5.354.294,06**	**$26.555.840,95**	**$4.312.867,06**	**$216.471.637,75**	**-$74.610.656,08**	**$2.404,92**	**$0,12**
	SWAX voyage chartered container vessel	$790.694,05	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.076,66	$28.748,61	$1.971.883,82	-$898.870,13	$3.286,47	$0,15
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.076,66	$28.748,61	$1.937.139,19	-$864.125,50	$3.228,57	$0,15
	Total SWAX [Annual]	**$20.895.324,36**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.247.986,19**	**$1.494.927,92**	**$95.500.028,08**	**-$39.703.316,00**	**$3.060,90**	**$0,15**
Total Asia - West Africa [Annual]		**$50.956.726,62**	**$59.896.510,07**	**$27.261.119,65**	**$3.146.000,00**	**$39.357.704,76**	**$28.165.154,69**	**$9.709.919,56**	**$7.411.522,90**	**$36.803.827,14**	**$5.807.794,98**	**$311.971.665,83**	**-$114.313.972,08**	**$2.573,77**	**$0,13**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$811.619,29	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$3.744.122,58	-$582.586,31	$1.995,80	$0,18
	WEWA 2 voyage owned container vessel	$0,00	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$4.080.449,56	-$918.913,29	$2.175,08	$0,20
Total Europe - West Africa [Annual]		**$21.221.593,11**	**$21.730.931,20**	**$11.315.547,60**	**$1.573.000,00**	**$45.557.094,76**	**$25.767.157,30**	**$6.204.933,19**	**$6.577.002,82**	**$29.090.363,22**	**$4.674.141,31**	**$196.297.076,23**	**-$31.897.190,14**	**$2.012,23**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.357.306,85	-$718.757,31	$2.720,05	$0,30
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.400.198,58	-$761.649,04	$2.806,01	$0,31
Total South America - West Africa [Annual]		**$11.044.678,96**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.992.873,56**	**$1.243.281,72**	**$68.260.744,37**	**-$35.056.168,34**	**$2.630,67**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,77	$9.439,13	$449.705,68	-$248.914,55	$2.282,77	$1,79
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,77	$9.439,13	$403.718,11	-$202.926,97	$2.049,33	$1,61
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.368,20**	**$490.834,67**	**$21.299.957,32**	**-$10.858.818,18**	**$2.079,26**	**$1,67**
	Feeder 2 voyage chartered container vessel	$263.930,29	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.409.783,30	-$737.850,97	$1.968,97	$5,76
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.438.027,62	-$766.095,29	$2.008,42	$5,87
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.783.947,32**	**$71.364.788,70**	**-$36.424.307,65**	**$1.916,76**	**$5,83**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.220,48**	**$2.274.781,99**	**$92.664.746,02**	**-$47.283.125,83**	**$1.951,82**	**$4,27**
Grand Total [Annual]		**$91.089.798,21**	**$96.386.387,27**	**$51.425.769,76**	**$9.438.000,00**	**$128.638.573,07**	**$78.978.148,10**	**$19.079.275,37**	**$17.133.246,09**	**$80.868.284,41**	**$14.000.000,00**	**$669.194.232,46**	**-$228.550.456,40**	**$2.290,29**	**$0,70**

Table 358: Specifications container vessels scenario 2

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	2.219	765	2.612	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.645	558	1.939	781	142	789
Amount of reefer plugs	308	121	359	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	197,6	138,5	206,5	160,4	97,6	160,9
B [m]	32,9	25,2	34,4	26,7	17,7	26,8
T [m]	9,4	7,4	9,8	7,9	5,2	7,9
D [m]	17,4	12,4	18,3	13,8	8,2	13,8
LBD [m³]	102.491,5	39.852,4	118.436,1	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	40.786	17.214	46.544	22.471	6.018	22.659
Displacement Volume [m³]	39.791	16.795	45.408	21.923	5.871	22.106
DWT [t]	31.732	12.698	36.507	16.851	4.160	17.000
Gross Tonnage [m³]	23.704	9.199	27.399	12.324	2.904	12.437
Wsm [t]	12.314	5.445	13.953	7.006	2.014	7.061
Wst [t]	8.729	3.731	9.943	4.851	1.324	4.891
Vs (design) [kn]	20,4	17,2	20,8	18,5	14,6	18,5
Vs (Max)	20,5	17,3	20,9	18,6	14,6	18,6
LCB [m]	-1,20	-1,72	-1,15	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,2	6,7	8,5	7,2	5,3	7,2
Ta [m]	8,7	7,2	9,0	7,7	5,8	7,7
Tf [m]	7,7	6,2	8,0	6,7	4,8	6,7
Tav (in ballast) [m]	8,2	6,7	8,5	7,2	5,3	7,2
Pb (MCR) [kW]	20.900	7.400	24.000	10.800	2.400	10.900
Cad [-]	488	466	492	474	429	473
Fuel consumption design condition [t/h]	3,97	1,41	4,56	2,05	0,46	2,07
Generator power [kW]	2.303	1.074	2.847	1.297	657	1.306
Operational costs [$/day]	$3.295,96	$2.418,33	$3.527,75	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$9.092,12	$4.423,16	$10.178,01	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$9.151,11	$7.155,93	$9.690,23	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	3.038	1.205	3.499	1.604	391	1.618
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	38.886	14.579	44.411	19.727	4.401	19.916
Displacement outbound [t]	32.406	15.053	37.096	18.610	5.957	18.741
Pb inbound [kW]	3.419	1.629	3.707	2.239	797	1.979
Pb outbound [kW]	3.028	1.664	3.288	2.153	975	1.900
Fuel consumption inbound [t/h]	0,650	0,309	0,704	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,575	0,316	0,625	0,409	0,185	0,361

T.3 Scenario 3

Table 359: Results computer model scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$0,00
	FEWA voyage owned container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$1.474.146,56
	Total FEWA [Annual]	**2.054**	**1.522**	**106.808**	**79.149**	**15**	**11**	**124,68**	**1.101.880**	**18**	**9**	**9**	**22.581**	**31.616**	**54.197**	**85.904**	**84.240**	**1.664**	**85.904**	**1.664**	**84.240**	**171.808**	**85.904**	**85.904**	**$132.332.913,09**	**$788.177,25**	**$133.121.090,34**	**$28.750.376,75**
	SWAX voyage chartered container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$0,00
	SWAX voyage owned container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$766.641,09
	Total SWAX [Annual]	**781**	**570**	**40.612**	**29.641**	**11**	**11**	**110,66**	**1.121.328**	**16**	**8**	**8**	**17.209**	**17.618**	**34.827**	**32.396**	**30.368**	**2.028**	**32.396**	**2.028**	**30.368**	**64.792**	**32.396**	**32.396**	**$54.475.771,55**	**$1.040.918,33**	**$55.516.689,88**	**$13.378.461,25**
Total Asia - West Africa [Annual]				**147.420**	**108.790**				**2.223.208**		**17**	**17**	**39.790**	**49.234**	**89.024**	**118.300**	**114.608**	**3.692**	**118.300**	**3.692**	**114.608**	**236.600**	**118.300**	**118.300**	**$186.808.684,65**	**$1.829.095,58**	**$188.637.780,23**	**$42.128.838,00**
Europe - West Africa	WEWA voyage chartered container vessel	2.410	1.788	125.320	92.994	9	12	77,00	10.801	11	5	6	286	410	697	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$0,00
	WEWA voyage owned container vessel	2.410	1.788	125.320	92.994	9	12	77,00	10.801	11	5	6	286	410	697	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$1.001.633,66
Total Europe - West Africa [Annual]		**2.410**	**1.788**	**125.320**	**92.994**	**9**	**12**	**77,00**	**561.652**	**11**	**6**	**5**	**14.887**	**21.345**	**36.232**	**87.828**	**86.216**	**1.612**	**87.828**	**1.612**	**86.216**	**175.656**	**87.828**	**87.828**	**$152.214.367,16**	**$1.040.918,33**	**$153.255.285,49**	**$21.287.446,89**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$451.606,04
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**54,98**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.151.663,35**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$0,00
	Feeder 1 voyage owned container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$69.731,82
	Total Feeder 1 [Annual]	**214**	**146**	**11.128**	**7.590**	**3**	**11**	**17,94**	**66.300**	**3**	**2**	**1**	**1.037**	**650**	**1.687**	**9.776**	**9.256**	**520**	**9.776**	**520**	**9.256**	**19.552**	**9.776**	**9.776**	**$10.061.247,43**	**$155.695,73**	**$10.216.943,16**	**$1.595.863,07**
	Feeder 2 voyage chartered container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$0,00
	Feeder 2 voyage owned container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$282.957,53
	Total Feeder 2 [Annual]	**1.042**	**765**	**54.184**	**39.791**	**5**	**11**	**34,37**	**17.784**	**5**	**3**	**2**	**1.929**	**329**	**2.258**	**36.140**	**36.140**	**0**	**36.140**	**0**	**36.140**	**72.280**	**36.140**	**36.140**	**$33.906.766,36**	**$0,00**	**$33.906.766,36**	**$6.110.830,42**
Total Inter West Africa [Annual]				**65.312**	**47.381**				**84.084**	**8**	**5**	**3**	**2.966**	**979**	**3.945**	**45.916**	**45.396**	**520**	**45.916**	**520**	**45.396**	**91.832**	**45.916**	**45.916**	**$43.968.013,79**	**$155.695,73**	**$44.123.709,52**	**$7.706.693,48**
Grand Total [Annual]				**391.872**	**288.684**				**3.341.884**	**27**	**32**	**29**	**68.063**	**80.727**	**148.790**	**277.316**	**271.492**	**5.824**	**277.316**	**5.824**	**271.492**	**554.632**	**277.316**	**277.316**	**$415.343.911,35**	**$3.025.709,64**	**$418.369.620,99**	**$79.274.641,73**

Table 360: Results computer model scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transhipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.112.692,40	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$3.945.795,33	-$1.385.774,36	$2.388,50	$0,11
	FEWA voyage owned container vessel	$0,00	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$4.307.249,49	-$1.747.228,53	$2.607,29	$0,12
	Total FEWA [Annual]	**$29.317.635,56**	**$33.710.378,62**	**$15.938.103,48**	**$1.573.000,00**	**$32.083.314,38**	**$19.702.834,62**	**$9.356.635,68**	**$5.041.804,12**	**$25.578.510,48**	**$4.336.771,05**	**$205.389.364,74**	**-$72.268.274,40**	**$2.390,92**	**$0,12**
	SWAX voyage chartered container vessel	$794.309,50	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.361,38	$31.451,48	$2.002.987,24	-$935.358,59	$3.215,07	$0,15
	SWAX voyage owned container vessel	$0,00	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.361,38	$31.451,48	$1.975.318,83	-$907.690,18	$3.170,66	$0,15
	Total SWAX [Annual]	**$20.959.433,54**	**$21.662.274,39**	**$9.955.659,43**	**$1.573.000,00**	**$6.423.407,69**	**$8.549.951,81**	**$170.717,65**	**$2.045.962,80**	**$10.834.791,53**	**$1.635.477,22**	**$97.189.137,30**	**-$41.672.447,42**	**$3.000,04**	**$0,15**
Total Asia - West Africa [Annual]		**$50.277.069,10**	**$55.372.653,01**	**$25.893.762,91**	**$3.146.000,00**	**$38.506.722,07**	**$28.252.786,43**	**$9.527.353,33**	**$7.087.766,92**	**$36.413.302,01**	**$5.972.248,27**	**$302.578.502,04**	**-$113.940.721,81**	**$2.557,72**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$724.803,64	$433.387,14	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$498.350,63	$85.267,35	$3.462.352,74	-$515.135,71	$2.049,94	$0,19
	WEWA voyage owned container vessel	$0,00	$433.387,14	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$498.350,63	$85.267,35	$3.739.182,76	-$791.965,73	$2.213,84	$0,20
Total Europe - West Africa [Annual]		**$17.179.093,65**	**$22.536.131,41**	**$9.959.222,52**	**$1.573.000,00**	**$42.560.610,16**	**$23.238.477,20**	**$6.011.980,59**	**$6.124.996,61**	**$25.914.232,73**	**$4.433.902,12**	**$180.819.093,88**	**-$27.563.808,39**	**$2.058,79**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$413.817,11	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.340.497,58	-$718.327,47	$2.758,23	$0,30
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.378.286,51	-$756.116,40	$2.835,98	$0,31
Total South America - West Africa [Annual]		**$10.988.583,42**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.841.117,62**	**$4.866.695,53**	**$2.624.155,35**	**$1.294.113,83**	**$6.908.745,10**	**$1.275.829,74**	**$67.327.631,25**	**-$34.974.785,50**	**$2.664,12**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	$114.792,76	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.416,37	$9.490,98	$441.857,61	-$245.377,94	$2.350,31	$1,84
	Feeder 1 voyage owned container vessel	$0,00	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.416,37	$9.490,98	$396.796,67	-$200.316,99	$2.110,62	$1,66
	Total Feeder 1 [Annual]	**$2.335.945,54**	**$1.049.287,61**	**$2.504.752,54**	**$1.573.000,00**	**$5.188.705,95**	**$3.716.277,45**	**$308.724,16**	**$435.442,17**	**$1.737.651,39**	**$493.530,85**	**$20.939.180,72**	**-$10.722.237,56**	**$2.141,90**	**$1,72**
	Feeder 2 voyage chartered container vessel	$259.038,62	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$115.836,32	$35.086,33	$1.377.062,24	-$725.009,04	$1.981,38	$5,79
	Feeder 2 voyage owned container vessel	$0,00	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$115.836,32	$35.086,33	$1.400.981,15	-$748.927,95	$2.015,80	$5,89
	Total Feeder 2 [Annual]	**$5.501.303,65**	**$1.404.426,55**	**$4.686.738,68**	**$1.573.000,00**	**$25.485.943,60**	**$15.787.405,30**	**$19.295,26**	**$1.332.441,02**	**$6.023.488,83**	**$1.824.489,03**	**$69.749.362,34**	**-$35.842.595,98**	**$1.929,98**	**$5,85**
Total Inter West Africa [Annual]		**$7.837.249,19**	**$2.453.714,15**	**$7.191.491,22**	**$3.146.000,00**	**$30.674.649,55**	**$19.503.682,76**	**$328.019,42**	**$1.767.883,19**	**$7.761.140,22**	**$2.318.019,88**	**$90.688.543,06**	**-$46.564.833,54**	**$1.975,10**	**$4,30**
Grand Total [Annual]		**$86.281.995,37**	**$92.547.335,19**	**$48.663.367,32**	**$9.438.000,00**	**$123.583.099,39**	**$75.861.641,92**	**$18.491.508,69**	**$16.274.760,55**	**$76.997.420,07**	**$14.000.000,00**	**$641.413.770,23**	**-$223.044.149,24**	**$2.312,93**	**$0,71**

Table 361: Specifications container vessels scenario 3

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	2.054	781	2.410	1.035	214	1.042
14 ton TEU capacity [14 ton TEU]	1.522	570	1.788	760	146	765
Amount of reefer plugs	287	123	333	155	50	156
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	193,5	139,3	202,0	159,3	98,2	159,6
B [m]	32,3	25,3	33,7	26,5	17,9	26,6
T [m]	9,2	7,4	9,6	7,8	5,3	7,8
D [m]	16,9	12,5	17,8	13,6	8,3	13,7
LBD [m³]	95.702,4	40.590,8	110.279,7	52.107,3	12.874,3	52.419,8
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [ton]	38.312	17.505	43.607	21.990	6.134	22.111
Displacement Volume [m³]	37.377	17.079	42.544	21.454	5.985	21.571
DWT [ton]	29.692	12.926	34.067	16.468	4.246	16.564
Gross Tonnage [m³]	22.131	9.370	25.509	12.035	2.965	12.107
Wsm [ton]	11.606	5.532	13.119	6.864	2.051	6.900
Wst [ton]	8.207	3.793	9.324	4.749	1.349	4.774
Vs (design) [kn]	20,2	17,3	20,6	18,4	14,7	18,4
Vs (Max)	20,3	17,4	20,7	18,5	14,7	18,5
LCB [m]	-1,23	-1,71	-1,18	-1,49	-2,42	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,4	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,9	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,9	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,4	7,2
Pb (MCR) [kW]	19.500	7.600	22.400	10.500	2.500	10.500
Cad [-]	488	467	491	473	426	475
Fuel consumption design condition [ton/h]	3,71	1,44	4,26	2,00	0,48	2,00
Generator power [kW]	2.075	1.086	2.568	1.276	661	1.282
Operational costs [$/day]	$3.193,02	$2.438,61	$3.407,99	$2.733,33	$1.744,39	$2.737,14
Average capital costs [$/day]	$8.630,83	$4.489,25	$9.600,47	$5.480,40	$2.143,25	$5.494,74
Average charter price [$/day]	$8.924,70	$7.177,89	$9.413,20	$7.526,43	$6.399,85	$7.536,03
Capacity fuel tanks [m³]	2.841	1.227	3.263	1.567	399	1.576
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	36.198	14.859	41.821	19.258	4.497	19.377
Displacement outbound [ton]	30.437	15.244	34.686	18.275	6.059	18.359
Pb inbound [kW]	2.858	1.647	4.059	2.208	815	1.933
Pb outbound [kW]	2.546	1.675	3.583	2.132	994	1.865
Fuel consumption inbound [ton/h]	0,543	0,313	0,771	0,420	0,155	0,367
Fuel consumption outbound [ton/h]	0,484	0,318	0,681	0,405	0,189	0,354

T.4 Scenario 4

Table 362: Results computer model scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$0,00
	SWAX 2 voyage owned container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$1.714.105,61
Total Asia - West Africa [Annual]		**2.496**	**1.853**	**129.792**	**96.339**	**6**	**11**	**129,00**	**1.321.580**	**19**	**10**	**9**	**31.026**	**38.604**	**69.631**	**98.332**	**95.628**	**2.704**	**98.332**	**2.704**	**95.628**	**196.664**	**98.332**	**98.332**	**$128.359.754,75**	**$1.160.770,13**	**$129.520.524,89**	**$36.322.464,41**
Europe - West Africa	WEWA voyage chartered container vessel	2.387	1.771	124.124	92.100	9	12	75,92	10.801	11	5	6	284	407	691	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$0,00
	WEWA voyage owned container vessel	2.387	1.771	124.124	92.100	9	12	75,92	10.801	11	5	6	284	407	691	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$978.061,03
Total Europe - West Africa [Annual]		**2.387**	**1.771**	**124.124**	**92.100**	**9**	**12**	**75,92**	**561.652**	**11**	**6**	**5**	**14.767**	**21.182**	**35.950**	**85.436**	**83.824**	**1.612**	**85.436**	**1.612**	**83.824**	**170.872**	**85.436**	**85.436**	**$150.590.236,79**	**$885.363,73**	**$151.475.600,53**	**$21.061.583,33**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$452.911,15
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**55,14**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.152.097,66**
Inter West Africa	Feeder 3 voyage chartered container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$0,00
	Feeder 3 voyage owned container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$67.130,63
	Total Feeder 3 [Annual]	**204**	**138**	**10.608**	**7.201**	**4**	**11**	**17,64**	**23.556**	**3**	**2**	**1**	**845**	**382**	**1.227**	**7.384**	**7.072**	**312**	**7.384**	**312**	**7.072**	**14.768**	**7.384**	**7.384**	**$6.466.919,44**	**$90.113,23**	**$6.557.032,67**	**$1.549.120,33**
	Feeder 4 voyage chartered container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$0,00
	Feeder 4 voyage owned container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$109.694,49
	Total Feeder 4 [Annual]	**287**	**201**	**14.924**	**10.429**	**4**	**11**	**25,22**	**100.516**	**4**	**2**	**2**	**1.732**	**965**	**2.697**	**14.300**	**13.364**	**936**	**14.300**	**936**	**13.364**	**28.600**	**14.300**	**14.300**	**$19.877.940,37**	**$270.339,69**	**$20.148.280,07**	**$1.871.718,99**
	Feeder 5 voyage chartered container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$0,00
	Feeder 5 voyage owned container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$312.905,11
	Total Feeder 5 [Annual]	**1.036**	**761**	**53.872**	**39.558**	**5**	**11**	**38,08**	**31.772**	**6**	**3**	**3**	**2.200**	**551**	**2.751**	**35.932**	**35.932**	**0**	**35.932**	**0**	**35.932**	**71.864**	**35.932**	**35.932**	**$33.924.244,60**	**$0,00**	**$33.924.244,60**	**$6.107.396,33**
	Feeder 6 voyage chartered container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$0,00
	Feeder 6 voyage owned container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$383.088,03
	Total feeder 6 [Annual]	**1.040**	**764**	**54.080**	**39.714**	**5**	**11**	**46,57**	**253.396**	**7**	**4**	**3**	**4.634**	**3.882**	**8.517**	**45.448**	**45.084**	**364**	**45.448**	**364**	**45.084**	**90.896**	**45.448**	**45.448**	**$47.525.710,41**	**$100.313,47**	**$47.626.023,88**	**$8.143.755,09**
Total Inter West Africa [Annual]				**133.484**	**96.901**				**409.240**	**20**	**11**	**9**	**9.411**	**5.780**	**15.191**	**103.064**	**101.452**	**1.612**	**103.064**	**1.612**	**101.452**	**206.128**	**103.064**	**103.064**	**$107.794.814,82**	**$460.766,39**	**$108.255.581,22**	**$17.671.990,74**
Grand Total [Annual]				**441.220**	**324.859**				**2.765.412**	**58**	**31**	**27**	**65.625**	**74.737**	**140.361**	**312.104**	**306.176**	**5.928**	**312.104**	**5.928**	**306.176**	**624.208**	**312.104**	**312.104**	**$419.097.652,11**	**$2.506.900,26**	**$421.604.552,37**	**$83.208.136,14**

Table 363: Results computer model scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$1.229.512,23	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$3.826.496,35	-$1.335.717,02	$2.023,53	$0,08
	SWAX 2 voyage owned container vessel	$0,00	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$4.311.089,73	-$1.820.310,40	$2.279,79	$0,09
Total Asia - West Africa [Annual]		**$31.310.028,79**	**$43.310.254,24**	**$6.703.315,01**	**$1.573.000,00**	**$24.559.268,94**	**$15.520.772,85**	**$11.383.402,99**	**$4.590.364,12**	**$22.991.933,13**	**$4.410.863,05**	**$202.675.667,52**	**-$73.155.142,63**	**$2.061,14**	**$0,08**
Europe - West Africa	WEWA voyage chartered container vessel	$712.297,33	$430.011,84	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.325.529,84	-$412.537,53	$2.024,06	$0,19
	WEWA voyage owned container vessel	$0,00	$430.011,84	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.591.293,55	-$678.301,23	$2.185,81	$0,20
Total Europe - West Africa [Annual]		**$17.121.495,56**	**$22.360.615,88**	**$9.933.614,96**	**$1.573.000,00**	**$39.958.349,38**	**$22.027.881,22**	**$3.902.849,89**	**$6.070.273,06**	**$26.229.117,26**	**$3.832.389,20**	**$174.071.169,75**	**-$22.595.569,23**	**$2.037,45**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$415.013,01	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.311.570,65	-$689.400,53	$2.698,71	$0,30
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.349.468,78	-$727.298,67	$2.776,68	$0,31
Total South America - West Africa [Annual]		**$10.988.583,42**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.412.278,79**	**$5.018.600,95**	**$1.395.397,34**	**$1.294.113,83**	**$6.990.256,49**	**$1.133.622,13**	**$65.761.677,91**	**-$33.408.832,17**	**$2.602,16**	**$0,30**
Inter West Africa	Feeder 3 voyage chartered container vessel	$112.671,04	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$301.975,26	-$175.878,48	$2.126,59	$4,69
	Feeder 3 voyage owned container vessel	$0,00	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$256.434,85	-$130.338,07	$1.805,88	$3,99
	Total Feeder 3 [Annual]	**$2.330.937,01**	**$763.228,35**	**$3.334.721,73**	**$1.573.000,00**	**$842.734,24**	**$454.976,03**	**$1.579.694,78**	**$253.005,70**	**$711.235,82**	**$331.222,93**	**$13.723.876,91**	**-$7.166.844,25**	**$1.858,60**	**$4,22**
	Feeder 4 voyage chartered container vessel	$163.958,07	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$530.978,06	-$143.511,14	$1.930,83	$1,00
	Feeder 4 voyage owned container vessel	$0,00	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$476.714,49	-$89.247,56	$1.733,51	$0,90
	Total Feeder 4 [Annual]	**$4.745.015,62**	**$1.677.351,70**	**$3.375.792,78**	**$1.573.000,00**	**$3.763.089,74**	**$2.106.936,44**	**$3.506.715,55**	**$829.920,04**	**$1.610.780,73**	**$641.452,85**	**$25.701.774,43**	**-$5.553.494,37**	**$1.797,33**	**$0,95**
	Feeder 5 voyage chartered container vessel	$286.683,85	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$912.553,77	-$260.164,45	$1.320,63	$2,16
	Feeder 5 voyage owned container vessel	$0,00	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$938.775,03	-$286.385,71	$1.358,57	$2,22
	Total Feeder 5 [Annual]	**$8.242.940,12**	**$1.710.982,35**	**$4.683.027,44**	**$1.573.000,00**	**$5.204.211,99**	**$3.269.905,53**	**$9.451.135,53**	**$1.336.471,74**	**$3.704.705,17**	**$1.611.796,07**	**$46.895.572,27**	**-$12.971.327,68**	**$1.305,12**	**$2,19**
	Feeder 6 voyage chartered container vessel	$350.798,19	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.229.715,50	-$313.830,43	$1.407,00	$0,29
	Feeder 6 voyage owned container vessel	$0,00	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.262.005,33	-$346.120,26	$1.443,94	$0,30
	Total feeder 6 [Annual]	**$8.248.950,36**	**$5.297.394,29**	**$4.685.501,60**	**$1.573.000,00**	**$8.501.988,26**	**$5.625.449,13**	**$9.685.781,42**	**$2.049.180,43**	**$6.246.750,97**	**$2.038.653,78**	**$62.096.405,33**	**-$14.470.381,44**	**$1.366,32**	**$0,29**
Total Inter West Africa [Annual]		**$23.567.843,12**	**$9.448.956,68**	**$16.079.043,55**	**$6.292.000,00**	**$18.312.024,23**	**$11.457.267,12**	**$24.223.327,28**	**$4.468.577,91**	**$12.273.472,69**	**$4.623.125,62**	**$148.417.628,95**	**-$40.162.047,73**	**$1.440,05**	**$1,58**
Grand Total [Annual]		**$82.987.950,89**	**$87.304.663,42**	**$38.334.864,20**	**$11.011.000,00**	**$94.241.921,34**	**$54.024.522,15**	**$40.904.977,51**	**$16.423.328,92**	**$68.484.779,58**	**$14.000.000,00**	**$590.926.144,13**	**-$169.321.591,76**	**$1.893,36**	**$0,65**

Table 364: Specifications container vessels scenario 4

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.496	2.387	1.035	204	287	1.036	1.040
14 ton TEU capacity [14 ton TEU]	1.853	1.771	760	138	201	761	764
Amount of reefer plugs	344	330	155	48	59	156	156
Amount of ship cranes	3	3	2	2	2	2	2
Lpp [m]	204,0	201,5	159,3	96,9	106,3	159,3	159,5
B [m]	34,0	33,6	26,5	17,6	19,3	26,6	26,6
T [m]	9,7	9,6	7,8	5,2	5,7	7,8	7,8
D [m]	18,0	17,8	13,6	8,2	9,1	13,6	13,7
LBD [m³]	113.763,3	109.345,6	52.107,3	12.339,2	16.702,7	52.151,9	52.330,5
B/T [-]	3,5	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.864	43.270	21.990	5.901	7.781	22.007	22.076
Displacement Volume [m³]	43.769	42.215	21.454	5.757	7.591	21.471	21.538
DWT [t]	35.110	33.787	16.468	4.075	5.465	16.482	16.537
Gross Tonnage [m³]	26.316	25.292	12.035	2.842	3.849	12.045	12.087
Wsm [t]	13.476	13.023	6.864	1.977	2.568	6.869	6.889
Wst [t]	9.589	9.253	4.749	1.299	1.706	4.752	4.767
Vs (design) [kn]	20,7	20,5	18,4	14,6	15,2	18,4	18,4
Vs (Max)	20,8	20,6	18,5	14,6	15,2	18,5	18,5
LCB [m]	-1,16	-1,18	-1,49	-2,45	-2,24	-1,49	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Ta [m]	8,9	8,8	7,7	5,8	6,1	7,7	7,7
Tf [m]	7,9	7,8	6,7	4,8	5,1	6,7	6,7
Tav (in ballast) [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Pb (MCR) [kW]	23.100	21.900	10.500	2.350	3.150	10.500	10.500
Cad [-]	492	492	473	432	438	474	475
Fuel consumption design condition [t/h]	4,39	4,16	2,00	0,45	0,60	2,00	2,00
Generator power [kW]	2.687	2.536	1.276	653	715	1.277	1.280
Operational costs [$/day]	$3.458,67	$3.382,10	$2.733,33	$1.724,52	$1.848,65	$2.733,87	$2.736,05
Average capital costs [$/day]	$9.829,12	$9.499,91	$5.480,40	$2.080,40	$2.500,12	$5.482,45	$5.490,65
Average charter price [$/day]	$9.531,21	$9.381,64	$7.526,43	$6.386,13	$6.500,02	$7.527,80	$7.533,29
Capacity fuel tanks [m³]	3.364	3.236	1.567	383	515	1.568	1.573
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	43.364	41.443	19.258	4.306	5.528	19.279	16.235
Displacement outbound [t]	35.712	34.412	18.275	5.855	7.547	18.287	18.335
Pb inbound [kW]	3.195	4.023	2.208	779	909	1.933	1.720
Pb outbound [kW]	2.807	3.554	2.132	956	1.119	1.866	1.865
Fuel consumption inbound [t/h]	0,607	0,764	0,420	0,148	0,173	0,367	0,327
Fuel consumption outbound [t/h]	0,533	0,675	0,405	0,182	0,213	0,355	0,354

Appendix U : Results sensitivity analysis

U.1 20% decrease in the TEUs in the trip matrix

U.1.1 Scenario 1

Figure 428: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	1.686	1.247	87.672	64.837	15	12	118,42	21.190	17	9	8	425	604	1.029	1.336	1.336	0	1.336	0	1.336	2.672	1.336	1.336	$2.098.434,97	$0,00	$2.098.434,97	$0,00
	FEWA voyage owned container vessel	1.686	1.247	87.672	64.837	15	12	118,42	21.190	17	9	8	425	604	1.029	1.336	1.336	0	1.336	0	1.336	2.672	1.336	1.336	$2.098.434,97	$0,00	$2.098.434,97	$1.249.094,16
	Total FEWA [Annual]	**1.686**	**1.247**	**87.672**	**64.837**	**15**	**12**	**118,42**	**1.101.880**	**17**	**9**	**8**	**22.079**	**31.417**	**53.496**	**69.472**	**69.472**	**0**	**69.472**	**0**	**69.472**	**138.944**	**69.472**	**69.472**	**$109.118.618,29**	**$0,00**	**$109.118.618,29**	**$25.284.824,48**
	SWAX voyage chartered container vessel	619	449	32.188	23.341	11	11	109,41	21.564	16	8	8	297	314	612	484	482	2	484	2	482	968	484	484	$864.333,80	$1.002,20	$865.335,99	$0,00
	SWAX voyage owned container vessel	619	449	32.188	23.341	11	11	109,41	21.564	16	8	8	297	314	612	484	482	2	484	2	482	968	484	484	$864.333,80	$1.002,20	$865.335,99	$674.322,09
	Total SWAX [Annual]	**619**	**449**	**32.188**	**23.341**	**11**	**11**	**109,41**	**1.121.328**	**16**	**8**	**8**	**15.462**	**16.350**	**31.812**	**25.168**	**25.064**	**104**	**25.168**	**104**	**25.064**	**50.336**	**25.168**	**25.168**	**$44.945.357,58**	**$52.114,15**	**$44.997.471,72**	**$11.634.647,69**
Total Asia - West Africa [Annual]				**119.860**	**88.178**				**2.223.208**	**33**	**17**	**16**	**37.541**	**47.768**	**85.309**	**94.640**	**94.536**	**104**	**94.640**	**104**	**94.536**	**189.280**	**94.640**	**94.640**	**$154.063.975,87**	**$52.114,15**	**$154.116.090,01**	**$36.919.472,17**
Europe - West Africa	WEWA voyage chartered container vessel	2.043	1.514	106.236	78.721	9	12	76,54	10.801	11	6	5	242	350	591	1.435	1.369	66	1.435	66	1.369	2.870	1.435	1.435	$2.411.641,26	$36.890,16	$2.448.531,41	$0,00
	WEWA voyage owned container vessel	2.043	1.514	106.236	78.721	9	12	76,54	10.801	11	6	5	242	350	591	1.435	1.369	66	1.435	66	1.369	2.870	1.435	1.435	$2.411.641,26	$36.890,16	$2.448.531,41	$898.104,65
Total Europe - West Africa [Annual]		**2.043**	**1.514**	**106.236**	**78.721**	**9**	**12**	**76,54**	**561.652**	**11**	**6**	**5**	**12.559**	**18.193**	**30.752**	**74.620**	**71.188**	**3.432**	**74.620**	**3.432**	**71.188**	**149.240**	**74.620**	**74.620**	**$125.405.345,44**	**$1.918.288,09**	**$127.323.633,53**	**$18.990.398,52**
South America - West Africa	ECSA voyage chartered container vessel	860	629	44.720	32.713	6	11	55,92	9.095	8	4	4	171	154	325	402	402	0	402	0	402	804	402	402	$512.725,75	$0,00	$512.725,75	$0,00
	ECSA voyage owned container vessel	860	629	44.720	32.713	6	11	55,92	9.095	8	4	4	171	154	325	402	402	0	402	0	402	804	402	402	$512.725,75	$0,00	$512.725,75	$407.586,41
Total South America - West Africa [Annual]		**860**	**629**	**44.720**	**32.713**	**6**	**11**	**55,92**	**472.940**	**8**	**4**	**4**	**8.915**	**7.991**	**16.907**	**20.904**	**20.904**	**0**	**20.904**	**0**	**20.904**	**41.808**	**20.904**	**20.904**	**$26.661.738,86**	**$0,00**	**$26.661.738,86**	**$7.101.671,07**
Inter West Africa	Feeder 1 voyage chartered container vessel	176	118	9.152	6.112	3	11	17,71	1.275	3	2	1	19	12	30	162	149	13	162	13	149	324	162	162	$162.330,84	$4.098,91	$166.429,74	$0,00
	Feeder 1 voyage owned container vessel	176	118	9.152	6.112	3	11	17,71	1.275	3	2	1	19	12	30	162	149	13	162	13	149	324	162	162	$162.330,84	$4.098,91	$166.429,74	$62.769,57
	Total Feeder 1 [Annual]	**176**	**118**	**9.152**	**6.112**	**3**	**11**	**17,71**	**66.300**	**3**	**2**	**1**	**982**	**598**	**1.580**	**8.424**	**7.748**	**676**	**8.424**	**676**	**7.748**	**16.848**	**8.424**	**8.424**	**$8.441.203,57**	**$213.143,12**	**$8.654.346,69**	**$1.402.803,92**
	Feeder 2 voyage chartered container vessel	868	635	45.136	33.024	5	11	32,03	342	5	3	2	36	6	42	577	577	0	577	0	577	1.154	577	577	$541.833,91	$0,00	$541.833,91	$0,00
	Feeder 2 voyage owned container vessel	868	635	45.136	33.024	5	11	32,03	342	5	3	2	36	6	42	577	577	0	577	0	577	1.154	577	577	$541.833,91	$0,00	$541.833,91	$234.201,45
	Total Feeder 2 [Annual]	**868**	**635**	**45.136**	**33.024**	**5**	**11**	**32,03**	**17.784**	**5**	**3**	**2**	**1.888**	**314**	**2.202**	**30.004**	**30.004**	**0**	**30.004**	**0**	**30.004**	**60.008**	**30.004**	**30.004**	**$28.175.363,19**	**$0,00**	**$28.175.363,19**	**$5.320.324,83**
Total Inter West Africa [Annual]				**54.288**	**39.136**				**84.084**	**8**	**5**	**3**	**2.871**	**912**	**3.782**	**38.428**	**37.752**	**676**	**38.428**	**676**	**37.752**	**76.856**	**38.428**	**38.428**	**$36.616.566,76**	**$213.143,12**	**$36.829.709,88**	**$6.723.128,74**
Grand Total [Annual]				**325.104**	**238.748**				**3.341.884**	**60**	**32**	**28**	**61.886**	**74.863**	**136.750**	**228.592**	**224.380**	**4.212**	**228.592**	**4.212**	**224.380**	**457.184**	**228.592**	**228.592**	**$342.747.626,92**	**$2.183.545,36**	**$344.931.172,28**	**$69.734.670,51**

Figure 429: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transhipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$997.055,87	$639.898,46	$293.369,91	$30.250,00	$500.966,85	$305.331,43	$148.423,81	$79.515,45	$376.223,65	$81.822,64	$3.452.858,05	-$1.354.423,09	$2.584,47	$0,12
	FEWA voyage owned container vessel	$0,00	$639.898,46	$293.369,91	$30.250,00	$500.966,85	$305.331,43	$148.423,81	$79.515,45	$376.223,65	$81.822,64	$3.704.896,35	-$1.606.461,38	$2.773,13	$0,13
	Total FEWA [Annual]	**$24.585.609,26**	**$33.274.719,69**	**$15.255.235,32**	**$1.573.000,00**	**$26.050.276,18**	**$15.877.234,21**	**$7.718.038,05**	**$4.134.803,35**	**$19.563.629,74**	**$4.254.777,07**	**$177.572.147,36**	**-$68.453.529,07**	**$2.556,02**	**$0,13**
	SWAX voyage chartered container vessel	$761.012,89	$380.525,57	$187.215,61	$30.250,00	$95.762,46	$128.984,85	$1.856,03	$31.974,02	$155.528,75	$29.642,33	$1.802.752,51	-$937.416,51	$3.724,70	$0,17
	SWAX voyage owned container vessel	$0,00	$380.525,57	$187.215,61	$30.250,00	$95.762,46	$128.984,85	$1.856,03	$31.974,02	$155.528,75	$29.642,33	$1.716.061,71	-$850.725,71	$3.545,58	$0,16
	Total SWAX [Annual]	**$20.310.328,06**	**$19.787.329,59**	**$9.735.211,77**	**$1.573.000,00**	**$4.979.647,77**	**$6.707.212,04**	**$96.513,57**	**$1.662.648,98**	**$8.087.494,90**	**$1.541.401,27**	**$86.115.435,63**	**-$41.117.963,91**	**$3.421,62**	**$0,17**
Total Asia - West Africa [Annual]		**$44.895.937,32**	**$53.062.049,28**	**$24.990.447,09**	**$3.146.000,00**	**$31.029.923,95**	**$22.584.446,24**	**$7.814.551,61**	**$5.797.452,33**	**$27.651.124,64**	**$5.796.178,34**	**$263.687.582,99**	**-$109.571.492,98**	**$2.786,22**	**$0,15**
Europe - West Africa	WEWA voyage chartered container vessel	$681.926,53	$367.841,73	$183.665,67	$30.250,00	$689.798,29	$381.155,45	$96.690,81	$97.960,63	$407.563,43	$87.885,84	$3.024.738,38	-$576.206,97	$2.107,83	$0,20
	WEWA voyage owned container vessel	$0,00	$367.841,73	$183.665,67	$30.250,00	$689.798,29	$381.155,45	$96.690,81	$97.960,63	$407.563,43	$87.885,84	$3.240.916,50	-$792.385,09	$2.258,48	$0,21
Total Europe - West Africa [Annual]		**$16.260.028,40**	**$19.127.769,87**	**$9.550.615,00**	**$1.573.000,00**	**$35.869.511,05**	**$19.820.083,42**	**$5.027.922,33**	**$5.093.952,72**	**$21.193.298,34**	**$4.570.063,69**	**$157.076.643,34**	**-$29.753.009,80**	**$2.105,02**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$407.423,71	$202.229,33	$105.557,64	$30.250,00	$187.479,88	$76.867,25	$42.672,21	$20.509,03	$106.327,23	$24.620,28	$1.203.936,57	-$691.210,82	$2.994,87	$0,33
	ECSA voyage owned container vessel	$0,00	$202.229,33	$105.557,64	$30.250,00	$187.479,88	$76.867,25	$42.672,21	$20.509,03	$106.327,23	$24.620,28	$1.204.099,27	-$691.373,53	$2.995,27	$0,33
Total South America - West Africa [Annual]		**$10.637.986,32**	**$10.515.925,37**	**$5.488.997,28**	**$1.573.000,00**	**$9.748.953,91**	**$3.997.097,17**	**$2.218.954,90**	**$1.066.469,55**	**$5.529.016,05**	**$1.280.254,78**	**$59.158.326,40**	**-$32.496.587,54**	**$2.830,00**	**$0,33**
Inter West Africa	Feeder 1 voyage chartered container vessel	$112.402,78	$18.902,62	$47.897,11	$30.250,00	$84.242,95	$60.324,18	$6.679,13	$7.097,16	$27.885,68	$9.921,61	$405.603,21	-$239.173,47	$2.503,72	$1,96
	Feeder 1 voyage owned container vessel	$0,00	$18.902,62	$47.897,11	$30.250,00	$84.242,95	$60.324,18	$6.679,13	$7.097,16	$27.885,68	$9.921,61	$355.970,00	-$189.540,25	$2.197,35	$1,72
	Total Feeder 1 [Annual]	**$2.316.913,13**	**$982.936,24**	**$2.490.649,82**	**$1.573.000,00**	**$4.380.633,39**	**$3.136.857,16**	**$347.314,68**	**$369.052,20**	**$1.450.055,23**	**$515.923,57**	**$18.966.139,33**	**-$10.311.792,64**	**$2.251,44**	**$1,80**
	Feeder 2 voyage chartered container vessel	$233.762,33	$26.339,98	$88.059,86	$30.250,00	$407.378,41	$251.853,31	$371,06	$21.283,02	$92.856,92	$35.338,07	$1.187.492,97	-$645.659,06	$2.058,05	$6,02
	Feeder 2 voyage owned container vessel	$0,00	$26.339,98	$88.059,86	$30.250,00	$407.378,41	$251.853,31	$371,06	$21.283,02	$92.856,92	$35.338,07	$1.187.932,09	-$646.098,18	$2.058,81	$6,02
	Total Feeder 2 [Annual]	**$5.327.006,81**	**$1.369.679,18**	**$4.579.112,72**	**$1.573.000,00**	**$21.183.677,42**	**$13.096.372,00**	**$19.295,26**	**$1.106.717,28**	**$4.828.559,73**	**$1.837.579,62**	**$60.241.324,84**	**-$32.065.961,65**	**$2.007,78**	**$6,02**
Total Inter West Africa [Annual]		**$7.643.919,94**	**$2.352.615,42**	**$7.069.762,54**	**$3.146.000,00**	**$25.564.310,80**	**$16.233.229,16**	**$366.609,94**	**$1.475.769,49**	**$6.278.614,96**	**$2.353.503,18**	**$79.207.464,17**	**-$42.377.754,29**	**$2.061,19**	**$4,44**
Grand Total [Annual]		**$79.437.871,97**	**$85.058.359,93**	**$47.099.821,91**	**$9.438.000,00**	**$102.212.699,70**	**$62.634.855,99**	**$15.428.038,78**	**$13.433.644,09**	**$60.652.053,99**	**$14.000.000,00**	**$559.130.016,89**	**-$214.198.844,61**	**$2.445,97**	**$0,75**

Figure 430: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 1, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	1.686	619	2.043	860	176	868
14 ton TEU capacity [14 ton TEU]	1.247	449	1.514	629	118	635
Amount of reefer plugs	239	102	285	133	45	134
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	183,5	130,8	193,2	143,0	87,4	143,3
B [m]	30,6	23,8	32,2	26,0	17,5	26,1
T [m]	8,7	7,0	9,2	7,6	5,1	7,7
D [m]	15,9	11,6	16,9	12,9	7,8	12,9
LBD [m³]	80.328,4	33.027,5	95.247,7	44.212,6	10.824,7	44.577,3
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	32.650	14.501	38.146	18.927	5.236	19.069
Displacement Volume [m³]	31.854	14.147	37.215	18.465	5.108	18.604
DWT [t]	25.055	10.584	29.555	14.043	3.589	14.155
Gross Tonnage [m³]	18.569	7.621	22.025	10.208	2.492	10.292
Wsm [t]	9.977	4.629	11.559	5.956	1.766	5.998
Wst [t]	7.010	3.150	8.172	4.096	1.154	4.126
Vs (design) [kn]	19,7	16,8	20,1	17,5	13,9	17,5
Vs (Max)	19,8	16,9	20,2	17,6	13,9	17,6
LCB [m]	-1,30	-1,82	-1,23	-1,66	-2,72	-1,66
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	7,8	6,5	8,1	6,8	5,1	6,8
Ta [m]	8,3	7,0	8,6	7,3	5,6	7,3
Tf [m]	7,3	6,0	7,6	6,3	4,6	6,3
Tav (in ballast) [m]	7,8	6,5	8,1	6,8	5,1	6,8
Pb (MCR) [kW]	16.400	6.200	19.100	8.300	1.900	8.300
Cad [-]	484	463	489	466	426	469
Fuel consumption design condition [t/h]	3,12	1,18	3,63	1,58	0,36	1,58
Generator power [kW]	1.765	964	2.060	1.145	632	1.151
Operational costs [$/day]	$2.957,65	$2.263,59	$3.173,54	$2.521,62	$1.663,48	$2.526,14
Average capital costs [$/day]	$7.590,44	$3.899,65	$8.560,50	$4.767,58	$1.881,30	$4.784,84
Average charter price [$/day]	$8.419,73	$6.955,59	$8.909,60	$7.286,29	$6.347,71	$7.297,27
Capacity fuel tanks [m³]	2.393	1.003	2.827	1.334	337	1.345
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	34.866	13.682	41.182	18.572	4.128	18.747
Displacement outbound [t]	26.045	13.310	30.306	16.187	5.284	16.282
Pb inbound [kW]	2.810	1.573	3.105	2.187	769	1.916
Pb outbound [kW]	2.314	1.545	2.531	1.996	906	1.744
Fuel consumption inbound [t/h]	0,534	0,299	0,590	0,416	0,146	0,364
Fuel consumption outbound [t/h]	0,440	0,293	0,481	0,379	0,172	0,331

U.1.2 Scenario 2

Figure 431: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	1.788	1.323	92.976	68.804	16	11	123,42	21.223	18	9	9	412	572	984	1.391	1.383	8	1.391	8	1.383	2.782	1.391	1.391	$2.187.105,79	$4.409,38	$2.191.515,17	$0,00
	FEWA 2 voyage owned container vessel	1.788	1.323	92.976	68.804	16	11	123,42	21.223	18	9	9	412	572	984	1.391	1.383	8	1.391	8	1.383	2.782	1.391	1.391	$2.187.105,79	$4.409,38	$2.191.515,17	$1.344.910,87
	Total FEWA [Annual]	**1.788**	**1.323**	**92.976**	**68.804**	**16**	**11**	**123,42**	**1.103.596**	**18**	**9**	**9**	**21.432**	**29.761**	**51.192**	**72.332**	**71.916**	**416**	**72.332**	**416**	**71.916**	**144.664**	**72.332**	**72.332**	**$113.729.501,03**	**$229.287,93**	**$113.958.788,96**	**$26.242.819,19**
	SWAX voyage chartered container vessel	619	449	32.188	23.341	11	11	109,41	21.564	16	8	8	297	314	612	484	482	2	484	2	482	968	484	484	$864.333,80	$1.002,20	$865.335,99	$0,00
	SWAX voyage owned container vessel	619	449	32.188	23.341	11	11	109,41	21.564	16	8	8	297	314	612	484	482	2	484	2	482	968	484	484	$864.333,80	$1.002,20	$865.335,99	$674.322,09
	Total SWAX [Annual]	**619**	**449**	**32.188**	**23.341**	**11**	**11**	**109,41**	**1.121.328**	**16**	**8**	**8**	**15.462**	**16.350**	**31.812**	**25.168**	**25.064**	**104**	**25.168**	**104**	**25.064**	**50.336**	**25.168**	**25.168**	**$44.945.357,58**	**$52.114,15**	**$44.997.471,72**	**$11.634.647,69**
Total Asia - West Africa [Annual]				**125.164**	**92.144**				**2.224.924**		**17**	**17**	**36.894**	**46.111**	**83.005**	**97.500**	**96.980**	**520**	**97.500**	**520**	**96.980**	**195.000**	**97.500**	**97.500**	**$158.674.858,61**	**$281.402,07**	**$158.956.260,68**	**$37.877.466,87**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.105	1.560	109.460	81.132	10	11	82,59	10.827	12	6	6	215	342	557	1.511	1.401	110	1.511	110	1.401	3.022	1.511	1.511	$2.475.781,74	$64.636,60	$2.540.418,34	$0,00
	WEWA 2 voyage owned container vessel	2.105	1.560	109.460	81.132	10	11	82,59	10.827	12	6	6	215	342	557	1.511	1.401	110	1.511	110	1.401	3.022	1.511	1.511	$2.475.781,74	$64.636,60	$2.540.418,34	$987.829,13
Total Europe - West Africa [Annual]		**2.105**	**1.560**	**109.460**	**81.132**	**10**	**11**	**82,59**	**563.004**	**12**	**6**	**6**	**11.176**	**17.798**	**28.974**	**78.572**	**72.852**	**5.720**	**78.572**	**5.720**	**72.852**	**157.144**	**78.572**	**78.572**	**$128.740.650,73**	**$3.361.103,07**	**$132.101.753,80**	**$19.416.566,17**
South America - West Africa	ECSA voyage chartered container vessel	860	629	44.720	32.713	6	11	55,92	9.095	8	4	4	171	154	325	402	402	0	402	0	402	804	402	402	$512.725,75	$0,00	$512.725,75	$0,00
	ECSA voyage owned container vessel	860	629	44.720	32.713	6	11	55,92	9.095	8	4	4	171	154	325	402	402	0	402	0	402	804	402	402	$512.725,75	$0,00	$512.725,75	$407.586,41
Total South America - West Africa [Annual]		**860**	**629**	**44.720**	**32.713**	**6**	**11**	**55,92**	**472.940**	**8**	**4**	**4**	**8.915**	**7.991**	**16.907**	**20.904**	**20.904**	**0**	**20.904**	**0**	**20.904**	**41.808**	**20.904**	**20.904**	**$26.661.738,86**	**$0,00**	**$26.661.738,86**	**$7.101.671,07**
Inter West Africa	Feeder 1 voyage chartered container vessel	176	118	9.152	6.112	3	11	17,71	1.275	3	2	1	19	12	30	162	149	13	162	13	149	324	162	162	$162.330,84	$4.098,91	$166.429,74	$0,00
	Feeder 1 voyage owned container vessel	176	118	9.152	6.112	3	11	17,71	1.275	3	2	1	19	12	30	162	149	13	162	13	149	324	162	162	$162.330,84	$4.098,91	$166.429,74	$62.769,57
	Total Feeder 1 [Annual]	**176**	**118**	**9.152**	**6.112**	**3**	**11**	**17,71**	**66.300**	**3**	**2**	**1**	**982**	**598**	**1.580**	**8.424**	**7.748**	**676**	**8.424**	**676**	**7.748**	**16.848**	**8.424**	**8.424**	**$8.441.203,57**	**$213.143,12**	**$8.654.346,69**	**$1.402.803,92**
	Feeder 2 voyage chartered container vessel	868	635	45.136	33.024	5	11	32,03	342	5	3	2	36	6	42	577	577	0	577	0	577	1.154	577	577	$541.833,91	$0,00	$541.833,91	$0,00
	Feeder 2 voyage owned container vessel	868	635	45.136	33.024	5	11	32,03	342	5	3	2	36	6	42	577	577	0	577	0	577	1.154	577	577	$541.833,91	$0,00	$541.833,91	$234.201,45
	Total Feeder 2 [Annual]	**868**	**635**	**45.136**	**33.024**	**5**	**11**	**32,03**	**17.784**	**5**	**3**	**2**	**1.888**	**314**	**2.202**	**30.004**	**30.004**	**0**	**30.004**	**0**	**30.004**	**60.008**	**30.004**	**30.004**	**$28.175.363,19**	**$0,00**	**$28.175.363,19**	**$5.320.324,83**
Total Inter West Africa [Annual]				**54.288**	**39.136**				**84.084**	**8**	**5**	**3**	**2.871**	**912**	**3.782**	**38.428**	**37.752**	**676**	**38.428**	**676**	**37.752**	**76.856**	**38.428**	**38.428**	**$36.616.566,76**	**$213.143,12**	**$36.829.709,88**	**$6.723.128,74**
Grand Total [Annual]				**333.632**	**245.126**				**3.344.952**	**28**	**32**	**30**	**59.856**	**72.812**	**132.668**	**235.404**	**228.488**	**6.916**	**235.404**	**6.916**	**228.488**	**470.808**	**235.404**	**235.404**	**$350.693.814,95**	**$3.855.648,26**	**$354.549.463,22**	**$71.118.832,86**

Figure 432: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$1.056.471,25	$612.337,75	$316.810,43	$30.250,00	$513.247,75	$306.289,72	$148.423,81	$82.773,26	$401.674,83	$82.725,87	$3.551.004,66	-$1.359.489,49	$2.552,84	$0,12
	FEWA 2 voyage owned container vessel	$0,00	$612.337,75	$316.810,43	$30.250,00	$513.247,75	$306.289,72	$148.423,81	$82.773,26	$401.674,83	$82.725,87	$3.839.444,28	-$1.647.929,11	$2.760,20	$0,13
	Total FEWA [Annual]	**$28.118.593,48**	**$31.841.562,90**	**$16.474.142,46**	**$1.573.000,00**	**$26.688.882,99**	**$15.927.065,59**	**$7.718.038,05**	**$4.304.209,32**	**$20.887.091,32**	**$4.301.745,09**	**$184.077.150,38**	**-$70.118.361,42**	**$2.544,89**	**$0,13**
	SWAX voyage chartered container vessel	$761.012,89	$380.525,57	$187.215,61	$30.250,00	$95.762,46	$128.984,85	$1.856,03	$31.974,02	$155.309,73	$28.784,56	$1.801.675,72	-$936.339,72	$3.722,47	$0,17
	SWAX voyage owned container vessel	$0,00	$380.525,57	$187.215,61	$30.250,00	$95.762,46	$128.984,85	$1.856,03	$31.974,02	$155.309,73	$28.784,56	$1.714.984,91	-$849.648,92	$3.543,36	$0,16
	Total SWAX [Annual]	**$20.310.328,06**	**$19.787.329,59**	**$9.735.211,77**	**$1.573.000,00**	**$4.979.647,77**	**$6.707.212,04**	**$96.513,57**	**$1.662.648,98**	**$8.076.106,09**	**$1.496.797,00**	**$86.059.442,54**	**-$41.061.970,82**	**$3.419,40**	**$0,17**
Total Asia - West Africa [Annual]		**$48.428.921,53**	**$51.628.892,49**	**$26.209.354,24**	**$3.146.000,00**	**$31.668.530,76**	**$22.634.277,63**	**$7.814.551,61**	**$5.966.858,30**	**$28.963.197,41**	**$5.798.542,08**	**$270.136.592,92**	**-$111.180.332,24**	**$2.770,63**	**$0,15**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$742.887,69	$346.574,36	$205.547,95	$30.250,00	$704.995,14	$399.242,06	$96.690,81	$101.636,11	$439.039,71	$89.862,53	$3.156.726,37	-$616.308,02	$2.089,16	$0,19
	WEWA 2 voyage owned container vessel	$0,00	$346.574,36	$205.547,95	$30.250,00	$704.995,14	$399.242,06	$96.690,81	$101.636,11	$439.039,71	$89.862,53	$3.401.667,80	-$861.249,46	$2.251,27	$0,21
Total Europe - West Africa [Annual]		**$19.698.351,39**	**$18.021.866,63**	**$10.688.493,40**	**$1.573.000,00**	**$36.659.747,27**	**$20.760.587,14**	**$5.027.922,33**	**$5.285.077,53**	**$22.830.065,04**	**$4.672.851,78**	**$164.634.528,68**	**-$32.532.774,88**	**$2.095,33**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$407.423,71	$202.229,33	$105.557,64	$30.250,00	$187.479,88	$76.867,25	$42.672,21	$20.509,03	$106.410,34	$23.907,84	$1.203.307,23	-$690.581,49	$2.993,30	$0,33
	ECSA voyage owned container vessel	$0,00	$202.229,33	$105.557,64	$30.250,00	$187.479,88	$76.867,25	$42.672,21	$20.509,03	$106.410,34	$23.907,84	$1.203.469,94	-$690.744,19	$2.993,71	$0,33
Total South America - West Africa [Annual]		**$10.637.986,32**	**$10.515.925,37**	**$5.488.997,28**	**$1.573.000,00**	**$9.748.953,91**	**$3.997.097,17**	**$2.218.954,90**	**$1.066.469,55**	**$5.533.337,87**	**$1.243.207,42**	**$59.125.600,86**	**-$32.463.862,01**	**$2.828,43**	**$0,33**
Inter West Africa	Feeder 1 voyage chartered container vessel	$112.402,78	$18.902,62	$47.897,11	$30.250,00	$84.242,95	$60.324,18	$6.679,13	$7.097,16	$28.020,68	$9.634,50	$405.451,11	-$239.021,37	$2.502,78	$1,96
	Feeder 1 voyage owned container vessel	$0,00	$18.902,62	$47.897,11	$30.250,00	$84.242,95	$60.324,18	$6.679,13	$7.097,16	$28.020,68	$9.634,50	$355.817,90	-$189.388,15	$2.196,41	$1,72
	Total Feeder 1 [Annual]	**$2.316.913,13**	**$982.936,24**	**$2.490.649,82**	**$1.573.000,00**	**$4.380.633,39**	**$3.136.857,16**	**$347.314,68**	**$369.052,20**	**$1.457.075,58**	**$500.994,04**	**$18.958.230,15**	**-$10.303.883,46**	**$2.250,50**	**$1,80**
	Feeder 2 voyage chartered container vessel	$233.762,33	$26.339,98	$88.059,86	$30.250,00	$407.378,41	$251.853,31	$371,06	$21.283,02	$92.856,92	$34.315,47	$1.186.470,37	-$644.636,47	$2.056,27	$6,01
	Feeder 2 voyage owned container vessel	$0,00	$26.339,98	$88.059,86	$30.250,00	$407.378,41	$251.853,31	$371,06	$21.283,02	$92.856,92	$34.315,47	$1.186.909,49	-$645.075,58	$2.057,04	$6,01
	Total Feeder 2 [Annual]	**$5.327.006,81**	**$1.369.679,18**	**$4.579.112,72**	**$1.573.000,00**	**$21.183.677,42**	**$13.096.372,00**	**$19.295,26**	**$1.106.717,28**	**$4.828.559,73**	**$1.784.404,68**	**$60.188.149,91**	**-$32.012.786,71**	**$2.006,00**	**$6,01**
Total Inter West Africa [Annual]		**$7.643.919,94**	**$2.352.615,42**	**$7.069.762,54**	**$3.146.000,00**	**$25.564.310,80**	**$16.233.229,16**	**$366.609,94**	**$1.475.769,49**	**$6.285.635,31**	**$2.285.398,72**	**$79.146.380,05**	**-$42.316.670,17**	**$2.059,60**	**$4,43**
Grand Total [Annual]		**$86.409.179,18**	**$82.519.299,91**	**$49.456.607,46**	**$9.438.000,00**	**$103.641.542,74**	**$63.625.191,10**	**$15.428.038,78**	**$13.794.174,87**	**$63.612.235,63**	**$14.000.000,00**	**$573.043.102,52**	**-$218.493.639,30**	**$2.434,30**	**$0,73**

Figure 433: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 2, specifications container vessels

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	1.788	619	2.105	860	176	868
14 ton TEU capacity [14 ton TEU]	1.323	449	1.560	629	118	635
Amount of reefer plugs	252	102	293	133	45	134
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	186,4	130,8	194,8	143,0	87,4	143,3
B [m]	31,1	23,8	32,5	26,0	17,5	26,1
T [m]	8,9	7,0	9,3	7,6	5,1	7,7
D [m]	16,2	11,6	17,1	12,9	7,8	12,9
LBD [m³]	84.624,5	33.027,5	97.807,2	44.212,6	10.824,7	44.577,3
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	34.241	14.501	39.081	18.927	5.236	19.069
Displacement Volume [m³]	33.406	14.147	38.127	18.465	5.108	18.604
DWT [t]	26.353	10.584	30.325	14.043	3.589	14.155
Gross Tonnage [m³]	19.564	7.621	22.618	10.208	2.492	10.292
Wsm [t]	10.436	4.629	11.827	5.956	1.766	5.998
Wst [t]	7.347	3.150	8.369	4.096	1.154	4.126
Vs (design) [kn]	19,8	16,8	20,2	17,5	13,9	17,5
Vs (Max)	19,9	16,9	20,3	17,6	13,9	17,6
LCB [m]	-1,27	-1,82	-1,22	-1,66	-2,72	-1,66
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	7,9	6,5	8,1	6,8	5,1	6,8
Ta [m]	8,4	7,0	8,6	7,3	5,6	7,3
Tf [m]	7,4	6,0	7,6	6,3	4,6	6,3
Tav (in ballast) [m]	7,9	6,5	8,1	6,8	5,1	6,8
Pb (MCR) [kW]	17.200	6.200	19.700	8.300	1.900	8.300
Cad [-]	483	463	489	466	426	469
Fuel consumption design condition [t/h]	3,27	1,18	3,74	1,58	0,36	1,58
Generator power [kW]	1.841	964	2.145	1.145	632	1.151
Operational costs [$/day]	$3.021,52	$2.263,59	$3.215,62	$2.521,62	$1.663,48	$2.526,14
Average capital costs [$/day]	$7.875,16	$3.899,65	$8.744,74	$4.767,58	$1.881,30	$4.784,84
Average charter price [$/day]	$8.559,69	$6.955,59	$8.994,68	$7.286,29	$6.347,71	$7.297,27
Capacity fuel tanks [m³]	2.518	1.003	2.902	1.334	337	1.345
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	36.820	13.682	42.072	18.572	4.128	18.747
Displacement outbound [t]	27.262	13.310	31.046	16.187	5.284	16.282
Pb inbound [kW]	3.333	1.573	3.599	2.187	769	1.916
Pb outbound [kW]	2.728	1.545	2.939	1.996	906	1.744
Fuel consumption inbound [t/h]	0,633	0,299	0,684	0,416	0,146	0,364
Fuel consumption outbound [t/h]	0,518	0,293	0,558	0,379	0,172	0,331

U.1.3 Scenario 3

Figure 434: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	1.665	1.231	86.580	64.020	15	12	118,44	21.190	17	9	8	423	603	1.025	1.339	1.310	29	1.339	29	1.310	2.678	1.339	1.339	$2.055.419,26	$13.503,74	$2.068.922,99	$0,00
	FEWA voyage owned container vessel	1.665	1.231	86.580	64.020	15	12	118,44	21.190	17	9	8	423	603	1.025	1.339	1.310	29	1.339	29	1.310	2.678	1.339	1.339	$2.055.419,26	$13.503,74	$2.068.922,99	$1.237.881,54
	Total FEWA [Annual]	**1.665**	**1.231**	**86.580**	**64.020**	**15**	**12**	**118,44**	**1.101.880**	**17**	**9**	**8**	**21.992**	**31.330**	**53.322**	**69.628**	**68.120**	**1.508**	**69.628**	**1.508**	**68.120**	**139.256**	**69.628**	**69.628**	**$106.881.801,37**	**$702.194,28**	**$107.583.995,65**	**$25.029.684,25**
	SWAX voyage chartered container vessel	632	459	32.864	23.846	11	11	109,59	21.564	16	8	8	302	318	620	504	470	34	504	34	470	1.008	504	504	$841.945,37	$17.261,80	$859.207,17	$0,00
	SWAX voyage owned container vessel	632	459	32.864	23.846	11	11	109,59	21.564	16	8	8	302	318	620	504	470	34	504	34	470	1.008	504	504	$841.945,37	$17.261,80	$859.207,17	$682.027,80
	Total SWAX [Annual]	**632**	**459**	**32.864**	**23.846**	**11**	**11**	**109,59**	**1.121.328**	**16**	**8**	**8**	**15.691**	**16.539**	**32.230**	**26.208**	**24.440**	**1.768**	**26.208**	**1.768**	**24.440**	**52.416**	**26.208**	**26.208**	**$43.781.159,26**	**$897.613,38**	**$44.678.772,63**	**$11.773.079,14**
Total Asia - West Africa [Annual]				**119.444**	**87.866**				**2.223.208**		**17**	**16**	**37.683**	**47.869**	**85.552**	**95.836**	**92.560**	**3.276**	**95.836**	**3.276**	**92.560**	**191.672**	**95.836**	**95.836**	**$150.662.960,63**	**$1.599.807,65**	**$152.262.768,28**	**$36.802.763,39**
Europe - West Africa	WEWA voyage chartered container vessel	1.939	1.436	100.828	74.676	9	12	75,94	10.801	11	6	5	237	343	580	1.359	1.332	27	1.359	27	1.332	2.718	1.359	1.359	$2.346.756,25	$17.261,80	$2.364.018,05	$0,00
	WEWA voyage owned container vessel	1.939	1.436	100.828	74.676	9	12	75,94	10.801	11	6	5	237	343	580	1.359	1.332	27	1.359	27	1.332	2.718	1.359	1.359	$2.346.756,25	$17.261,80	$2.364.018,05	$866.209,67
Total Europe - West Africa [Annual]		**1.939**	**1.436**	**100.828**	**74.676**	**9**	**12**	**75,94**	**561.652**	**11**	**6**	**5**	**12.328**	**17.825**	**30.154**	**70.668**	**69.264**	**1.404**	**70.668**	**1.404**	**69.264**	**141.336**	**70.668**	**70.668**	**$122.031.325,14**	**$897.613,38**	**$122.928.938,51**	**$18.395.310,47**
South America - West Africa	ECSA voyage chartered container vessel	841	615	43.732	31.974	6	11	55,86	9.095	8	4	4	170	152	322	393	393	0	393	0	393	786	393	393	$501.557,96	$0,00	$501.557,96	$0,00
	ECSA voyage owned container vessel	841	615	43.732	31.974	6	11	55,86	9.095	8	4	4	170	152	322	393	393	0	393	0	393	786	393	393	$501.557,96	$0,00	$501.557,96	$403.110,35
Total South America - West Africa [Annual]		**841**	**615**	**43.732**	**31.974**	**6**	**11**	**55,86**	**472.940**	**8**	**4**	**4**	**8.817**	**7.925**	**16.742**	**20.436**	**20.436**	**0**	**20.436**	**0**	**20.436**	**40.872**	**20.436**	**20.436**	**$26.081.013,66**	**$0,00**	**$26.081.013,66**	**$7.018.704,26**
Inter West Africa	Feeder 1 voyage chartered container vessel	176	118	9.152	6.112	3	11	17,65	1.275	3	2	1	19	12	30	155	146	9	155	9	146	310	155	155	$159.383,14	$2.678,85	$162.061,99	$0,00
	Feeder 1 voyage owned container vessel	176	118	9.152	6.112	3	11	17,65	1.275	3	2	1	19	12	30	155	146	9	155	9	146	310	155	155	$159.383,14	$2.678,85	$162.061,99	$62.560,46
	Total Feeder 1 [Annual]	**176**	**118**	**9.152**	**6.112**	**3**	**11**	**17,65**	**66.300**	**3**	**2**	**1**	**983**	**598**	**1.581**	**8.060**	**7.592**	**468**	**8.060**	**468**	**7.592**	**16.120**	**8.060**	**8.060**	**$8.287.923,33**	**$139.300,11**	**$8.427.223,44**	**$1.402.705,79**
	Feeder 2 voyage chartered container vessel	848	620	44.096	32.247	5	11	31,75	342	5	3	2	36	6	42	564	564	0	564	0	564	1.128	564	564	$529.740,63	$0,00	$529.740,63	$0,00
	Feeder 2 voyage owned container vessel	848	620	44.096	32.247	5	11	31,75	342	5	3	2	36	6	42	564	564	0	564	0	564	1.128	564	564	$529.740,63	$0,00	$529.740,63	$229.760,85
	Total Feeder 2 [Annual]	**848**	**620**	**44.096**	**32.247**	**5**	**11**	**31,75**	**17.784**	**5**	**3**	**2**	**1.883**	**312**	**2.195**	**29.328**	**29.328**	**0**	**29.328**	**0**	**29.328**	**58.656**	**29.328**	**29.328**	**$27.546.512,74**	**$0,00**	**$27.546.512,74**	**$5.255.402,58**
Total Inter West Africa [Annual]				**53.248**	**38.359**				**84.084**	**8**	**5**	**3**	**2.865**	**910**	**3.776**	**37.388**	**36.920**	**468**	**37.388**	**468**	**36.920**	**74.776**	**37.388**	**37.388**	**$35.834.436,08**	**$139.300,11**	**$35.973.736,18**	**$6.658.108,37**
Grand Total [Annual]				**317.252**	**232.876**				**3.341.884**	**27**	**32**	**28**	**61.693**	**74.530**	**136.223**	**224.328**	**219.180**	**5.148**	**224.328**	**5.148**	**219.180**	**448.656**	**224.328**	**224.328**	**$334.609.735,50**	**$2.636.721,13**	**$337.246.456,64**	**$68.874.886,49**

Figure 435: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$993.778,24	$637.813,15	$292.620,53	$30.250,00	$499.158,99	$307.342,69	$146.197,43	$78.397,99	$378.918,80	$83.565,14	$3.448.042,96	-$1.379.119,97	$2.575,09	$0,12
	FEWA voyage owned container vessel	$0,00	$637.813,15	$292.620,53	$30.250,00	$499.158,99	$307.342,69	$146.197,43	$78.397,99	$378.918,80	$83.565,14	$3.692.146,26	-$1.623.223,26	$2.757,39	$0,13
	Total FEWA [Annual]	**$24.501.465,96**	**$33.166.283,68**	**$15.216.267,30**	**$1.573.000,00**	**$25.956.267,66**	**$15.981.819,70**	**$7.602.266,49**	**$4.076.695,73**	**$19.703.777,63**	**$4.345.387,11**	**$177.152.915,50**	**-$69.568.919,86**	**$2.544,28**	**$0,13**
	SWAX voyage chartered container vessel	$764.186,56	$385.522,13	$187.555,81	$30.250,00	$99.505,79	$132.461,02	$2.997,63	$31.703,15	$161.703,22	$31.453,94	$1.827.339,25	-$968.132,08	$3.625,67	$0,17
	SWAX voyage owned container vessel	$0,00	$385.522,13	$187.555,81	$30.250,00	$99.505,79	$132.461,02	$2.997,63	$31.703,15	$161.703,22	$31.453,94	$1.745.180,49	-$885.973,33	$3.462,66	$0,16
	Total SWAX [Annual]	**$20.362.416,77**	**$20.047.150,82**	**$9.752.902,02**	**$1.573.000,00**	**$5.174.300,88**	**$6.887.972,80**	**$155.876,83**	**$1.648.563,96**	**$8.408.567,52**	**$1.635.605,01**	**$87.419.435,75**	**-$42.740.663,11**	**$3.335,60**	**$0,16**
Total Asia - West Africa [Annual]		**$44.863.882,73**	**$53.213.434,50**	**$24.969.169,32**	**$3.146.000,00**	**$31.130.568,53**	**$22.869.792,50**	**$7.758.143,32**	**$5.725.259,69**	**$28.112.345,15**	**$5.980.992,12**	**$264.572.351,25**	**-$112.309.582,97**	**$2.760,68**	**$0,14**
Europe - West Africa	WEWA voyage chartered container vessel	$665.741,11	$360.682,36	$181.438,93	$30.250,00	$658.327,58	$359.603,09	$93.722,31	$94.482,39	$385.439,23	$84.813,31	$2.914.500,31	-$550.482,26	$2.144,59	$0,20
	WEWA voyage owned container vessel	$0,00	$360.682,36	$181.438,93	$30.250,00	$658.327,58	$359.603,09	$93.722,31	$94.482,39	$385.439,23	$84.813,31	$3.114.968,86	-$750.950,81	$2.292,10	$0,21
Total Europe - West Africa [Annual]		**$15.999.584,84**	**$18.755.482,82**	**$9.434.824,31**	**$1.573.000,00**	**$34.233.034,04**	**$18.699.360,45**	**$4.873.560,25**	**$4.913.084,16**	**$20.042.840,01**	**$4.410.292,07**	**$151.330.373,41**	**-$28.401.434,89**	**$2.141,43**	**$0,21**
South America - West Africa	ECSA voyage chartered container vessel	$405.525,49	$200.259,61	$105.286,43	$30.250,00	$183.459,51	$75.356,75	$41.559,02	$20.062,32	$104.075,07	$24.526,59	$1.190.360,78	-$688.802,82	$3.028,91	$0,33
	ECSA voyage owned container vessel	$0,00	$200.259,61	$105.286,43	$30.250,00	$183.459,51	$75.356,75	$41.559,02	$20.062,32	$104.075,07	$24.526,59	$1.187.945,64	-$686.387,69	$3.022,76	$0,33
Total South America - West Africa [Annual]		**$10.599.921,49**	**$10.413.499,46**	**$5.474.894,57**	**$1.573.000,00**	**$9.539.894,53**	**$3.918.550,96**	**$2.161.069,12**	**$1.043.240,55**	**$5.411.903,55**	**$1.275.382,48**	**$58.430.060,96**	**-$32.349.047,30**	**$2.859,17**	**$0,33**
Inter West Africa	Feeder 1 voyage chartered container vessel	$112.028,33	$18.909,96	$47.897,11	$30.250,00	$81.827,32	$58.703,28	$5.194,88	$6.921,65	$26.937,41	$9.673,34	$398.343,28	-$236.281,29	$2.569,96	$2,02
	Feeder 1 voyage owned container vessel	$0,00	$18.909,96	$47.897,11	$30.250,00	$81.827,32	$58.703,28	$5.194,88	$6.921,65	$26.937,41	$9.673,34	$348.875,41	-$186.813,42	$2.250,81	$1,77
	Total Feeder 1 [Annual]	**$2.316.913,13**	**$983.317,67**	**$2.490.649,82**	**$1.573.000,00**	**$4.255.020,61**	**$3.052.570,65**	**$270.133,64**	**$359.925,92**	**$1.400.745,58**	**$503.013,44**	**$18.607.996,26**	**-$10.180.772,82**	**$2.308,68**	**$1,85**
	Feeder 2 voyage chartered container vessel	$230.829,76	$26.251,75	$87.821,96	$30.250,00	$397.986,28	$246.224,91	$371,06	$20.794,07	$91.417,53	$35.198,46	$1.167.145,78	-$637.405,15	$2.069,41	$6,05
	Feeder 2 voyage owned container vessel	$0,00	$26.251,75	$87.821,96	$30.250,00	$397.986,28	$246.224,91	$371,06	$20.794,07	$91.417,53	$35.198,46	$1.166.076,87	-$636.336,24	$2.067,51	$6,05
	Total Feeder 2 [Annual]	**$5.306.972,69**	**$1.365.091,13**	**$4.566.741,92**	**$1.573.000,00**	**$20.695.286,30**	**$12.803.695,36**	**$19.295,26**	**$1.081.291,67**	**$4.753.711,50**	**$1.830.319,89**	**$59.250.808,30**	**-$31.704.295,55**	**$2.020,28**	**$6,05**
Total Inter West Africa [Annual]		**$7.623.885,82**	**$2.348.408,80**	**$7.057.391,74**	**$3.146.000,00**	**$24.950.306,91**	**$15.856.266,01**	**$289.428,90**	**$1.441.217,59**	**$6.154.457,08**	**$2.333.333,33**	**$77.858.804,55**	**-$41.885.068,37**	**$2.082,45**	**$4,47**
Grand Total [Annual]		**$79.087.274,87**	**$84.730.825,59**	**$46.936.279,94**	**$9.438.000,00**	**$99.853.804,01**	**$61.343.969,92**	**$15.082.201,59**	**$13.122.801,99**	**$59.721.545,78**	**$14.000.000,00**	**$552.191.590,17**	**-$214.945.133,53**	**$2.461,54**	**$0,76**

Figure 436: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 3, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	1.665	632	1.939	841	176	848
14 ton TEU capacity [14 ton TEU]	1.231	459	1.436	615	118	620
Amount of reefer plugs	237	103	272	130	45	131
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	182,8	131,6	190,5	142,1	87,4	142,4
B [m]	30,5	23,9	31,8	25,8	17,5	25,9
T [m]	8,7	7,0	9,1	7,6	5,1	7,6
D [m]	15,8	11,7	16,6	12,8	7,8	12,8
LBD [m³]	79.440,3	33.642,0	90.934,3	43.345,1	10.824,7	43.665,0
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	32.320	14.747	36.565	18.587	5.236	18.712
Displacement Volume [m³]	31.532	14.387	35.673	18.134	5.108	18.256
DWT [t]	24.786	10.775	28.256	13.776	3.589	13.875
Gross Tonnage [m³]	18.363	7.763	21.026	10.007	2.492	10.081
Wsm [t]	9.881	4.703	11.105	5.855	1.766	5.892
Wst [t]	6.941	3.203	7.838	4.024	1.154	4.050
Vs (design) [kn]	19,6	16,8	20,0	17,5	13,9	17,5
Vs (Max)	19,7	16,9	20,1	17,6	13,9	17,6
LCB [m]	-1,30	-1,81	-1,25	-1,67	-2,72	-1,67
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	7,8	6,5	8,0	6,8	5,1	6,8
Ta [m]	8,3	7,0	8,5	7,3	5,6	7,3
Tf [m]	7,3	6,0	7,5	6,3	4,6	6,3
Tav (in ballast) [m]	7,8	6,5	8,0	6,8	5,1	6,8
Pb (MCR) [kW]	16.100	6.300	18.400	8.200	1.900	8.200
Cad [-]	482	461	486	467	426	469
Fuel consumption design condition [t/h]	3,06	1,20	3,50	1,56	0,36	1,56
Generator power [kW]	1.749	974	1.954	1.131	632	1.136
Operational costs [$/day]	$2.938,54	$2.277,30	$3.115,12	$2.505,50	$1.663,48	$2.509,47
Average capital costs [$/day]	$7.513,44	$3.946,41	$8.291,67	$4.711,48	$1.881,30	$4.726,69
Average charter price [$/day]	$8.390,91	$6.973,43	$8.766,90	$7.260,22	$6.347,71	$7.269,83
Capacity fuel tanks [m³]	2.367	1.021	2.702	1.309	337	1.318
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	34.301	13.948	39.606	18.148	4.183	18.269
Displacement outbound [ton]	25.794	13.466	29.065	15.960	5.284	16.044
Pb inbound [kW]	2.789	1.601	3.950	2.153	776	1.885
Pb outbound [kW]	2.307	1.564	3.214	1.977	906	1.728
Fuel consumption inbound [ton/h]	0,530	0,304	0,751	0,409	0,147	0,358
Fuel consumption outbound [ton/h]	0,438	0,297	0,611	0,376	0,172	0,328

U.1.4 Scenario 4

Figure 437: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.009	1.488	104.468	77.399	6	11	126,92	25.415	19	10	9	529	668	1.197	1.523	1.479	44	1.523	44	1.479	3.046	1.523	1.523	$1.980.639,52	$18.739,88	$1.999.379,39	$0,00
	SWAX 2 voyage owned container vessel	2.009	1.488	104.468	77.399	6	11	126,92	25.415	19	10	9	529	668	1.197	1.523	1.479	44	1.523	44	1.479	3.046	1.523	1.523	$1.980.639,52	$18.739,88	$1.999.379,39	$1.478.341,22
Total Asia - West Africa [Annual]		**2.009**	**1.488**	**104.468**	**77.399**	**6**	**11**	**126,92**	**1.321.580**	**19**	**10**	**9**	**27.507**	**34.727**	**62.233**	**79.196**	**76.908**	**2.288**	**79.196**	**2.288**	**76.908**	**158.392**	**79.196**	**79.196**	**$102.993.254,83**	**$974.473,69**	**$103.967.728,52**	**$31.383.228,59**
Europe - West Africa	WEWA voyage chartered container vessel	1.920	1.422	99.840	73.938	9	11	76,83	10.801	11	6	5	218	314	532	1.321	1.294	27	1.321	27	1.294	2.642	1.321	1.321	$2.321.364,49	$14.819,12	$2.336.183,61	$0,00
	WEWA voyage owned container vessel	1.920	1.422	99.840	73.938	9	11	76,83	10.801	11	6	5	218	314	532	1.321	1.294	27	1.321	27	1.294	2.642	1.321	1.321	$2.321.364,49	$14.819,12	$2.336.183,61	$872.131,81
Total Europe - West Africa [Annual]		**1.920**	**1.422**	**99.840**	**73.938**	**9**	**11**	**76,83**	**561.652**	**11**	**6**	**5**	**11.334**	**16.347**	**27.681**	**68.692**	**67.288**	**1.404**	**68.692**	**1.404**	**67.288**	**137.384**	**68.692**	**68.692**	**$120.710.953,62**	**$770.594,36**	**$121.481.547,98**	**$18.297.960,30**
South America - West Africa	ECSA voyage chartered container vessel	841	615	43.732	31.974	6	11	55,99	9.095	8	4	4	170	152	322	393	393	0	393	0	393	786	393	393	$501.557,96	$0,00	$501.557,96	$0,00
	ECSA voyage owned container vessel	841	615	43.732	31.974	6	11	55,99	9.095	8	4	4	170	152	322	393	393	0	393	0	393	786	393	393	$501.557,96	$0,00	$501.557,96	$404.048,08
Total South America - West Africa [Annual]		**841**	**615**	**43.732**	**31.974**	**6**	**11**	**55,99**	**472.940**	**8**	**4**	**4**	**8.817**	**7.925**	**16.742**	**20.436**	**20.436**	**0**	**20.436**	**0**	**20.436**	**40.872**	**20.436**	**20.436**	**$26.081.013,66**	**$0,00**	**$26.081.013,66**	**$7.019.029,81**
Inter West Africa	Feeder 3 voyage chartered container vessel	168	112	8.736	5.801	4	11	17,37	453	3	2	1	16	7	23	117	111	6	117	6	111	234	117	117	$101.388,36	$1.732,95	$103.121,30	$0,00
	Feeder 3 voyage owned container vessel	168	112	8.736	5.801	4	11	17,37	453	3	2	1	16	7	23	117	111	6	117	6	111	234	117	117	$124.363,84	$1.732,95	$126.096,78	$60.462,29
	Total Feeder 3 [Annual]	**168**	**112**	**8.736**	**5.801**	**4**	**11**	**17,37**	**23.556**	**3**	**2**	**1**	**822**	**372**	**1.193**	**6.084**	**5.772**	**312**	**6.084**	**312**	**5.772**	**12.168**	**6.084**	**6.084**	**$5.869.556,99**	**$90.113,23**	**$5.959.670,22**	**$1.365.992,11**
	Feeder 4 voyage chartered container vessel	236	162	12.272	8.445	4	11	24,74	1.933	4	2	2	32	17	49	226	211	15	226	15	211	452	226	226	$310.742,51	$4.332,37	$315.074,87	$0,00
	Feeder 4 voyage owned container vessel	236	162	12.272	8.445	4	11	24,74	1.933	4	2	2	32	17	49	226	211	15	226	15	211	452	226	226	$310.742,51	$4.332,37	$315.074,87	$99.745,22
	Total Feeder 4 [Annual]	**236**	**162**	**12.272**	**8.445**	**4**	**11**	**24,74**	**100.516**	**4**	**2**	**2**	**1.644**	**896**	**2.540**	**11.752**	**10.972**	**780**	**11.752**	**780**	**10.972**	**23.504**	**11.752**	**11.752**	**$16.158.610,34**	**$225.283,08**	**$16.383.893,42**	**$1.689.959,09**
	Feeder 5 voyage chartered container vessel	837	612	43.524	31.819	5	11	35,44	611	6	3	3	41	10	51	556	556	0	556	0	556	1.112	556	556	$524.248,85	$0,00	$524.248,85	$0,00
	Feeder 5 voyage owned container vessel	837	612	43.524	31.819	5	11	35,44	611	6	3	3	41	10	51	556	556	0	556	0	556	1.112	556	556	$524.248,85	$0,00	$524.248,85	$253.968,17
	Total Feeder 5 [Annual]	**837**	**612**	**43.524**	**31.819**	**5**	**11**	**35,44**	**31.772**	**6**	**3**	**3**	**2.122**	**507**	**2.630**	**28.912**	**28.912**	**0**	**28.912**	**0**	**28.912**	**57.824**	**28.912**	**28.912**	**$27.260.940,20**	**$0,00**	**$27.260.940,20**	**$5.205.106,25**
	Feeder 6 voyage chartered container vessel	843	616	43.836	32.052	5	11	44,26	4.873	7	4	3	82	67	149	709	703	6	709	6	703	1.418	709	709	$740.106,76	$1.653,52	$741.760,28	$0,00
	Feeder 6 voyage owned container vessel	843	616	43.836	32.052	5	11	44,26	4.873	7	4	3	82	67	149	709	703	6	709	6	703	1.418	709	709	$740.106,76	$1.653,52	$741.760,28	$319.675,41
	Total feeder 6 [Annual]	**843**	**616**	**43.836**	**32.052**	**5**	**11**	**44,26**	**253.396**	**7**	**4**	**3**	**4.244**	**3.505**	**7.750**	**36.868**	**36.556**	**312**	**36.868**	**312**	**36.556**	**73.736**	**36.868**	**36.868**	**$38.485.551,56**	**$85.982,97**	**$38.571.534,54**	**$6.996.054,68**
Total Inter West Africa [Annual]				**108.368**	**78.117**				**409.240**	**20**	**11**	**9**	**8.832**	**5.280**	**14.113**	**83.616**	**82.212**	**1.404**	**83.616**	**1.404**	**82.212**	**167.232**	**83.616**	**83.616**	**$87.774.659,10**	**$401.379,28**	**$88.176.038,38**	**$15.257.112,14**
Grand Total [Annual]				**356.408**	**261.428**				**2.765.412**	**58**	**31**	**27**	**56.490**	**64.279**	**120.769**	**251.940**	**246.844**	**5.096**	**251.940**	**5.096**	**246.844**	**503.880**	**251.940**	**251.940**	**$337.559.881,20**	**$2.146.447,33**	**$339.706.328,53**	**$71.957.330,84**

Figure 438: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$1.124.866,99	$744.405,53	$121.958,47	$30.250,00	$379.366,01	$239.529,98	$177.246,32	$70.894,08	$343.058,57	$84.631,26	$3.316.207,19	-$1.316.827,80	$2.177,42	$0,09
	SWAX 2 voyage owned container vessel	$0,00	$744.405,53	$121.958,47	$30.250,00	$379.366,01	$239.529,98	$177.246,32	$70.894,08	$343.058,57	$84.631,26	$3.669.681,43	-$1.670.302,04	$2.409,51	$0,09
Total Asia - West Africa [Annual]		**$29.114.790,09**	**$38.709.087,48**	**$6.341.840,23**	**$1.573.000,00**	**$19.727.032,62**	**$12.455.558,90**	**$9.216.808,53**	**$3.686.491,95**	**$17.839.045,48**	**$4.400.825,59**	**$174.447.709,47**	**-$70.479.980,95**	**$2.202,73**	**$0,09**
Europe - West Africa	WEWA voyage chartered container vessel	$671.533,63	$331.104,62	$181.032,12	$30.250,00	$616.800,31	$340.241,40	$61.140,29	$93.637,84	$391.474,67	$73.406,37	$2.790.621,26	-$454.437,65	$2.112,51	$0,20
	WEWA voyage owned container vessel	$0,00	$331.104,62	$181.032,12	$30.250,00	$616.800,31	$340.241,40	$61.140,29	$93.637,84	$391.474,67	$73.406,37	$2.991.219,44	-$655.035,83	$2.264,36	$0,21
Total Europe - West Africa [Annual]		**$15.952.003,80**	**$17.217.440,34**	**$9.413.670,24**	**$1.573.000,00**	**$32.073.616,37**	**$17.692.552,92**	**$3.179.295,29**	**$4.869.167,79**	**$20.356.682,95**	**$3.817.131,06**	**$144.442.521,06**	**-$22.960.973,09**	**$2.102,76**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$406.468,83	$200.259,61	$105.286,43	$30.250,00	$176.692,82	$77.753,68	$22.022,44	$20.062,32	$106.376,40	$21.838,53	$1.167.011,06	-$665.453,10	$2.969,49	$0,33
	ECSA voyage owned container vessel	$0,00	$200.259,61	$105.286,43	$30.250,00	$176.692,82	$77.753,68	$22.022,44	$20.062,32	$106.376,40	$21.838,53	$1.164.590,30	-$663.032,35	$2.963,33	$0,33
Total South America - West Africa [Annual]		**$10.599.921,49**	**$10.413.499,46**	**$5.474.894,57**	**$1.573.000,00**	**$9.188.026,77**	**$4.043.191,31**	**$1.145.166,82**	**$1.043.240,55**	**$5.531.572,63**	**$1.135.603,72**	**$57.167.147,12**	**-$31.086.133,46**	**$2.797,37**	**$0,33**
Inter West Africa	Feeder 3 voyage chartered container vessel	$110.092,97	$14.275,76	$63.786,69	$30.250,00	$13.445,33	$7.320,73	$25.110,68	$3.995,60	$10.939,14	$6.501,55	$285.718,44	-$182.597,14	$2.442,04	$5,39
	Feeder 3 voyage owned container vessel	$0,00	$14.275,76	$63.786,69	$30.250,00	$13.445,33	$7.320,73	$25.110,68	$3.995,60	$10.939,14	$6.501,55	$236.087,77	-$109.990,99	$2.017,84	$4,45
	Total Feeder 3 [Annual]	**$2.312.906,30**	**$742.339,57**	**$3.316.907,78**	**$1.573.000,00**	**$699.156,99**	**$380.677,82**	**$1.305.755,53**	**$207.771,36**	**$568.835,33**	**$338.080,50**	**$12.811.423,29**	**-$6.851.753,07**	**$2.105,76**	**$4,77**
	Feeder 4 voyage chartered container vessel	$159.077,46	$30.379,12	$64.433,78	$30.250,00	$59.234,01	$33.349,19	$55.475,68	$13.006,42	$25.316,89	$12.558,55	$483.081,09	-$168.006,22	$2.137,53	$1,11
	Feeder 4 voyage owned container vessel	$0,00	$30.379,12	$64.433,78	$30.250,00	$59.234,01	$33.349,19	$55.475,68	$13.006,42	$25.316,89	$12.558,55	$423.748,85	-$108.673,97	$1.874,99	$0,97
	Total Feeder 4 [Annual]	**$4.693.928,62**	**$1.579.714,20**	**$3.350.556,35**	**$1.573.000,00**	**$3.080.168,28**	**$1.734.157,76**	**$2.884.735,35**	**$676.334,06**	**$1.316.478,50**	**$653.044,38**	**$23.232.076,58**	**-$6.848.183,16**	**$1.976,86**	**$1,04**
	Feeder 5 voyage chartered container vessel	$257.137,90	$31.458,02	$87.691,12	$30.250,00	$80.307,45	$50.503,09	$146.465,66	$20.634,73	$56.140,95	$30.896,25	$791.485,17	-$267.236,32	$1.423,53	$2,33
	Feeder 5 voyage owned container vessel	$0,00	$31.458,02	$87.691,12	$30.250,00	$80.307,45	$50.503,09	$146.465,66	$20.634,73	$56.140,95	$30.896,25	$788.315,44	-$264.066,59	$1.417,83	$2,32
	Total Feeder 5 [Annual]	**$7.943.930,88**	**$1.635.816,99**	**$4.559.937,98**	**$1.573.000,00**	**$4.175.987,57**	**$2.626.160,72**	**$7.616.214,16**	**$1.073.006,12**	**$2.919.329,49**	**$1.606.604,75**	**$40.935.094,92**	**-$13.674.154,72**	**$1.415,85**	**$2,33**
	Feeder 6 voyage chartered container vessel	$321.467,93	$92.696,98	$87.762,49	$30.250,00	$132.619,04	$87.786,63	$151.120,33	$31.919,44	$94.171,04	$39.398,27	$1.069.192,15	-$327.431,87	$1.508,03	$0,31
	Feeder 6 voyage owned container vessel	$0,00	$92.696,98	$87.762,49	$30.250,00	$132.619,04	$87.786,63	$151.120,33	$31.919,44	$94.171,04	$39.398,27	$1.067.399,63	-$325.639,35	$1.505,50	$0,31
	Total feeder 6 [Annual]	**$7.952.946,24**	**$4.820.243,18**	**$4.563.649,22**	**$1.573.000,00**	**$6.896.189,99**	**$4.564.905,00**	**$7.858.257,28**	**$1.659.810,75**	**$4.896.893,97**	**$2.048.710,01**	**$53.830.660,32**	**-$15.259.125,78**	**$1.460,09**	**$0,31**
Total Inter West Africa [Annual]		**$22.903.712,04**	**$8.778.113,94**	**$15.791.051,33**	**$6.292.000,00**	**$14.851.502,83**	**$9.305.901,30**	**$19.664.962,32**	**$3.616.922,28**	**$9.701.537,30**	**$4.646.439,63**	**$130.809.255,11**	**-$42.633.216,73**	**$1.564,40**	**$1,73**
Grand Total [Annual]		**$78.570.427,43**	**$75.118.141,23**	**$37.021.456,37**	**$11.011.000,00**	**$75.840.178,59**	**$43.497.204,43**	**$33.206.232,96**	**$13.215.822,57**	**$53.428.838,35**	**$14.000.000,00**	**$506.866.632,76**	**-$167.160.304,23**	**$2.011,85**	**$0,71**

Figure 439: Results sensitivity analysis: 20% decrease in the TEUs in the trip matrix scenario 4, specifications container vessels

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.009	1.920	841	168	236	837	843
14 ton TEU capacity [14 ton TEU]	1.488	1.422	615	112	162	612	616
Amount of reefer plugs	281	269	130	44	52	130	131
Amount of ship cranes	3	3	2	2	2	2	2
Lpp [m]	192,3	190,0	142,1	86,3	100,8	141,9	142,2
B [m]	32,1	31,7	25,8	17,3	18,3	25,8	25,9
T [m]	9,2	9,0	7,6	5,1	5,4	7,6	7,6
D [m]	16,8	16,6	12,8	7,7	8,6	12,8	12,8
LBD [m³]	93.840,3	90.143,5	43.345,1	10.387,1	14.041,7	43.162,2	43.436,6
B/T [-]	3,5	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	37.631	36.274	18.587	5.042	6.640	18.515	18.623
Displacement Volume [m³]	36.713	35.390	18.134	4.919	6.478	18.064	18.169
DWT [t]	29.131	28.018	13.776	3.448	4.619	13.720	13.804
Gross Tonnage [m³]	21.699	20.843	10.007	2.391	3.235	9.965	10.029
Wsm [t]	11.411	11.021	5.855	1.704	2.211	5.833	5.865
Wst [t]	8.063	7.777	4.024	1.112	1.459	4.008	4.031
Vs (design) [kn]	20,1	20,0	17,5	13,8	14,9	17,4	17,5
Vs (Max)	20,2	20,1	17,6	13,8	14,9	17,5	17,6
LCB [m]	-1,24	-1,25	-1,67	-2,75	-2,36	-1,67	-1,67
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	8,0	6,8	5,0	5,5	6,8	6,8
Ta [m]	8,6	8,5	7,3	5,5	6,0	7,3	7,3
Tf [m]	7,6	7,5	6,3	4,5	5,0	6,3	6,3
Tav (in ballast) [m]	8,1	8,0	6,8	5,0	5,5	6,8	6,8
Pb (MCR) [kW]	19.000	18.300	8.200	1.800	2.700	8.000	8.200
Cad [-]	487	486	467	429	433	469	467
Fuel consumption design condition [t/h]	3,61	3,48	1,56	0,34	0,51	1,52	1,56
Generator power [kW]	2.012	1.940	1.131	626	677	1.128	1.132
Operational costs [$/day]	$3.159,74	$3.105,57	$2.505,50	$1.648,09	$1.776,99	$2.492,46	$2.506,64
Average capital costs [$/day]	$8.488,27	$8.246,29	$4.711,48	$1.832,00	$2.254,79	$4.672,84	$4.715,83
Average charter price [$/day]	$8.862,95	$8.740,82	$7.260,22	$6.336,73	$6.430,04	$7.254,73	$7.262,96
Capacity fuel tanks [m³]	2.786	2.679	1.309	323	434	1.303	1.311
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	41.093	39.242	18.148	4.006	5.135	18.139	15.108
Displacement outbound [t]	29.900	28.838	15.960	5.121	6.508	15.912	15.984
Pb inbound [kW]	3.112	3.925	2.153	748	875	1.875	1.666
Pb outbound [kW]	2.518	3.197	1.977	881	1.025	1.718	1.729
Fuel consumption inbound [t/h]	0,591	0,746	0,409	0,142	0,166	0,356	0,316
Fuel consumption outbound [t/h]	0,478	0,607	0,376	0,167	0,195	0,326	0,329

U.2 20 % increase in the TEUs in the trip matrix

U.2.1 Scenario 1

Figure 440: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.487	1.846	129.324	95.989	15	12	124,03	21.190	18	9	9	522	723	1.245	1.977	1.977	0	1.977	0	1.977	3.954	1.977	1.977	$3.115.309,39	$0,00	$3.115.309,39	$0,00
	FEWA voyage owned container vessel	2.487	1.846	129.324	95.989	15	12	124,03	21.190	18	9	9	522	723	1.245	1.977	1.977	0	1.977	0	1.977	3.954	1.977	1.977	$3.115.309,39	$0,00	$3.115.309,39	$1.637.912,41
	Total FEWA [Annual]	**2.487**	**1.846**	**129.324**	**95.989**	**15**	**12**	**124,03**	**1.101.880**	**18**	**9**	**9**	**27.150**	**37.614**	**64.764**	**102.804**	**102.804**	**0**	**102.804**	**0**	**102.804**	**205.608**	**102.804**	**102.804**	**$161.996.088,52**	**$0,00**	**$161.996.088,52**	**$32.503.911,81**
	SWAX voyage chartered container vessel	904	662	47.008	34.424	11	11	111,51	21.564	16	8	8	355	356	711	711	709	2	711	2	709	1.422	711	711	$1.274.260,15	$1.002,20	$1.275.262,35	$0,00
	SWAX voyage owned container vessel	904	662	47.008	34.424	11	11	111,51	21.564	16	8	8	355	356	711	711	709	2	711	2	709	1.422	711	711	$1.274.260,15	$1.002,20	$1.275.262,35	$832.810,52
	Total SWAX [Annual]	**904**	**662**	**47.008**	**34.424**	**11**	**11**	**111,51**	**1.121.328**	**16**	**8**	**8**	**18.439**	**18.533**	**36.972**	**36.972**	**36.868**	**104**	**36.972**	**104**	**36.868**	**73.944**	**36.972**	**36.972**	**$66.261.527,82**	**$52.114,15**	**$66.313.641,97**	**$14.612.552,09**
Total Asia - West Africa [Annual]				**176.332**	**130.413**				**2.223.208**	**34**	**17**	**17**	**45.589**	**56.148**	**101.736**	**139.776**	**139.672**	**104**	**139.776**	**104**	**139.672**	**279.552**	**139.776**	**139.776**	**$228.257.616,34**	**$52.114,15**	**$228.309.730,48**	**$47.116.463,89**
Europe - West Africa	WEWA voyage chartered container vessel	3.036	2.257	157.872	117.340	9	12	82,23	10.801	12	6	6	296	423	719	2.134	2.040	94	2.134	94	2.040	4.268	2.134	2.134	$3.601.820,32	$52.339,88	$3.654.160,20	$0,00
	WEWA voyage owned container vessel	3.036	2.257	157.872	117.340	9	12	82,23	10.801	12	6	6	296	423	719	2.134	2.040	94	2.134	94	2.040	4.268	2.134	2.134	$3.601.820,32	$52.339,88	$3.654.160,20	$1.227.078,34
Total Europe - West Africa [Annual]		**3.036**	**2.257**	**157.872**	**117.340**	**9**	**12**	**82,23**	**561.652**	**12**	**6**	**6**	**15.415**	**21.987**	**37.403**	**110.968**	**106.080**	**4.888**	**110.968**	**4.888**	**106.080**	**221.936**	**110.968**	**110.968**	**$187.294.656,45**	**$2.721.673,70**	**$190.016.330,15**	**$24.783.753,30**
South America - West Africa	ECSA voyage chartered container vessel	1.264	931	65.728	48.425	6	12	55,71	9.095	8	4	4	220	189	409	595	595	0	595	0	595	1.190	595	595	$762.139,77	$0,00	$762.139,77	$0,00
	ECSA voyage owned container vessel	1.264	931	65.728	48.425	6	12	55,71	9.095	8	4	4	220	189	409	595	595	0	595	0	595	1.190	595	595	$762.139,77	$0,00	$762.139,77	$511.652,62
Total South America - West Africa [Annual]		**1.264**	**931**	**65.728**	**48.425**	**6**	**12**	**55,71**	**472.940**	**8**	**4**	**4**	**11.423**	**9.844**	**21.267**	**30.940**	**30.940**	**0**	**30.940**	**0**	**30.940**	**61.880**	**30.940**	**30.940**	**$39.631.268,16**	**$0,00**	**$39.631.268,16**	**$9.271.901,60**
Inter West Africa	Feeder 1 voyage chartered container vessel	241	166	12.532	8.640	3	11	18,30	1.275	3	2	1	20	13	33	230	210	20	230	20	210	460	230	230	$229.959,15	$6.306,01	$236.265,16	$0,00
	Feeder 1 voyage owned container vessel	241	166	12.532	8.640	3	11	18,30	1.275	3	2	1	20	13	33	230	210	20	230	20	210	460	230	230	$229.959,15	$6.306,01	$236.265,16	$74.139,65
	Total Feeder 1 [Annual]	**241**	**166**	**12.532**	**8.640**	**3**	**11**	**18,30**	**66.300**	**3**	**2**	**1**	**1.059**	**671**	**1.730**	**11.960**	**10.920**	**1.040**	**11.960**	**1.040**	**10.920**	**23.920**	**11.960**	**11.960**	**$11.957.875,86**	**$327.912,49**	**$12.285.788,36**	**$1.690.712,68**
	Feeder 2 voyage chartered container vessel	1.272	937	66.144	48.736	5	11	37,53	342	6	3	3	38	7	45	849	849	0	849	0	849	1.698	849	849	$796.594,95	$0,00	$796.594,95	$0,00
	Feeder 2 voyage owned container vessel	1.272	937	66.144	48.736	5	11	37,53	342	6	3	3	38	7	45	849	849	0	849	0	849	1.698	849	849	$796.594,95	$0,00	$796.594,95	$345.417,08
	Total Feeder 2 [Annual]	**1.272**	**937**	**66.144**	**48.736**	**5**	**11**	**37,53**	**17.784**	**6**	**3**	**3**	**1.979**	**347**	**2.326**	**44.148**	**44.148**	**0**	**44.148**	**0**	**44.148**	**88.296**	**44.148**	**44.148**	**$41.422.937,65**	**$0,00**	**$41.422.937,65**	**$6.958.456,75**
Total Inter West Africa [Annual]				**78.676**	**57.376**				**84.084**	**9**	**5**	**4**	**3.038**	**1.018**	**4.056**	**56.108**	**55.068**	**1.040**	**56.108**	**1.040**	**55.068**	**112.216**	**56.108**	**56.108**	**$53.380.813,52**	**$327.912,49**	**$53.708.726,01**	**$8.649.169,42**
Grand Total [Annual]				**478.608**	**353.554**				**3.341.884**	**63**	**32**	**31**	**75.465**	**88.997**	**164.462**	**337.792**	**331.760**	**6.032**	**337.792**	**6.032**	**331.760**	**675.584**	**337.792**	**337.792**	**$508.564.354,47**	**$3.101.700,34**	**$511.666.054,81**	**$89.821.288,22**

Figure 441: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.180.653,21	$774.675,21	$321.953,60	$30.250,00	$743.868,99	$452.880,74	$216.641,67	$118.003,73	$582.596,34	$81.938,00	$4.503.461,48	-$1.388.152,09	$2.277,93	$0,11
	FEWA voyage owned container vessel	$0,00	$774.675,21	$321.953,60	$30.250,00	$743.868,99	$452.880,74	$216.641,67	$118.003,73	$582.596,34	$81.938,00	$4.960.720,68	-$1.845.411,28	$2.509,22	$0,12
	Total FEWA [Annual]	**$31.269.459,70**	**$40.283.110,70**	**$16.741.586,94**	**$1.573.000,00**	**$38.681.187,43**	**$23.549.798,25**	**$11.265.366,95**	**$6.136.193,97**	**$30.295.009,76**	**$4.260.775,86**	**$236.559.401,37**	**-$74.563.312,85**	**$2.301,07**	**$0,11**
	SWAX voyage chartered container vessel	$819.197,69	$442.245,20	$194.673,78	$30.250,00	$141.159,84	$189.961,21	$2.141,43	$46.978,94	$237.025,55	$29.467,84	$2.133.101,46	-$857.839,11	$3.000,14	$0,14
	SWAX voyage owned container vessel	$0,00	$442.245,20	$194.673,78	$30.250,00	$141.159,84	$189.961,21	$2.141,43	$46.978,94	$237.025,55	$29.467,84	$2.146.714,30	-$871.451,95	$3.019,29	$0,14
	Total SWAX [Annual]	**$21.452.272,90**	**$22.996.750,52**	**$10.123.036,35**	**$1.573.000,00**	**$7.340.311,47**	**$9.877.982,73**	**$111.354,38**	**$2.442.904,70**	**$12.325.328,47**	**$1.532.327,59**	**$104.387.821,21**	**-$38.074.179,24**	**$2.823,43**	**$0,14**
Total Asia - West Africa [Annual]		**$52.721.732,60**	**$63.279.861,22**	**$26.864.623,29**	**$3.146.000,00**	**$46.021.498,90**	**$33.427.780,99**	**$11.376.721,33**	**$8.579.098,67**	**$42.620.338,23**	**$5.793.103,45**	**$340.947.222,57**	**-$112.637.492,09**	**$2.439,24**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$844.631,92	$447.391,99	$204.926,80	$60.500,00	$1.027.674,02	$566.555,40	$142.331,53	$146.185,78	$635.916,30	$88.444,96	$4.164.558,67	-$510.398,48	$1.951,53	$0,18
	WEWA voyage owned container vessel	$0,00	$447.391,99	$204.926,80	$60.500,00	$1.027.674,02	$566.555,40	$142.331,53	$146.185,78	$635.916,30	$88.444,96	$4.547.005,10	-$892.844,90	$2.130,74	$0,20
Total Europe - West Africa [Annual]		**$22.496.116,25**	**$23.264.383,23**	**$10.656.193,39**	**$3.146.000,00**	**$53.439.048,80**	**$29.460.880,60**	**$7.401.239,30**	**$7.601.660,58**	**$33.067.647,49**	**$4.599.137,93**	**$219.916.060,88**	**-$29.899.730,72**	**$1.981,80**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$436.809,76	$254.389,01	$111.324,34	$30.250,00	$279.463,50	$114.135,30	$61.596,41	$30.485,59	$161.672,05	$24.660,15	$1.504.786,10	-$742.646,33	$2.529,05	$0,28
	ECSA voyage owned container vessel	$0,00	$254.389,01	$111.324,34	$30.250,00	$279.463,50	$114.135,30	$61.596,41	$30.485,59	$161.672,05	$24.660,15	$1.579.628,96	-$817.489,19	$2.654,84	$0,29
Total South America - West Africa [Annual]		**$11.447.364,77**	**$13.228.228,49**	**$5.788.865,47**	**$1.573.000,00**	**$14.532.102,20**	**$5.935.035,84**	**$3.203.013,15**	**$1.585.250,73**	**$8.406.946,47**	**$1.282.327,59**	**$76.254.036,30**	**-$36.622.768,13**	**$2.464,58**	**$0,28**
Inter West Africa	Feeder 1 voyage chartered container vessel	$117.770,47	$20.697,85	$48.361,02	$30.250,00	$119.376,68	$85.744,97	$9.647,63	$10.073,66	$40.952,65	$9.532,49	$492.407,42	-$256.142,26	$2.140,90	$1,68
	Feeder 1 voyage owned container vessel	$0,00	$20.697,85	$48.361,02	$30.250,00	$119.376,68	$85.744,97	$9.647,63	$10.073,66	$40.952,65	$9.532,49	$448.776,60	-$212.511,44	$1.951,20	$1,53
	Total Feeder 1 [Annual]	**$2.349.468,57**	**$1.076.288,35**	**$2.514.772,88**	**$1.573.000,00**	**$6.207.587,27**	**$4.458.738,37**	**$501.676,76**	**$523.830,58**	**$2.129.537,56**	**$495.689,66**	**$23.521.302,67**	**-$11.235.514,31**	**$1.966,66**	**$1,58**
	Feeder 2 voyage chartered container vessel	$294.673,53	$27.820,94	$92.865,44	$30.250,00	$598.873,69	$370.954,81	$371,06	$31.260,40	$143.080,80	$35.187,33	$1.625.338,01	-$828.743,05	$1.914,41	$5,60
	Feeder 2 voyage owned container vessel	$0,00	$27.820,94	$92.865,44	$30.250,00	$598.873,69	$370.954,81	$371,06	$31.260,40	$143.080,80	$35.187,33	$1.676.081,56	-$879.486,60	$1.974,18	$5,77
	Total Feeder 2 [Annual]	**$8.597.544,05**	**$1.446.688,71**	**$4.829.002,88**	**$1.573.000,00**	**$31.141.431,62**	**$19.289.650,24**	**$19.295,26**	**$1.625.540,80**	**$7.440.201,76**	**$1.829.741,38**	**$84.750.553,44**	**-$43.327.615,79**	**$1.919,69**	**$5,69**
Total Inter West Africa [Annual]		**$10.947.012,62**	**$2.522.977,06**	**$7.343.775,76**	**$3.146.000,00**	**$37.349.018,89**	**$23.748.388,60**	**$520.972,02**	**$2.149.371,38**	**$9.569.739,32**	**$2.325.431,03**	**$108.271.856,11**	**-$54.563.130,10**	**$1.929,70**	**$4,32**
Grand Total [Annual]		**$97.612.226,23**	**$102.295.449,99**	**$50.653.457,92**	**$11.011.000,00**	**$151.341.668,79**	**$92.572.086,02**	**$22.501.945,81**	**$19.915.381,36**	**$93.664.671,51**	**$14.000.000,00**	**$745.389.175,85**	**-$233.723.121,04**	**$2.206,65**	**$0,76**

Figure 442: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 1, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	2.487	904	3.036	1.264	241	1.272
14 ton TEU capacity [14 ton TEU]	1.846	662	2.257	931	166	937
Amount of reefer plugs	343	139	413	185	53	186
Amount of ship cranes	3	2	4	3	2	3
Lpp [m]	203,8	144,9	213,0	168,1	101,4	168,4
B [m]	34,0	26,3	35,5	28,0	18,4	28,1
T [m]	9,7	7,7	10,4	8,2	5,4	8,3
D [m]	18,0	13,1	19,2	14,5	8,6	14,6
LBD [m³]	113.399,4	46.213,4	135.346,8	62.215,1	14.305,3	62.564,3
B/T [-]	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.733	19.707	52.576	25.855	6.754	25.987
Displacement Volume [m³]	43.642	19.226	51.294	25.224	6.589	25.353
DWT [t]	35.001	14.659	41.551	19.557	4.703	19.663
Gross Tonnage [m³]	26.232	10.671	31.320	14.374	3.295	14.455
Wsm [t]	13.439	6.188	15.658	8.000	2.247	8.039
Wst [t]	9.561	4.262	11.212	5.570	1.484	5.598
Vs (design) [kn]	20,6	17,6	21,1	18,9	14,9	18,9
Vs (Max)	20,7	17,7	21,2	18,9	14,9	18,9
LCB [m]	-1,17	-1,64	-1,12	-1,41	-2,34	-1,41
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	6,9	8,7	7,4	5,5	7,4
Ta [m]	8,9	7,4	9,2	7,9	6,0	7,9
Tf [m]	7,9	6,4	8,2	6,9	5,0	6,9
Tav (in ballast) [m]	8,4	6,9	8,7	7,4	5,5	7,4
Pb (MCR) [kW]	22.700	8.600	26.900	12.300	2.700	12.300
Cad [-]	492	470	497	480	438	482
Fuel consumption design condition [t/h]	4,31	1,63	5,11	2,34	0,51	2,34
Generator power [kW]	2.674	1.178	3.434	1.448	681	1.454
Operational costs [$/day]	$3.440,72	$2.562,30	$3.747,33	$2.945,87	$1.780,79	$2.950,07
Average capital costs [$/day]	$9.764,73	$4.906,45	$11.176,09	$6.238,21	$2.271,41	$6.253,64
Average charter price [$/day]	$9.518,86	$7.346,67	$10.272,20	$7.840,66	$6.436,90	$7.851,64
Capacity fuel tanks [m³]	3.354	1.393	3.988	1.864	442	1.874
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	38.675	15.396	45.692	20.821	4.657	20.992
Displacement outbound [t]	35.605	16.712	42.157	21.008	6.610	21.104
Pb inbound [kW]	2.957	1.675	3.273	2.294	811	2.012
Pb outbound [kW]	2.798	1.769	3.102	2.308	1.024	2.019
Fuel consumption inbound [t/h]	0,562	0,318	0,622	0,436	0,154	0,382
Fuel consumption outbound [t/h]	0,532	0,336	0,589	0,438	0,195	0,384

U.2.2 Scenario 2

Figure 443: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.638	1.959	137.176	101.861	16	12	125,67	21.223	18	9	9	547	744	1.291	2.059	2.047	12	2.059	12	2.047	4.118	2.059	2.059	$3.247.372,32	$6.614,07	$3.253.986,40	$0,00
	FEWA 2 voyage owned container vessel	2.638	1.959	137.176	101.861	16	12	125,67	21.223	18	9	9	547	744	1.291	2.059	2.047	12	2.059	12	2.047	4.118	2.059	2.059	$3.247.372,32	$6.614,07	$3.253.986,40	$1.719.337,88
	Total FEWA [Annual]	**2.638**	**1.959**	**137.176**	**101.861**	**16**	**12**	**125,67**	**1.103.596**	**18**	**9**	**9**	**28.428**	**38.694**	**67.122**	**107.068**	**106.444**	**624**	**107.068**	**624**	**106.444**	**214.136**	**107.068**	**107.068**	**$168.863.360,69**	**$343.931,89**	**$169.207.292,58**	**$33.817.454,51**
	SWAX voyage chartered container vessel	904	662	47.008	34.424	11	11	111,51	21.564	16	8	8	355	356	711	711	709	2	711	2	709	1.422	711	711	$1.274.260,15	$1.002,20	$1.275.262,35	$0,00
	SWAX voyage owned container vessel	904	662	47.008	34.424	11	11	111,51	21.564	16	8	8	355	356	711	711	709	2	711	2	709	1.422	711	711	$1.274.260,15	$1.002,20	$1.275.262,35	$832.810,52
	Total SWAX [Annual]	**904**	**662**	**47.008**	**34.424**	**11**	**11**	**111,51**	**1.121.328**	**16**	**8**	**8**	**18.439**	**18.533**	**36.972**	**36.972**	**36.868**	**104**	**36.972**	**104**	**36.868**	**73.944**	**36.972**	**36.972**	**$66.261.527,82**	**$52.114,15**	**$66.313.641,97**	**$14.612.552,09**
Total Asia - West Africa [Annual]				**184.184**	**136.286**				**2.224.924**		**17**	**17**	**46.867**	**57.227**	**104.094**	**144.040**	**143.312**	**728**	**144.040**	**728**	**143.312**	**288.080**	**144.040**	**144.040**	**$235.124.888,51**	**$396.046,04**	**$235.520.934,54**	**$48.430.006,59**
Europe - West Africa	WEWA 2 voyage chartered container vessel	3.130	2.327	162.760	120.995	10	11	88,57	10.827	13	6	7	263	413	675	2.248	2.088	160	2.248	160	2.088	4.496	2.248	2.248	$3.698.031,05	$93.959,54	$3.791.990,59	$0,00
	WEWA 2 voyage owned container vessel	3.130	2.327	162.760	120.995	10	11	88,57	10.827	13	6	7	263	413	675	2.248	2.088	160	2.248	160	2.088	4.496	2.248	2.248	$3.698.031,05	$93.959,54	$3.791.990,59	$1.347.843,33
Total Europe - West Africa [Annual]		**3.130**	**2.327**	**162.760**	**120.995**	**10**	**11**	**88,57**	**563.004**	**13**	**6**	**7**	**13.657**	**21.469**	**35.126**	**116.896**	**108.576**	**8.320**	**116.896**	**8.320**	**108.576**	**233.792**	**116.896**	**116.896**	**$192.297.614,38**	**$4.885.896,17**	**$197.183.510,55**	**$25.338.806,67**
South America - West Africa	ECSA voyage chartered container vessel	1.264	931	65.728	48.425	6	12	55,71	9.095	8	4	4	220	189	409	595	595	0	595	0	595	1.190	595	595	$762.139,77	$0,00	$762.139,77	$0,00
	ECSA voyage owned container vessel	1.264	931	65.728	48.425	6	12	55,71	9.095	8	4	4	220	189	409	595	595	0	595	0	595	1.190	595	595	$762.139,77	$0,00	$762.139,77	$511.652,62
Total South America - West Africa [Annual]		**1.264**	**931**	**65.728**	**48.425**	**6**	**12**	**55,71**	**472.940**	**8**	**4**	**4**	**11.423**	**9.844**	**21.267**	**30.940**	**30.940**	**0**	**30.940**	**0**	**30.940**	**61.880**	**30.940**	**30.940**	**$39.631.268,16**	**$0,00**	**$39.631.268,16**	**$9.271.901,60**
Inter West Africa	Feeder 1 voyage chartered container vessel	241	166	12.532	8.640	3	11	18,30	1.275	3	2	1	20	13	33	230	210	20	230	20	210	460	230	230	$229.959,15	$6.306,01	$236.265,16	$0,00
	Feeder 1 voyage owned container vessel	241	166	12.532	8.640	3	11	18,30	1.275	3	2	1	20	13	33	230	210	20	230	20	210	460	230	230	$229.959,15	$6.306,01	$236.265,16	$74.139,65
	Total Feeder 1 [Annual]	**241**	**166**	**12.532**	**8.640**	**3**	**11**	**18,30**	**66.300**	**3**	**2**	**1**	**1.059**	**671**	**1.730**	**11.960**	**10.920**	**1.040**	**11.960**	**1.040**	**10.920**	**23.920**	**11.960**	**11.960**	**$11.957.875,86**	**$327.912,49**	**$12.285.788,36**	**$1.690.712,68**
	Feeder 2 voyage chartered container vessel	1.272	937	66.144	48.736	5	11	37,53	342	6	3	3	38	7	45	849	849	0	849	0	849	1.698	849	849	$796.594,95	$0,00	$796.594,95	$0,00
	Feeder 2 voyage owned container vessel	1.272	937	66.144	48.736	5	11	37,53	342	6	3	3	38	7	45	849	849	0	849	0	849	1.698	849	849	$796.594,95	$0,00	$796.594,95	$345.417,08
	Total Feeder 2 [Annual]	**1.272**	**937**	**66.144**	**48.736**	**5**	**11**	**37,53**	**17.784**	**6**	**3**	**3**	**1.979**	**347**	**2.326**	**44.148**	**44.148**	**0**	**44.148**	**0**	**44.148**	**88.296**	**44.148**	**44.148**	**$41.422.937,65**	**$0,00**	**$41.422.937,65**	**$6.958.456,75**
Total Inter West Africa [Annual]				**78.676**	**57.376**				**84.084**	**9**	**5**	**4**	**3.038**	**1.018**	**4.056**	**56.108**	**55.068**	**1.040**	**56.108**	**1.040**	**55.068**	**112.216**	**56.108**	**56.108**	**$53.380.813,52**	**$327.912,49**	**$53.708.726,01**	**$8.649.169,42**
Grand Total [Annual]				**491.348**	**363.082**				**3.344.952**	**30**	**32**	**32**	**74.985**	**89.558**	**164.543**	**347.984**	**337.896**	**10.088**	**347.984**	**10.088**	**337.896**	**695.968**	**347.984**	**347.984**	**$520.434.584,57**	**$5.609.854,70**	**$526.044.439,27**	**$91.689.884,29**

Figure 444: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$1.222.254,26	$802.881,89	$349.164,83	$30.250,00	$762.258,38	$455.026,33	$216.641,67	$122.857,43	$618.061,69	$82.837,14	$4.662.233,61	-$1.408.247,22	$2.264,32	$0,11
	FEWA 2 voyage owned container vessel	$0,00	$802.881,89	$349.164,83	$30.250,00	$762.258,38	$455.026,33	$216.641,67	$122.857,43	$618.061,69	$82.837,14	$5.159.317,23	-$1.905.330,84	$2.505,74	$0,12
	Total FEWA [Annual]	**$31.950.118,93**	**$41.749.858,07**	**$18.156.571,26**	**$1.573.000,00**	**$39.637.435,76**	**$23.661.369,09**	**$11.265.366,95**	**$6.388.586,11**	**$32.139.207,73**	**$4.307.531,38**	**$244.646.499,79**	**-$75.439.207,21**	**$2.284,96**	**$0,11**
	SWAX voyage chartered container vessel	$819.197,69	$442.245,20	$194.673,78	$30.250,00	$141.159,84	$189.961,21	$2.141,43	$46.978,94	$236.626,97	$28.604,76	$2.131.839,81	-$856.577,46	$2.998,37	$0,14
	SWAX voyage owned container vessel	$0,00	$442.245,20	$194.673,78	$30.250,00	$141.159,84	$189.961,21	$2.141,43	$46.978,94	$236.626,97	$28.604,76	$2.145.452,64	-$870.190,30	$3.017,51	$0,14
	Total SWAX [Annual]	**$21.452.272,90**	**$22.996.750,52**	**$10.123.036,35**	**$1.573.000,00**	**$7.340.311,47**	**$9.877.982,73**	**$111.354,38**	**$2.442.904,70**	**$12.304.602,36**	**$1.487.447,70**	**$104.322.215,21**	**-$38.008.573,24**	**$2.821,65**	**$0,14**
Total Asia - West Africa [Annual]		**$53.402.391,82**	**$64.746.608,59**	**$28.279.607,62**	**$3.146.000,00**	**$46.977.747,23**	**$33.539.351,83**	**$11.376.721,33**	**$8.831.490,81**	**$44.443.810,09**	**$5.794.979,08**	**$348.968.715,00**	**-$113.447.780,46**	**$2.422,72**	**$0,13**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$921.247,18	$420.156,71	$229.932,70	$60.500,00	$1.050.469,29	$593.685,31	$142.331,53	$151.699,00	$686.201,18	$90.440,94	$4.346.663,83	-$554.673,25	$1.933,57	$0,18
	WEWA 2 voyage owned container vessel	$0,00	$420.156,71	$229.932,70	$60.500,00	$1.050.469,29	$593.685,31	$142.331,53	$151.699,00	$686.201,18	$90.440,94	$4.773.259,98	-$981.269,39	$2.123,34	$0,20
Total Europe - West Africa [Annual]		**$26.575.030,23**	**$21.848.148,91**	**$11.956.500,40**	**$3.146.000,00**	**$54.624.403,13**	**$30.871.636,18**	**$7.401.239,30**	**$7.888.347,80**	**$35.682.461,45**	**$4.702.928,87**	**$230.035.502,94**	**-$32.851.992,39**	**$1.967,86**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$436.809,76	$254.389,01	$111.324,34	$30.250,00	$279.463,50	$114.135,30	$61.596,41	$30.485,59	$161.814,04	$23.937,88	$1.504.205,84	-$742.066,06	$2.528,08	$0,28
	ECSA voyage owned container vessel	$0,00	$254.389,01	$111.324,34	$30.250,00	$279.463,50	$114.135,30	$61.596,41	$30.485,59	$161.814,04	$23.937,88	$1.579.048,69	-$816.908,92	$2.653,86	$0,29
Total South America - West Africa [Annual]		**$11.447.364,77**	**$13.228.228,49**	**$5.788.865,47**	**$1.573.000,00**	**$14.532.102,20**	**$5.935.035,84**	**$3.203.013,15**	**$1.585.250,73**	**$8.414.330,19**	**$1.244.769,87**	**$76.223.862,30**	**-$36.592.594,13**	**$2.463,60**	**$0,28**
Inter West Africa	Feeder 1 voyage chartered container vessel	$117.770,47	$20.697,85	$48.361,02	$30.250,00	$119.376,68	$85.744,97	$9.647,63	$10.073,66	$41.072,88	$9.253,30	$492.248,45	-$255.983,29	$2.140,21	$1,68
	Feeder 1 voyage owned container vessel	$0,00	$20.697,85	$48.361,02	$30.250,00	$119.376,68	$85.744,97	$9.647,63	$10.073,66	$41.072,88	$9.253,30	$448.617,64	-$212.352,48	$1.950,51	$1,53
	Total Feeder 1 [Annual]	**$2.349.468,57**	**$1.076.288,35**	**$2.514.772,88**	**$1.573.000,00**	**$6.207.587,27**	**$4.458.738,37**	**$501.676,76**	**$523.830,58**	**$2.135.789,55**	**$481.171,55**	**$23.513.036,56**	**-$11.227.248,20**	**$1.965,97**	**$1,58**
	Feeder 2 voyage chartered container vessel	$294.673,53	$27.820,94	$92.865,44	$30.250,00	$598.873,69	$370.954,81	$371,06	$31.260,40	$143.080,80	$34.156,74	$1.624.307,42	-$827.712,46	$1.913,20	$5,59
	Feeder 2 voyage owned container vessel	$0,00	$27.820,94	$92.865,44	$30.250,00	$598.873,69	$370.954,81	$371,06	$31.260,40	$143.080,80	$34.156,74	$1.675.050,97	-$878.456,01	$1.972,97	$5,77
	Total Feeder 2 [Annual]	**$8.597.544,05**	**$1.446.688,71**	**$4.829.002,88**	**$1.573.000,00**	**$31.141.431,62**	**$19.289.650,24**	**$19.295,26**	**$1.625.540,80**	**$7.440.201,76**	**$1.776.150,63**	**$84.696.962,69**	**-$43.274.025,04**	**$1.918,48**	**$5,68**
Total Inter West Africa [Annual]		**$10.947.012,62**	**$2.522.977,06**	**$7.343.775,76**	**$3.146.000,00**	**$37.349.018,89**	**$23.748.388,60**	**$520.972,02**	**$2.149.371,38**	**$9.575.991,31**	**$2.257.322,18**	**$108.209.999,24**	**-$54.501.273,23**	**$1.928,60**	**$4,31**
Grand Total [Annual]		**$102.371.799,44**	**$102.345.963,05**	**$53.368.749,25**	**$11.011.000,00**	**$153.483.271,46**	**$94.094.412,44**	**$22.501.945,81**	**$20.454.460,72**	**$98.116.593,04**	**$14.000.000,00**	**$763.438.079,49**	**-$237.393.640,22**	**$2.193,89**	**$0,75**

Figure 445: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 2, specifications container vessels

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	2.638	904	3.130	1.264	241	1.272
14 ton TEU capacity [14 ton TEU]	1.959	662	2.327	931	166	937
Amount of reefer plugs	362	139	425	185	53	186
Amount of ship cranes	4	2	4	3	2	3
Lpp [m]	205,0	144,9	214,7	168,1	101,4	168,4
B [m]	34,2	26,3	35,8	28,0	18,4	28,1
T [m]	10,1	7,7	10,5	8,2	5,4	8,3
D [m]	18,3	13,1	19,3	14,5	8,6	14,6
LBD [m³]	119.486,0	46.213,4	139.057,4	62.215,1	14.305,3	62.564,3
B/T [-]	3,4	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	46.920	19.707	53.891	25.855	6.754	25.987
Displacement Volume [m³]	45.776	19.226	52.577	25.224	6.589	25.353
DWT [t]	36.821	14.659	42.655	19.557	4.703	19.663
Gross Tonnage [m³]	27.643	10.671	32.180	14.374	3.295	14.455
Wsm [t]	14.060	6.188	16.029	8.000	2.247	8.039
Wst [t]	10.022	4.262	11.488	5.570	1.484	5.598
Vs (design) [kn]	20,7	17,6	21,2	18,9	14,9	18,9
Vs (Max)	20,8	17,7	21,3	18,9	14,9	18,9
LCB [m]	-1,16	-1,64	-1,11	-1,41	-2,34	-1,41
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	6,9	8,7	7,4	5,5	7,4
Ta [m]	8,9	7,4	9,2	7,9	6,0	7,9
Tf [m]	7,9	6,4	8,2	6,9	5,0	6,9
Tav (in ballast) [m]	8,4	6,9	8,7	7,4	5,5	7,4
Pb (MCR) [kW]	23.700	8.600	27.700	12.300	2.700	12.300
Cad [-]	494	470	498	480	438	482
Fuel consumption design condition [t/h]	4,50	1,63	5,26	2,34	0,51	2,34
Generator power [kW]	2.883	1.178	3.565	1.448	681	1.454
Operational costs [$/day]	$3.521,82	$2.562,30	$3.801,10	$2.945,87	$1.780,79	$2.950,07
Average capital costs [$/day]	$10.159,78	$4.906,45	$11.416,50	$6.238,21	$2.271,41	$6.253,64
Average charter price [$/day]	$9.726,06	$7.346,67	$10.401,19	$7.840,66	$6.436,90	$7.851,64
Capacity fuel tanks [m³]	3.530	1.393	4.094	1.864	442	1.874
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	40.806	15.396	46.694	20.821	4.657	20.992
Displacement outbound [t]	37.407	16.712	43.279	21.008	6.610	21.104
Pb inbound [kW]	3.491	1.675	3.790	2.294	811	2.012
Pb outbound [kW]	3.294	1.769	3.603	2.308	1.024	2.019
Fuel consumption inbound [t/h]	0,663	0,318	0,720	0,436	0,154	0,382
Fuel consumption outbound [t/h]	0,626	0,336	0,685	0,438	0,195	0,384

U.2.3 Scenario 3

Figure 446: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]
Asia - West Africa	FEWA voyage chartered container vessel	2.437	1.809	126.724	94.044	15	12	123,89	21.190	18	9	9	517	717	1.234
Asia - West Africa	FEWA voyage owned container vessel	2.437	1.809	126.724	94.044	15	12	123,89	21.190	18	9	9	517	717	1.234
Asia - West Africa	**Total FEWA [Annual]**	**2.437**	**1.809**	**126.724**	**94.044**	**15**	**12**	**123,89**	**1.101.880**	**18**	**9**	**9**	**26.887**	**37.289**	**64.176**
Asia - West Africa	SWAX voyage chartered container vessel	922	675	47.944	35.124	11	11	111,69	21.564	16	8	8	360	361	722
Asia - West Africa	SWAX voyage owned container vessel	922	675	47.944	35.124	11	11	111,69	21.564	16	8	8	360	361	722
Asia - West Africa	**Total SWAX [Annual]**	**922**	**675**	**47.944**	**35.124**	**11**	**11**	**111,69**	**1.121.328**	**16**	**8**	**8**	**18.740**	**18.798**	**37.537**
Total Asia - West Africa [Annual]				**174.668**	**129.169**				**2.223.208**		**17**	**17**	**45.627**	**56.086**	**101.713**
Europe - West Africa	WEWA voyage chartered container vessel	2.884	2.143	149.968	111.428	9	11	83,06	10.801	12	6	6	267	378	645
Europe - West Africa	WEWA voyage owned container vessel	2.884	2.143	149.968	111.428	9	11	83,06	10.801	12	6	6	267	378	645
Total Europe - West Africa [Annual]		**2.884**	**2.143**	**149.968**	**111.428**	**9**	**11**	**83,06**	**561.652**	**12**	**6**	**6**	**13.858**	**19.669**	**33.527**
South America - West Africa	ECSA voyage chartered container vessel	1.230	906	63.960	47.103	6	12	55,60	9.095	8	4	4	218	188	406
South America - West Africa	ECSA voyage owned container vessel	1.230	906	63.960	47.103	6	12	55,60	9.095	8	4	4	218	188	406
Total South America - West Africa [Annual]		**1.230**	**906**	**63.960**	**47.103**	**6**	**12**	**55,60**	**472.940**	**8**	**4**	**4**	**11.326**	**9.787**	**21.113**
Inter West Africa	Feeder 1 voyage chartered container vessel	244	168	12.688	8.757	3	11	18,17	1.275	3	2	1	21	13	34
Inter West Africa	Feeder 1 voyage owned container vessel	244	168	12.688	8.757	3	11	18,17	1.275	3	2	1	21	13	34
Inter West Africa	**Total Feeder 1 [Annual]**	**244**	**168**	**12.688**	**8.757**	**3**	**11**	**18,17**	**66.300**	**3**	**2**	**1**	**1.069**	**681**	**1.751**
Inter West Africa	Feeder 2 voyage chartered container vessel	1.123	826	58.396	42.942	5	11	37,03	342	6	3	3	38	7	44
Inter West Africa	Feeder 2 voyage owned container vessel	1.123	826	58.396	42.942	5	11	37,03	342	6	3	3	38	7	44
Inter West Africa	**Total Feeder 2 [Annual]**	**1.123**	**826**	**58.396**	**42.942**	**5**	**11**	**37,03**	**17.784**	**6**	**3**	**3**	**1.969**	**343**	**2.312**
Total Inter West Africa [Annual]				**71.084**	**51.698**				**84.084**	**9**	**5**	**4**	**3.038**	**1.024**	**4.063**
Grand Total [Annual]				**459.680**	**339.398**				**3.341.884**	**29**	**32**	**31**	**73.849**	**86.566**	**160.415**

Trade	Service voyage	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	1.964	1.930	34	1.964	34	1.930	3.928	1.964	1.964	$3.037.075,36	$16.259,60	$3.053.334,96	$0,00
Asia - West Africa	FEWA voyage owned container vessel	1.964	1.930	34	1.964	34	1.930	3.928	1.964	1.964	$3.037.075,36	$16.259,60	$3.053.334,96	$1.620.046,34
Asia - West Africa	**Total FEWA [Annual]**	**102.128**	**100.360**	**1.768**	**102.128**	**1.768**	**100.360**	**204.256**	**102.128**	**102.128**	**$157.927.918,57**	**$845.499,23**	**$158.773.417,80**	**$32.148.730,83**
Asia - West Africa	SWAX voyage chartered container vessel	735	692	43	735	43	692	1.470	735	735	$1.242.438,66	$22.222,35	$1.264.661,01	$0,00
Asia - West Africa	SWAX voyage owned container vessel	735	692	43	735	43	692	1.470	735	735	$1.242.438,66	$22.222,35	$1.264.661,01	$846.282,68
Asia - West Africa	**Total SWAX [Annual]**	**38.220**	**35.984**	**2.236**	**38.220**	**2.236**	**35.984**	**76.440**	**38.220**	**38.220**	**$64.606.810,06**	**$1.155.562,29**	**$65.762.372,36**	**$14.856.633,57**
Total Asia - West Africa [Annual]		**140.348**	**136.344**	**4.004**	**140.348**	**4.004**	**136.344**	**280.696**	**140.348**	**140.348**	**$222.534.728,63**	**$2.001.061,53**	**$224.535.790,15**	**$47.005.364,40**
Europe - West Africa	WEWA voyage chartered container vessel	2.014	1.981	33	2.014	33	1.981	4.028	2.014	2.014	$3.499.109,57	$22.222,35	$3.521.331,92	$0,00
Europe - West Africa	WEWA voyage owned container vessel	2.014	1.981	33	2.014	33	1.981	4.028	2.014	2.014	$3.499.109,57	$22.222,35	$3.521.331,92	$1.196.837,14
Total Europe - West Africa [Annual]		**104.728**	**103.012**	**1.716**	**104.728**	**1.716**	**103.012**	**209.456**	**104.728**	**104.728**	**$181.953.697,76**	**$1.155.562,29**	**$183.109.260,06**	**$23.863.885,50**
South America - West Africa	ECSA voyage chartered container vessel	579	579	0	579	0	579	1.158	579	579	$742.782,27	$0,00	$742.782,27	$0,00
South America - West Africa	ECSA voyage owned container vessel	579	579	0	579	0	579	1.158	579	579	$742.782,27	$0,00	$742.782,27	$504.969,37
Total South America - West Africa [Annual]		**30.108**	**30.108**	**0**	**30.108**	**0**	**30.108**	**60.216**	**30.108**	**30.108**	**$38.624.677,83**	**$0,00**	**$38.624.677,83**	**$9.153.798,39**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	204	10	214	10	204	428	214	214	$222.744,64	$2.994,15	$225.738,79	$0,00
Inter West Africa	Feeder 1 voyage owned container vessel	214	204	10	214	10	204	428	214	214	$222.744,64	$2.994,15	$225.738,79	$74.069,15
Inter West Africa	**Total Feeder 1 [Annual]**	**11.128**	**10.608**	**520**	**11.128**	**520**	**10.608**	**22.256**	**11.128**	**11.128**	**$11.582.721,18**	**$155.695,73**	**$11.738.416,91**	**$1.704.494,52**
Inter West Africa	Feeder 2 voyage chartered container vessel	826	826	0	826	0	826	1.652	826	826	$774.972,96	$0,00	$774.972,96	$0,00
Inter West Africa	Feeder 2 voyage owned container vessel	826	826	0	826	0	826	1.652	826	826	$774.972,96	$0,00	$774.972,96	$318.187,32
Inter West Africa	**Total Feeder 2 [Annual]**	**42.952**	**42.952**	**0**	**42.952**	**0**	**42.952**	**85.904**	**42.952**	**42.952**	**$40.298.593,69**	**$0,00**	**$40.298.593,69**	**$6.424.926,55**
Total Inter West Africa [Annual]		**54.080**	**53.560**	**520**	**54.080**	**520**	**53.560**	**108.160**	**54.080**	**54.080**	**$51.881.314,87**	**$155.695,73**	**$52.037.010,60**	**$8.129.421,06**
Grand Total [Annual]		**329.264**	**323.024**	**6.240**	**329.264**	**6.240**	**323.024**	**658.528**	**329.264**	**329.264**	**$494.994.419,09**	**$3.312.319,55**	**$498.306.738,64**	**$88.152.469,34**

Figure 447: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.170.758,66	$767.639,95	$320.169,35	$30.250,00	$735.959,65	$451.231,72	$212.931,05	$115.609,20	$610.251,90	$83.507,46	$4.498.308,93	-$1.444.973,97	$2.290,38	$0,11
Asia - West Africa	FEWA voyage owned container vessel	$0,00	$767.639,95	$320.169,35	$30.250,00	$735.959,65	$451.231,72	$212.931,05	$115.609,20	$610.251,90	$83.507,46	$4.947.596,62	-$1.894.261,66	$2.519,14	$0,12
Asia - West Africa	**Total FEWA [Annual]**	**$31.044.075,85**	**$39.917.277,35**	**$16.648.805,94**	**$1.573.000,00**	**$38.269.901,99**	**$23.464.049,55**	**$11.072.414,35**	**$6.011.678,29**	**$31.733.098,88**	**$4.342.387,87**	**$236.225.420,90**	**-$77.452.003,10**	**$2.313,03**	**$0,11**
Asia - West Africa	SWAX voyage chartered container vessel	$823.315,06	$449.005,21	$195.144,82	$30.250,00	$145.776,75	$194.179,48	$3.283,03	$46.551,53	$256.721,39	$31.251,52	$2.175.478,79	-$910.817,79	$2.959,84	$0,14
Asia - West Africa	SWAX voyage owned container vessel	$0,00	$449.005,21	$195.144,82	$30.250,00	$145.776,75	$194.179,48	$3.283,03	$46.551,53	$256.721,39	$31.251,52	$2.198.446,41	-$933.785,41	$2.991,08	$0,14
Asia - West Africa	**Total SWAX [Annual]**	**$21.524.395,73**	**$23.348.271,08**	**$10.147.530,54**	**$1.573.000,00**	**$7.580.390,95**	**$10.097.332,86**	**$170.717,65**	**$2.420.679,71**	**$13.349.512,37**	**$1.625.078,96**	**$106.693.543,42**	**-$40.931.171,07**	**$2.791,56**	**$0,14**
Total Asia - West Africa [Annual]		**$52.568.471,58**	**$63.265.548,44**	**$26.796.336,48**	**$3.146.000,00**	**$45.850.292,94**	**$33.561.382,41**	**$11.243.132,00**	**$8.432.358,01**	**$45.082.611,25**	**$5.967.466,84**	**$342.918.964,32**	**-$118.383.174,17**	**$2.443,35**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$835.845,32	$401.030,57	$201.672,32	$30.250,00	$977.600,86	$532.546,81	$137.507,71	$140.715,25	$630.984,97	$85.633,41	$3.973.787,23	-$452.455,31	$1.973,08	$0,18
Europe - West Africa	WEWA voyage owned container vessel	$0,00	$401.030,57	$201.672,32	$30.250,00	$977.600,86	$532.546,81	$137.507,71	$140.715,25	$630.984,97	$85.633,41	$4.334.779,04	-$813.447,12	$2.152,32	$0,20
Total Europe - West Africa [Annual]		**$22.039.338,31**	**$20.853.589,72**	**$10.486.960,85**	**$1.573.000,00**	**$50.835.244,76**	**$27.692.433,99**	**$7.150.400,92**	**$7.317.193,14**	**$32.811.218,36**	**$4.452.937,46**	**$209.076.203,01**	**-$25.966.942,95**	**$1.996,37**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$433.372,38	$252.545,27	$110.839,02	$30.250,00	$272.267,07	$111.451,54	$59.370,03	$29.711,29	$165.666,75	$24.618,54	$1.490.091,90	-$747.309,64	$2.573,56	$0,28
South America - West Africa	ECSA voyage owned container vessel	$0,00	$252.545,27	$110.839,02	$30.250,00	$272.267,07	$111.451,54	$59.370,03	$29.711,29	$165.666,75	$24.618,54	$1.561.688,89	-$818.906,62	$2.697,22	$0,30
Total South America - West Africa [Annual]		**$11.379.248,76**	**$13.132.353,85**	**$5.763.629,04**	**$1.573.000,00**	**$14.157.887,76**	**$5.795.480,32**	**$3.087.241,59**	**$1.544.987,11**	**$8.614.670,94**	**$1.280.164,25**	**$75.482.462,01**	**-$36.857.784,18**	**$2.507,06**	**$0,29**
Inter West Africa	Feeder 1 voyage chartered container vessel	$117.007,22	$20.939,49	$48.382,43	$30.250,00	$114.458,69	$82.111,24	$5.937,00	$9.613,07	$38.970,70	$9.099,08	$476.768,93	-$251.030,14	$2.227,89	$1,75
Inter West Africa	Feeder 1 voyage owned container vessel	$0,00	$20.939,49	$48.382,43	$30.250,00	$114.458,69	$82.111,24	$5.937,00	$9.613,07	$38.970,70	$9.099,08	$433.830,86	-$208.092,07	$2.027,25	$1,59
Inter West Africa	**Total Feeder 1 [Annual]**	**$2.350.971,13**	**$1.088.853,23**	**$2.515.886,26**	**$1.573.000,00**	**$5.951.852,06**	**$4.269.784,62**	**$308.724,16**	**$499.879,61**	**$2.026.476,47**	**$473.152,24**	**$22.763.074,29**	**-$11.024.657,39**	**$2.045,57**	**$1,64**
Inter West Africa	Feeder 2 voyage chartered container vessel	$283.188,88	$27.655,17	$91.093,09	$30.250,00	$581.956,34	$360.993,46	$371,06	$30.409,16	$139.802,32	$35.120,75	$1.580.840,24	-$805.867,29	$1.913,85	$5,60
Inter West Africa	Feeder 2 voyage owned container vessel	$0,00	$27.655,17	$91.093,09	$30.250,00	$581.956,34	$360.993,46	$371,06	$30.409,16	$139.802,32	$35.120,75	$1.615.838,67	-$840.865,72	$1.956,22	$5,72
Inter West Africa	**Total Feeder 2 [Annual]**	**$8.373.662,76**	**$1.438.068,94**	**$4.736.840,42**	**$1.573.000,00**	**$30.261.729,90**	**$18.771.659,94**	**$19.295,26**	**$1.581.276,48**	**$7.269.720,40**	**$1.826.279,22**	**$82.276.459,87**	**-$41.977.866,18**	**$1.915,54**	**$5,66**
Total Inter West Africa [Annual]		**$10.724.633,89**	**$2.526.922,17**	**$7.252.726,68**	**$3.146.000,00**	**$36.213.581,96**	**$23.041.444,56**	**$328.019,42**	**$2.081.156,10**	**$9.296.196,87**	**$2.299.431,46**	**$105.039.534,16**	**-$53.002.523,57**	**$1.942,30**	**$4,32**
Grand Total [Annual]		**$96.711.692,54**	**$99.778.414,18**	**$50.299.653,04**	**$9.438.000,00**	**$147.057.007,42**	**$90.090.741,28**	**$21.808.793,94**	**$19.375.694,35**	**$95.804.697,41**	**$14.000.000,00**	**$732.517.163,50**	**-$234.210.424,87**	**$2.224,71**	**$0,76**

Figure 448: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 3, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	2.437	922	2.884	1.230	244	1.123
14 ton TEU capacity [14 ton TEU]	1.809	675	2.143	906	168	826
Amount of reefer plugs	336	141	394	181	53	167
Amount of ship cranes	3	2	4	3	2	2
Lpp [m]	202,6	145,7	210,0	166,9	101,7	162,8
B [m]	33,8	26,5	35,0	27,8	18,5	27,1
T [m]	9,6	7,8	10,3	8,2	5,4	8,0
D [m]	17,9	13,2	18,8	14,4	8,6	14,0
LBD [m³]	111.374,9	47.028,7	129.319,0	60.728,5	14.463,1	56.018,7
B/T [-]	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.003	20.024	50.434	25.290	6.822	23.493
Displacement Volume [m³]	42.929	19.536	49.204	24.673	6.656	22.920
DWT [t]	34.395	14.910	39.755	19.104	4.753	17.665
Gross Tonnage [m³]	25.763	10.860	29.922	14.030	3.332	12.940
Wsm [t]	13.231	6.282	15.054	7.835	2.268	7.307
Wst [t]	9.407	4.330	10.761	5.450	1.498	5.068
Vs (design) [kn]	20,6	17,7	20,9	18,8	14,9	18,6
Vs (Max)	20,7	17,8	21,0	18,9	14,9	18,7
LCB [m]	-1,17	-1,63	-1,13	-1,42	-2,34	-1,46
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	6,9	8,6	7,4	5,5	7,3
Ta [m]	8,9	7,4	9,1	7,9	6,0	7,8
Tf [m]	7,9	6,4	8,1	6,9	5,0	6,8
Tav (in ballast) [m]	8,4	6,9	8,6	7,4	5,5	7,3
Pb (MCR) [kW]	22.500	8.900	25.400	12.200	2.750	11.300
Cad [-]	491	467	498	477	433	475
Fuel consumption design condition [t/h]	4,28	1,69	4,83	2,32	0,52	2,15
Generator power [kW]	2.605	1.192	3.224	1.423	683	1.342
Operational costs [$/day]	$3.419,29	$2.588,11	$3.651,73	$2.923,25	$1.786,90	$2.820,13
Average capital costs [$/day]	$9.657,57	$4.988,89	$10.758,26	$6.158,39	$2.290,46	$5.772,14
Average charter price [$/day]	$9.450,25	$7.371,37	$10.063,62	$7.794,01	$6.441,02	$7.647,18
Capacity fuel tanks [m³]	3.295	1.417	3.814	1.820	447	1.682
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	37.986	15.684	43.950	20.326	4.736	19.825
Displacement outbound [ton]	35.008	16.927	40.343	20.603	6.671	19.326
Pb inbound [kW]	2.928	1.707	4.136	2.272	830	1.965
Pb outbound [kW]	2.773	1.796	3.906	2.293	1.043	1.931
Fuel consumption inbound [ton/h]	0,556	0,324	0,786	0,432	0,158	0,373
Fuel consumption outbound [ton/h]	0,527	0,341	0,742	0,436	0,198	0,367

U.2.4 Scenario 4

Figure 449: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.982	2.216	155.064	115.240	6	11	131,08	25.415	19	9	10	658	811	1.469	2.259	2.198	61	2.259	61	2.198	4.518	2.259	2.259	$2.953.087,95	$26.180,71	$2.979.268,66	$0,00
	SWAX 2 voyage owned container vessel	2.982	2.216	155.064	115.240	6	11	131,08	25.415	19	9	10	658	811	1.469	2.259	2.198	61	2.259	61	2.198	4.518	2.259	2.259	$2.953.087,95	$26.180,71	$2.979.268,66	$1.930.921,58
Total Asia - West Africa [Annual]		**2.982**	**2.216**	**155.064**	**115.240**	**6**	**11**	**131,08**	**1.321.580**	**19**	**9**	**10**	**34.207**	**42.190**	**76.397**	**117.468**	**114.296**	**3.172**	**117.468**	**3.172**	**114.296**	**234.936**	**117.468**	**117.468**	**$153.560.573,48**	**$1.361.397,07**	**$154.921.970,55**	**$36.687.634,44**
Europe - West Africa	WEWA voyage chartered container vessel	2.845	2.114	147.940	109.911	9	11	81,77	10.801	12	6	6	266	377	642	1.958	1.925	33	1.958	33	1.925	3.916	1.958	1.958	$3.461.719,84	$18.287,43	$3.480.007,27	$0,00
	WEWA voyage owned container vessel	2.845	2.114	147.940	109.911	9	11	81,77	10.801	12	6	6	266	377	642	1.958	1.925	33	1.958	33	1.925	3.916	1.958	1.958	$3.461.719,84	$18.287,43	$3.480.007,27	$1.171.087,19
Total Europe - West Africa [Annual]		**2.845**	**2.114**	**147.940**	**109.911**	**9**	**11**	**81,77**	**561.652**	**12**	**6**	**6**	**13.818**	**19.590**	**33.408**	**101.816**	**100.100**	**1.716**	**101.816**	**1.716**	**100.100**	**203.632**	**101.816**	**101.816**	**$180.009.431,66**	**$950.946,23**	**$180.960.377,90**	**$23.697.388,82**
South America - West Africa	ECSA voyage chartered container vessel	1.230	906	63.960	47.103	6	12	55,79	9.095	8	4	4	218	188	406	579	579	0	579	0	579	1.158	579	579	$742.782,27	$0,00	$742.782,27	$0,00
	ECSA voyage owned container vessel	1.230	906	63.960	47.103	6	12	55,79	9.095	8	4	4	218	188	406	579	579	0	579	0	579	1.158	579	579	$742.782,27	$0,00	$742.782,27	$506.700,94
Total South America - West Africa [Annual]		**1.230**	**906**	**63.960**	**47.103**	**6**	**12**	**55,79**	**472.940**	**8**	**4**	**4**	**11.326**	**9.787**	**21.113**	**30.108**	**30.108**	**0**	**30.108**	**0**	**30.108**	**60.216**	**30.108**	**30.108**	**$38.624.677,83**	**$0,00**	**$38.624.677,83**	**$9.154.355,76**
Inter West Africa	Feeder 3 voyage chartered container vessel	235	162	12.220	8.407	4	11	17,89	453	3	2	1	17	8	24	165	158	7	165	7	158	330	165	165	$144.865,65	$2.008,53	$146.874,18	$0,00
	Feeder 3 voyage owned container vessel	235	162	12.220	8.407	4	11	17,89	453	3	2	1	17	8	24	165	158	7	165	7	158	330	165	165	$124.363,84	$1.732,95	$126.096,78	$72.043,45
	Total Feeder 3 [Annual]	**235**	**162**	**12.220**	**8.407**	**4**	**11**	**17,89**	**23.556**	**3**	**2**	**1**	**866**	**391**	**1.257**	**8.580**	**8.216**	**364**	**8.580**	**364**	**8.216**	**17.160**	**8.580**	**8.580**	**$6.999.966,65**	**$97.278,48**	**$7.097.245,13**	**$1.675.330,49**
	Feeder 4 voyage chartered container vessel	334	236	17.368	12.257	4	11	25,67	1.933	4	2	2	35	20	54	320	301	19	320	19	301	640	320	320	$452.132,72	$5.474,43	$457.607,15	$0,00
	Feeder 4 voyage owned container vessel	334	236	17.368	12.257	4	11	25,67	1.933	4	2	2	35	20	54	320	301	19	320	19	301	640	320	320	$452.132,72	$5.474,43	$457.607,15	$119.005,47
	Total Feeder 4 [Annual]	**334**	**236**	**17.368**	**12.257**	**4**	**11**	**25,67**	**100.516**	**4**	**2**	**2**	**1.796**	**1.014**	**2.810**	**16.640**	**15.652**	**988**	**16.640**	**988**	**15.652**	**33.280**	**16.640**	**16.640**	**$23.510.901,38**	**$284.670,19**	**$23.795.571,57**	**$2.035.848,04**
	Feeder 5 voyage chartered container vessel	1.228	904	63.856	47.025	5	11	40,61	611	6	3	3	44	11	55	820	820	0	820	0	820	1.640	820	820	$774.596,56	$0,00	$774.596,56	$0,00
	Feeder 5 voyage owned container vessel	1.228	904	63.856	47.025	5	11	40,61	611	6	3	3	44	11	55	820	820	0	820	0	820	1.640	820	820	$774.596,56	$0,00	$774.596,56	$368.644,25
	Total Feeder 5 [Annual]	**1.228**	**904**	**63.856**	**47.025**	**5**	**11**	**40,61**	**31.772**	**6**	**3**	**3**	**2.270**	**590**	**2.860**	**42.640**	**42.640**	**0**	**42.640**	**0**	**42.640**	**85.280**	**42.640**	**42.640**	**$40.279.021,18**	**$0,00**	**$40.279.021,18**	**$6.857.859,90**
	Feeder 6 voyage chartered container vessel	1.241	914	64.532	47.531	5	11	48,92	4.873	7	4	3	97	82	179	1.043	1.034	9	1.043	9	1.034	2.086	1.043	1.043	$1.090.069,46	$2.480,28	$1.092.549,74	$0,00
	Feeder 6 voyage owned container vessel	1.241	914	64.532	47.531	5	11	48,92	4.873	7	4	3	97	82	179	1.043	1.034	9	1.043	9	1.034	2.086	1.043	1.043	$1.090.069,46	$2.480,28	$1.092.549,74	$445.636,59
	Total feeder 6 [Annual]	**1.241**	**914**	**64.532**	**47.531**	**5**	**11**	**48,92**	**253.396**	**7**	**4**	**3**	**5.025**	**4.260**	**9.284**	**54.236**	**53.768**	**468**	**54.236**	**468**	**53.768**	**108.472**	**54.236**	**54.236**	**$56.683.612,12**	**$128.974,46**	**$56.812.586,57**	**$9.165.784,47**
Total Inter West Africa [Annual]				**157.976**	**115.219**				**409.240**	**20**	**11**	**9**	**9.956**	**6.255**	**16.211**	**122.096**	**120.276**	**1.820**	**122.096**	**1.820**	**120.276**	**244.192**	**122.096**	**122.096**	**$127.473.501,33**	**$510.923,13**	**$127.984.424,46**	**$19.734.822,90**
Grand Total [Annual]				**524.940**	**387.473**				**2.765.412**	**59**	**30**	**29**	**69.308**	**77.822**	**147.129**	**371.488**	**364.780**	**6.708**	**371.488**	**6.708**	**364.780**	**742.976**	**371.488**	**371.488**	**$499.668.184,30**	**$2.823.266,43**	**$502.491.450,73**	**$89.274.201,92**

Figure 450: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$1.336.737,09	$913.825,84	$135.847,07	$60.500,00	$564.778,62	$356.771,25	$260.841,36	$105.565,91	$532.433,28	$85.133,30	$4.352.433,74	-$1.373.165,07	$1.926,71	$0,08
	SWAX 2 voyage owned container vessel	$0,00	$913.825,84	$135.847,07	$60.500,00	$564.778,62	$356.771,25	$260.841,36	$105.565,91	$532.433,28	$85.133,30	$4.946.618,22	-$1.967.349,55	$2.189,74	$0,09
Total Asia - West Africa [Annual]		**$37.223.066,46**	**$47.518.943,81**	**$7.064.047,54**	**$3.146.000,00**	**$29.368.488,39**	**$18.552.105,18**	**$13.563.750,67**	**$5.489.427,43**	**$27.686.530,67**	**$4.426.931,69**	**$230.726.926,28**	**-$75.804.955,73**	**$1.964,17**	**$0,08**
Europe - West Africa	WEWA voyage chartered container vessel	$818.476,97	$399.607,25	$200.837,30	$30.250,00	$917.726,06	$504.876,29	$88.572,56	$139.455,36	$610.286,37	$73.789,73	$3.783.877,87	-$303.870,61	$1.932,52	$0,18
	WEWA voyage owned container vessel	$0,00	$399.607,25	$200.837,30	$30.250,00	$917.726,06	$504.876,29	$88.572,56	$139.455,36	$610.286,37	$73.789,73	$4.136.488,09	-$656.480,82	$2.112,61	$0,20
Total Europe - West Africa [Annual]		**$21.922.138,71**	**$20.779.576,76**	**$10.443.539,34**	**$1.573.000,00**	**$47.721.754,94**	**$26.253.566,92**	**$4.605.773,01**	**$7.251.678,91**	**$31.734.891,18**	**$3.837.066,07**	**$199.820.374,66**	**-$18.859.996,76**	**$1.962,56**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$434.858,44	$252.545,27	$110.839,02	$30.250,00	$262.398,99	$114.947,07	$31.274,56	$29.711,29	$161.728,40	$21.820,35	$1.450.373,39	-$707.591,12	$2.504,96	$0,28
	ECSA voyage owned container vessel	$0,00	$252.545,27	$110.839,02	$30.250,00	$262.398,99	$114.947,07	$31.274,56	$29.711,29	$161.728,40	$21.820,35	$1.522.215,89	-$779.433,62	$2.629,04	$0,29
Total South America - West Africa [Annual]		**$11.379.248,76**	**$13.132.353,85**	**$5.763.629,04**	**$1.573.000,00**	**$13.644.747,28**	**$5.977.247,49**	**$1.626.277,34**	**$1.544.987,11**	**$8.409.876,61**	**$1.134.658,45**	**$73.340.381,69**	**-$34.715.703,86**	**$2.435,91**	**$0,28**
Inter West Africa	Feeder 3 voyage chartered container vessel	$114.990,08	$15.033,10	$64.424,26	$30.250,00	$18.690,51	$9.968,51	$35.480,04	$5.649,06	$16.064,44	$6.218,24	$316.768,23	-$169.894,05	$1.919,81	$4,24
	Feeder 3 voyage owned container vessel	$0,00	$15.033,10	$64.424,26	$30.250,00	$18.690,51	$9.968,51	$35.480,04	$5.649,06	$16.064,44	$6.218,24	$273.821,60	-$147.724,82	$1.659,52	$3,66
	Total Feeder 3 [Annual]	**$2.346.463,46**	**$781.721,02**	**$3.350.061,52**	**$1.573.000,00**	**$971.906,63**	**$518.362,36**	**$1.844.962,17**	**$293.751,13**	**$835.350,86**	**$323.348,26**	**$14.514.257,90**	**-$7.417.012,77**	**$1.691,64**	**$3,85**
	Feeder 4 voyage chartered container vessel	$168.517,59	$33.613,95	$65.366,34	$30.250,00	$83.714,93	$46.727,74	$78.828,52	$18.811,97	$37.326,25	$12.059,61	$575.216,89	-$117.609,75	$1.797,55	$0,93
	Feeder 4 voyage owned container vessel	$0,00	$33.613,95	$65.366,34	$30.250,00	$83.714,93	$46.727,74	$78.828,52	$18.811,97	$37.326,25	$12.059,61	$525.704,77	-$68.097,62	$1.642,83	$0,85
	Total Feeder 4 [Annual]	**$4.792.095,80**	**$1.747.925,34**	**$3.399.049,89**	**$1.573.000,00**	**$4.353.176,50**	**$2.429.842,37**	**$4.099.082,85**	**$978.222,28**	**$1.940.964,83**	**$627.099,66**	**$27.976.307,57**	**-$4.180.736,00**	**$1.681,27**	**$0,89**
	Feeder 5 voyage chartered container vessel	$316.437,20	$34.210,30	$92.342,06	$30.250,00	$118.577,77	$74.537,11	$215.628,31	$30.480,52	$85.868,02	$30.902,75	$1.029.234,04	-$254.637,48	$1.255,16	$2,05
	Feeder 5 voyage owned container vessel	$0,00	$34.210,30	$92.342,06	$30.250,00	$118.577,77	$74.537,11	$215.628,31	$30.480,52	$85.868,02	$30.902,75	$1.081.441,09	-$306.844,53	$1.318,83	$2,16
	Total Feeder 5 [Annual]	**$8.531.431,45**	**$1.778.935,39**	**$4.801.787,12**	**$1.573.000,00**	**$6.166.044,21**	**$3.875.929,65**	**$11.212.672,05**	**$1.584.987,27**	**$4.465.137,22**	**$1.606.942,89**	**$52.454.727,15**	**-$12.175.705,96**	**$1.230,18**	**$2,11**
	Feeder 6 voyage chartered container vessel	$382.048,90	$111.055,56	$92.496,70	$30.250,00	$195.069,45	$128.916,33	$222.670,23	$46.958,66	$144.363,70	$39.306,79	$1.393.136,31	-$300.586,56	$1.335,70	$0,27
	Feeder 6 voyage owned container vessel	$0,00	$111.055,56	$92.496,70	$30.250,00	$195.069,45	$128.916,33	$222.670,23	$46.958,66	$144.363,70	$39.306,79	$1.456.724,00	-$364.174,26	$1.396,67	$0,29
	Total feeder 6 [Annual]	**$8.550.964,72**	**$5.774.889,34**	**$4.809.828,14**	**$1.573.000,00**	**$10.143.611,16**	**$6.703.649,17**	**$11.578.851,96**	**$2.441.850,34**	**$7.506.912,16**	**$2.043.952,97**	**$70.293.294,42**	**-$13.480.707,85**	**$1.296,06**	**$0,28**
Total Inter West Africa [Annual]		**$24.220.955,43**	**$10.083.471,09**	**$16.360.726,67**	**$6.292.000,00**	**$21.634.738,49**	**$13.527.783,56**	**$28.735.569,03**	**$5.298.811,02**	**$14.748.365,07**	**$4.601.343,78**	**$165.238.587,04**	**-$37.254.162,58**	**$1.353,35**	**$1,49**
Grand Total [Annual]		**$94.745.409,36**	**$91.514.345,52**	**$39.631.942,58**	**$12.584.000,00**	**$112.369.729,10**	**$64.310.703,14**	**$48.531.370,05**	**$19.584.904,47**	**$82.579.663,52**	**$14.000.000,00**	**$669.126.269,67**	**-$166.634.818,94**	**$1.801,21**	**$0,61**

Figure 451: Results sensitivity analysis: 20% increase in the TEUs in the trip matrix scenario 4, specifications container vessels

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.982	2.845	1.230	235	334	1.228	1.241
14 ton TEU capacity [14 ton TEU]	2.216	2.114	906	162	236	904	914
Amount of reefer plugs	406	389	181	52	65	180	182
Amount of ship cranes	4	4	3	2	2	3	3
Lpp [m]	211,9	209,3	166,9	100,7	110,7	166,8	167,3
B [m]	35,3	34,9	27,8	18,3	20,1	27,8	27,9
T [m]	10,4	10,3	8,2	5,4	5,9	8,2	8,2
D [m]	19,0	18,8	14,4	8,5	9,5	14,4	14,4
LBD [m³]	133.209,3	127.766,6	60.728,5	13.988,9	19.107,7	60.640,9	61.209,9
B/T [-]	3,4	3,4	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	51.818	49.881	25.290	6.617	8.798	25.257	25.473
Displacement Volume [m³]	50.554	48.664	24.673	6.456	8.583	24.641	24.852
DWT [t]	40.914	39.292	19.104	4.602	6.226	19.077	19.250
Gross Tonnage [m³]	30.824	29.562	14.030	3.222	4.404	14.010	14.142
Wsm [t]	15.444	14.898	7.835	2.204	2.885	7.825	7.888
Wst [t]	11.052	10.645	5.450	1.454	1.925	5.443	5.489
Vs (design) [kn]	21,0	20,9	18,8	14,9	15,5	18,8	18,8
Vs (Max)	21,1	21,0	18,9	14,9	15,6	18,9	18,9
LCB [m]	-1,12	-1,14	-1,42	-2,36	-2,15	-1,42	-1,42
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,6	8,6	7,4	5,5	5,8	7,4	7,4
Ta [m]	9,1	9,1	7,9	6,0	6,3	7,9	7,9
Tf [m]	8,1	8,1	6,9	5,0	5,3	6,9	6,9
Tav (in ballast) [m]	8,6	8,6	7,4	5,5	5,8	7,4	7,4
Pb (MCR) [kW]	26.300	25.300	12.200	2.700	3.600	12.200	12.200
Cad [-]	496	496	477	432	449	476	479
Fuel consumption design condition [t/h]	5,00	4,81	2,32	0,51	0,68	2,32	2,32
Generator power [kW]	3.360	3.170	1.423	676	751	1.421	1.431
Operational costs [$/day]	$3.711,04	$3.637,68	$2.923,25	$1.776,23	$1.914,28	$2.922,20	$2.929,05
Average capital costs [$/day]	$11.020,15	$10.684,91	$6.158,39	$2.251,45	$2.721,52	$6.154,50	$6.179,78
Average charter price [$/day]	$10.198,10	$10.010,11	$7.794,01	$6.428,67	$6.564,51	$7.791,26	$7.809,10
Capacity fuel tanks [m³]	3.926	3.769	1.820	433	587	1.818	1.834
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	45.530	43.506	20.326	4.555	5.876	20.330	17.334
Displacement outbound [t]	41.513	39.878	20.603	6.487	8.506	20.579	20.734
Pb inbound [kW]	3.270	4.122	2.272	810	923	1.991	1.780
Pb outbound [kW]	3.075	3.890	2.293	1.025	1.180	2.007	2.006
Fuel consumption inbound [t/h]	0,621	0,783	0,432	0,154	0,175	0,378	0,338
Fuel consumption outbound [t/h]	0,584	0,739	0,436	0,195	0,224	0,381	0,381

U.3 20% decrease in bunker price

U.3.1 Scenario 1

Figure 452: Results sensitivity analysis: 20% decrease in bunker price scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$0,00
	FEWA voyage owned container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$1.489.141,86
	Total FEWA [Annual]	**2.092**	**1.551**	**108.784**	**80.627**	**15**	**11**	**124,78**	**1.101.880**	**18**	**9**	**9**	**22.834**	**31.920**	**54.754**	**86.476**	**86.476**	**0**	**86.476**	**0**	**86.476**	**172.952**	**86.476**	**86.476**	**$135.884.346,25**	**$0,00**	**$135.884.346,25**	**$29.053.450,83**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**148.564**	**109.645**				**2.223.208**	**34**	**17**	**17**	**39.892**	**49.431**	**89.323**	**117.676**	**117.572**	**104**	**117.676**	**104**	**117.572**	**235.352**	**117.676**	**117.676**	**$191.628.944,18**	**$52.114,15**	**$191.681.058,33**	**$42.236.286,35**
Europe - West Africa	WEWA voyage chartered container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$0,00
	WEWA voyage owned container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$1.091.206,24
Total Europe - West Africa [Annual]		**2.537**	**1.883**	**131.924**	**97.933**	**9**	**11**	**81,13**	**561.652**	**12**	**6**	**6**	**12.996**	**18.594**	**31.591**	**92.664**	**88.504**	**4.160**	**92.664**	**4.160**	**88.504**	**185.328**	**92.664**	**92.664**	**$156.148.243,93**	**$2.311.783,09**	**$158.460.027,02**	**$22.116.834,82**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**402.480**	**296.618**				**3.341.884**	**62**	**32**	**30**	**66.394**	**78.247**	**144.641**	**283.764**	**278.616**	**5.148**	**283.764**	**5.148**	**278.616**	**567.528**	**283.764**	**283.764**	**$426.084.658,71**	**$2.642.622,85**	**$428.727.281,56**	**$80.469.174,19**

Figure 453: Results sensitivity analysis: 20% decrease in bunker price scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.120.123,02	$523.956,87	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$3.836.143,43	-$1.222.982,92	$2.306,76	$0,11
	FEWA voyage owned container vessel	$0,00	$523.956,87	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$4.205.162,27	-$1.592.001,77	$2.528,66	$0,12
	Total FEWA [Annual]	**$29.488.927,28**	**$27.245.757,16**	**$16.008.617,04**	**$1.573.000,00**	**$32.398.072,74**	**$19.756.720,18**	**$9.598.565,17**	**$5.145.111,82**	**$25.240.770,56**	**$4.266.446,77**	**$199.775.439,56**	**-$63.891.093,31**	**$2.310,18**	**$0,11**
	SWAX voyage chartered container vessel	$790.694,05	$330.791,00	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$1.890.575,10	-$817.561,41	$3.150,96	$0,15
	SWAX voyage owned container vessel	$0,00	$330.791,00	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$1.855.830,47	-$782.816,78	$3.093,05	$0,14
	Total SWAX [Annual]	**$20.895.324,36**	**$17.201.132,11**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.275.836,35**	**$1.539.307,31**	**$91.271.974,59**	**-$35.475.262,52**	**$2.925,38**	**$0,14**
Total Asia - West Africa [Annual]		**$50.384.251,64**	**$44.446.889,28**	**$25.942.503,86**	**$3.146.000,00**	**$38.574.495,02**	**$28.082.366,79**	**$9.709.919,56**	**$7.202.340,66**	**$35.516.606,91**	**$5.805.754,08**	**$291.047.414,16**	**-$99.366.355,83**	**$2.473,29**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$777.795,08	$302.299,05	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.488.482,13	-$441.173,91	$1.957,62	$0,18
	WEWA voyage owned container vessel	$0,00	$302.299,05	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.801.893,28	-$754.585,07	$2.133,50	$0,20
Total Europe - West Africa [Annual]		**$20.996.562,37**	**$15.719.550,64**	**$10.100.620,76**	**$1.573.000,00**	**$44.579.974,52**	**$24.603.082,09**	**$6.204.933,19**	**$6.339.408,46**	**$27.263.413,99**	**$4.571.742,72**	**$184.069.123,56**	**-$25.609.096,54**	**$1.986,41**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$189.372,29	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.310.567,39	-$672.017,85	$2.626,39	$0,29
	ECSA voyage owned container vessel	$0,00	$189.372,29	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.353.459,13	-$714.909,59	$2.712,34	$0,30
Total South America - West Africa [Annual]		**$11.044.678,96**	**$9.847.358,94**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.987.352,91**	**$1.280.190,58**	**$65.830.292,85**	**-$32.625.716,82**	**$2.537,01**	**$0,29**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$15.948,58	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$445.998,86	-$245.207,73	$2.263,95	$1,78
	Feeder 1 voyage owned container vessel	$0,00	$15.948,58	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$400.011,29	-$199.220,15	$2.030,51	$1,59
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$829.326,18**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.373,86**	**$505.405,90**	**$21.107.202,67**	**-$10.666.063,53**	**$2.060,45**	**$1,65**
	Feeder 2 voyage chartered container vessel	$263.930,29	$21.739,84	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.405.366,79	-$733.434,46	$1.962,80	$5,74
	Feeder 2 voyage owned container vessel	$0,00	$21.739,84	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.433.611,11	-$761.678,78	$2.002,25	$5,85
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.130.471,68**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.836.906,73**	**$71.135.130,19**	**-$36.194.649,13**	**$1.910,59**	**$5,81**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$1.959.797,86**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.226,14**	**$2.342.312,63**	**$92.242.332,85**	**-$46.860.712,67**	**$1.942,93**	**$4,25**
Grand Total [Annual]		**$90.292.292,49**	**$71.973.596,72**	**$48.892.227,12**	**$9.438.000,00**	**$126.878.243,09**	**$77.731.284,98**	**$19.079.275,37**	**$16.686.469,48**	**$77.748.599,96**	**$14.000.000,00**	**$633.189.163,41**	**-$204.461.881,85**	**$2.231,39**	**$0,69**

Figure 454: Results sensitivity analysis: 20% decrease in bunker price scenario 1, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	2.092	765	2.537	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.551	558	1.883	781	142	789
Amount of reefer plugs	292	121	349	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	194,5	138,5	204,9	160,4	97,6	160,9
B [m]	32,4	25,2	34,1	26,7	17,7	26,8
T [m]	9,3	7,4	9,8	7,9	5,2	7,9
D [m]	17,0	12,4	18,1	13,8	8,2	13,8
LBD [m³]	97.271,3	39.852,4	115.419,4	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	38.885	17.214	45.460	22.471	6.018	22.659
Displacement Volume [m³]	37.937	16.795	44.351	21.923	5.871	22.106
DWT [t]	30.163	12.698	35.605	16.851	4.160	17.000
Gross Tonnage [m³]	22.494	9.199	26.700	12.324	2.904	12.437
Wsm [t]	11.770	5.445	13.645	7.006	2.014	7.061
Wst [t]	8.328	3.731	9.714	4.851	1.324	4.891
Vs (design) [kn]	20,2	17,2	20,7	18,5	14,6	18,5
Vs (Max)	20,3	17,3	20,8	18,6	14,6	18,6
LCB [m]	-1,22	-1,72	-1,16	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,3	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,8	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,8	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,3	7,2
Pb (MCR) [kW]	19.700	7.400	23.300	10.800	2.400	10.900
Cad [-]	487	466	492	474	429	473
Fuel consumption design condition [t/h]	3,74	1,41	4,43	2,05	0,46	2,07
Generator power [kW]	2.127	1.074	2.744	1.297	657	1.306
Operational costs [$/day]	$3.211,94	$2.418,33	$3.480,65	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$8.722,27	$4.423,16	$9.970,07	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$8.976,84	$7.155,93	$9.587,47	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	2.886	1.205	3.412	1.604	391	1.618
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	36.840	14.579	43.477	19.727	4.401	19.916
Displacement outbound [t]	30.891	15.053	36.202	18.610	5.957	18.741
Pb inbound [kW]	2.892	1.629	3.200	2.239	797	1.979
Pb outbound [kW]	2.572	1.664	2.832	2.153	975	1.900
Fuel consumption inbound [t/h]	0,549	0,309	0,608	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,489	0,316	0,538	0,409	0,185	0,361

U.3.2 Scenario 2

Figure 455: Results sensitivity analysis: 20% decrease in bunker price scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$0,00
	FEWA 2 voyage owned container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$1.521.991,24
	Total FEWA [Annual]	**2.219**	**1.645**	**115.388**	**85.566**	**16**	**12**	**122,86**	**1.103.596**	**18**	**9**	**9**	**26.017**	**35.711**	**61.728**	**90.012**	**89.492**	**520**	**90.012**	**520**	**89.492**	**180.024**	**90.012**	**90.012**	**$141.574.371,76**	**$286.609,91**	**$141.860.981,67**	**$30.272.549,93**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**155.168**	**114.584**				**2.224.924**		**17**	**17**	**43.074**	**53.222**	**96.297**	**121.212**	**120.588**	**624**	**121.212**	**624**	**120.588**	**242.424**	**121.212**	**121.212**	**$197.318.969,69**	**$338.724,05**	**$197.657.693,75**	**$43.455.385,45**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$0,00
	WEWA 2 voyage owned container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$1.147.946,27
Total Europe - West Africa [Annual]		**2.612**	**1.939**	**135.818**	**100.845**	**10**	**12**	**83,76**	**563.004**	**12**	**6**	**6**	**13.522**	**21.416**	**34.937**	**97.552**	**90.584**	**6.968**	**97.552**	**6.968**	**90.584**	**195.104**	**97.552**	**97.552**	**$160.317.375,54**	**$4.082.510,56**	**$164.399.886,10**	**$22.585.311,72**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**412.978**	**304.469**				**3.344.952**	**28**	**32**	**30**	**70.102**	**84.860**	**154.962**	**292.188**	**283.712**	**8.476**	**292.188**	**8.476**	**283.712**	**584.376**	**292.188**	**292.188**	**$435.943.815,83**	**$4.699.960,23**	**$440.643.776,06**	**$82.156.750,18**

Figure 456: Results sensitivity analysis: 20% decrease in bunker price scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$1.124.300,01	$590.693,77	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$510.689,25	$82.939,75	$3.979.274,36	-$1.251.178,56	$2.298,83	$0,11
	FEWA 2 voyage owned container vessel	$0,00	$590.693,77	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$510.689,25	$82.939,75	$4.376.965,59	-$1.648.869,79	$2.528,58	$0,12
	Total FEWA [Annual]	**$30.061.402,26**	**$30.716.075,94**	**$17.327.232,83**	**$1.573.000,00**	**$33.181.282,48**	**$19.839.508,08**	**$9.598.565,17**	**$5.354.294,06**	**$26.555.840,95**	**$4.312.867,06**	**$208.792.618,77**	**-$66.931.637,09**	**$2.319,61**	**$0,11**
	SWAX voyage chartered container vessel	$790.694,05	$330.791,00	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.076,66	$28.748,61	$1.889.186,07	-$816.172,38	$3.148,64	$0,15
	SWAX voyage owned container vessel	$0,00	$330.791,00	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.076,66	$28.748,61	$1.854.441,44	-$781.427,75	$3.090,74	$0,14
	Total SWAX [Annual]	**$20.895.324,36**	**$17.201.132,11**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.247.986,19**	**$1.494.927,92**	**$91.199.745,05**	**-$35.403.032,97**	**$2.923,07**	**$0,14**
Total Asia - West Africa [Annual]		**$50.956.726,62**	**$47.917.208,06**	**$27.261.119,65**	**$3.146.000,00**	**$39.357.704,76**	**$28.165.154,69**	**$9.709.919,56**	**$7.411.522,90**	**$36.803.827,14**	**$5.807.794,98**	**$299.992.363,82**	**-$102.334.670,07**	**$2.474,94**	**$0,13**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$811.619,29	$334.322,02	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$3.660.542,08	-$499.005,81	$1.951,25	$0,18
	WEWA 2 voyage owned container vessel	$0,00	$334.322,02	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$3.996.869,06	-$835.332,79	$2.130,53	$0,20
Total Europe - West Africa [Annual]		**$21.221.593,11**	**$17.384.744,96**	**$11.315.547,60**	**$1.573.000,00**	**$45.557.094,76**	**$25.767.157,30**	**$6.204.933,19**	**$6.577.002,82**	**$29.090.363,22**	**$4.674.141,31**	**$191.950.889,99**	**-$27.551.003,89**	**$1.967,68**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$189.372,29	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.309.963,77	-$671.414,23	$2.625,18	$0,29
	ECSA voyage owned container vessel	$0,00	$189.372,29	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.352.855,51	-$714.305,97	$2.711,13	$0,30
Total South America - West Africa [Annual]		**$11.044.678,96**	**$9.847.358,94**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.992.873,56**	**$1.243.281,72**	**$65.798.904,64**	**-$32.594.328,61**	**$2.535,80**	**$0,29**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$15.948,58	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,77	$9.439,13	$445.718,54	-$244.927,40	$2.262,53	$1,77
	Feeder 1 voyage owned container vessel	$0,00	$15.948,58	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,77	$9.439,13	$399.730,97	-$198.939,83	$2.029,09	$1,59
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$829.326,18**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.368,20**	**$490.834,67**	**$21.092.625,78**	**-$10.651.486,64**	**$2.059,02**	**$1,65**
	Feeder 2 voyage chartered container vessel	$263.930,29	$21.739,84	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.404.348,34	-$732.416,01	$1.961,38	$5,74
	Feeder 2 voyage owned container vessel	$0,00	$21.739,84	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.432.592,66	-$760.660,33	$2.000,83	$5,85
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.130.471,68**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.783.947,32**	**$71.082.170,78**	**-$36.141.689,73**	**$1.909,17**	**$5,80**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$1.959.797,86**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.220,48**	**$2.274.781,99**	**$92.174.796,56**	**-$46.793.176,37**	**$1.941,50**	**$4,25**
Grand Total [Annual]		**$91.089.798,21**	**$77.109.109,82**	**$51.425.769,76**	**$9.438.000,00**	**$128.638.573,07**	**$78.978.148,10**	**$19.079.275,37**	**$17.133.246,09**	**$80.868.284,41**	**$14.000.000,00**	**$649.916.955,00**	**-$209.273.178,94**	**$2.224,31**	**$0,69**

Figure 457: Results sensitivity analysis: 20% decrease in bunker price scenario 2, specifications container vessels

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	2.219	765	2.612	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.645	558	1.939	781	142	789
Amount of reefer plugs	308	121	359	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	197,6	138,5	206,5	160,4	97,6	160,9
B [m]	32,9	25,2	34,4	26,7	17,7	26,8
T [m]	9,4	7,4	9,8	7,9	5,2	7,9
D [m]	17,4	12,4	18,3	13,8	8,2	13,8
LBD [m³]	102.491,5	39.852,4	118.436,1	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	40.786	17.214	46.544	22.471	6.018	22.659
Displacement Volume [m³]	39.791	16.795	45.408	21.923	5.871	22.106
DWT [t]	31.732	12.698	36.507	16.851	4.160	17.000
Gross Tonnage [m³]	23.704	9.199	27.399	12.324	2.904	12.437
Wsm [t]	12.314	5.445	13.953	7.006	2.014	7.061
Wst [t]	8.729	3.731	9.943	4.851	1.324	4.891
Vs (design) [kn]	20,4	17,2	20,8	18,5	14,6	18,5
Vs (Max)	20,5	17,3	20,9	18,6	14,6	18,6
LCB [m]	-1,20	-1,72	-1,15	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,2	6,7	8,5	7,2	5,3	7,2
Ta [m]	8,7	7,2	9,0	7,7	5,8	7,7
Tf [m]	7,7	6,2	8,0	6,7	4,8	6,7
Tav (in ballast) [m]	8,2	6,7	8,5	7,2	5,3	7,2
Pb (MCR) [kW]	20.900	7.400	24.000	10.800	2.400	10.900
Cad [-]	488	466	492	474	429	473
Fuel consumption design condition [t/h]	3,97	1,41	4,56	2,05	0,46	2,07
Generator power [kW]	2.303	1.074	2.847	1.297	657	1.306
Operational costs [$/day]	$3.295,96	$2.418,33	$3.527,75	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$9.092,12	$4.423,16	$10.178,01	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$9.151,11	$7.155,93	$9.690,23	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	3.038	1.205	3.499	1.604	391	1.618
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	38.886	14.579	44.411	19.727	4.401	19.916
Displacement outbound [t]	32.406	15.053	37.096	18.610	5.957	18.741
Pb inbound [kW]	3.419	1.629	3.707	2.239	797	1.979
Pb outbound [kW]	3.028	1.664	3.288	2.153	975	1.900
Fuel consumption inbound [t/h]	0,650	0,309	0,704	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,575	0,316	0,625	0,409	0,185	0,361

U.3.3 Scenario 3

Figure 458: Results sensitivity analysis: 20% decrease in bunker price scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$0,00
	FEWA voyage owned container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$1.474.146,56
	Total FEWA [Annual]	**2.054**	**1.522**	**106.808**	**79.149**	**15**	**11**	**124,68**	**1.101.880**	**18**	**9**	**9**	**22.581**	**31.616**	**54.197**	**85.904**	**84.240**	**1.664**	**85.904**	**1.664**	**84.240**	**171.808**	**85.904**	**85.904**	**$132.332.913,09**	**$788.177,25**	**$133.121.090,34**	**$28.750.376,75**
	SWAX voyage chartered container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$0,00
	SWAX voyage owned container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$766.641,09
	Total SWAX [Annual]	**781**	**570**	**40.612**	**29.641**	**11**	**11**	**110,66**	**1.121.328**	**16**	**8**	**8**	**17.209**	**17.618**	**34.827**	**32.396**	**30.368**	**2.028**	**32.396**	**2.028**	**30.368**	**64.792**	**32.396**	**32.396**	**$54.475.771,55**	**$1.040.918,33**	**$55.516.689,88**	**$13.378.461,25**
Total Asia - West Africa [Annual]				**147.420**	**108.790**				**2.223.208**		**17**	**17**	**39.790**	**49.234**	**89.024**	**118.300**	**114.608**	**3.692**	**118.300**	**3.692**	**114.608**	**236.600**	**118.300**	**118.300**	**$186.808.684,65**	**$1.829.095,58**	**$188.637.780,23**	**$42.128.838,00**
Europe - West Africa	WEWA voyage chartered container vessel	2.410	1.788	125.320	92.994	9	12	77,00	10.801	11	5	6	286	410	697	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$0,00
	WEWA voyage owned container vessel	2.410	1.788	125.320	92.994	9	12	77,00	10.801	11	5	6	286	410	697	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$1.001.633,66
Total Europe - West Africa [Annual]		**2.410**	**1.788**	**125.320**	**92.994**	**9**	**12**	**77,00**	**561.652**	**11**	**6**	**5**	**14.887**	**21.345**	**36.232**	**87.828**	**86.216**	**1.612**	**87.828**	**1.612**	**86.216**	**175.656**	**87.828**	**87.828**	**$152.214.367,16**	**$1.040.918,33**	**$153.255.285,49**	**$21.287.446,89**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$451.606,04
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**54,98**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.151.663,35**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$0,00
	Feeder 1 voyage owned container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$69.731,82
	Total Feeder 1 [Annual]	**214**	**146**	**11.128**	**7.590**	**3**	**11**	**17,94**	**66.300**	**3**	**2**	**1**	**1.037**	**650**	**1.687**	**9.776**	**9.256**	**520**	**9.776**	**520**	**9.256**	**19.552**	**9.776**	**9.776**	**$10.061.247,43**	**$155.695,73**	**$10.216.943,16**	**$1.595.863,07**
	Feeder 2 voyage chartered container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$0,00
	Feeder 2 voyage owned container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$282.957,53
	Total Feeder 2 [Annual]	**1.042**	**765**	**54.184**	**39.791**	**5**	**11**	**34,37**	**17.784**	**5**	**3**	**2**	**1.929**	**329**	**2.258**	**36.140**	**36.140**	**0**	**36.140**	**0**	**36.140**	**72.280**	**36.140**	**36.140**	**$33.906.766,36**	**$0,00**	**$33.906.766,36**	**$6.110.830,42**
Total Inter West Africa [Annual]				**65.312**	**47.381**				**84.084**	**8**	**5**	**3**	**2.966**	**979**	**3.945**	**45.916**	**45.396**	**520**	**45.916**	**520**	**45.396**	**91.832**	**45.916**	**45.916**	**$43.968.013,79**	**$155.695,73**	**$44.123.709,52**	**$7.706.693,48**
Grand Total [Annual]				**391.872**	**288.684**				**3.341.884**	**27**	**32**	**29**	**68.063**	**80.727**	**148.790**	**277.316**	**271.492**	**5.824**	**277.316**	**5.824**	**271.492**	**554.632**	**277.316**	**277.316**	**$415.343.911,35**	**$3.025.709,64**	**$418.369.620,99**	**$79.274.641,73**

Figure 459: Results sensitivity analysis: 20% decrease in bunker price scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.112.692,40	$518.621,21	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$3.816.140,03	-$1.256.119,06	$2.310,01	$0,11
	FEWA voyage owned container vessel	$0,00	$518.621,21	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$4.177.594,19	-$1.617.573,22	$2.528,81	$0,12
	Total FEWA [Annual]	**$29.317.635,56**	**$26.968.302,90**	**$15.938.103,48**	**$1.573.000,00**	**$32.083.314,38**	**$19.702.834,62**	**$9.356.635,68**	**$5.041.804,12**	**$25.578.510,48**	**$4.336.771,05**	**$198.647.289,01**	**-$65.526.198,67**	**$2.312,43**	**$0,11**
	SWAX voyage chartered container vessel	$794.309,50	$333.265,76	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.361,38	$31.451,48	$1.919.670,80	-$852.042,15	$3.081,33	$0,14
	SWAX voyage owned container vessel	$0,00	$333.265,76	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.361,38	$31.451,48	$1.892.002,39	-$824.373,74	$3.036,92	$0,14
	Total SWAX [Annual]	**$20.959.433,54**	**$17.329.819,51**	**$9.955.659,43**	**$1.573.000,00**	**$6.423.407,69**	**$8.549.951,81**	**$170.717,65**	**$2.045.962,80**	**$10.834.791,53**	**$1.635.477,22**	**$92.856.682,42**	**-$37.339.992,54**	**$2.866,30**	**$0,14**
Total Asia - West Africa [Annual]		**$50.277.069,10**	**$44.298.122,41**	**$25.893.762,91**	**$3.146.000,00**	**$38.506.722,07**	**$28.252.786,43**	**$9.527.353,33**	**$7.087.766,92**	**$36.413.302,01**	**$5.972.248,27**	**$291.503.971,44**	**-$102.866.191,21**	**$2.464,11**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$724.803,64	$346.709,71	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$498.350,63	$85.267,35	$3.375.675,31	-$428.458,28	$1.998,62	$0,19
	WEWA voyage owned container vessel	$0,00	$346.709,71	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$498.350,63	$85.267,35	$3.652.505,33	-$705.288,30	$2.162,53	$0,20
Total Europe - West Africa [Annual]		**$17.179.093,65**	**$18.028.905,12**	**$9.959.222,52**	**$1.573.000,00**	**$42.560.610,16**	**$23.238.477,20**	**$6.011.980,59**	**$6.124.996,61**	**$25.914.232,73**	**$4.433.902,12**	**$176.311.867,60**	**-$23.056.582,11**	**$2.007,47**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$413.817,11	$187.459,02	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.293.632,82	-$671.462,71	$2.661,80	$0,29
	ECSA voyage owned container vessel	$0,00	$187.459,02	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.331.421,75	-$709.251,64	$2.739,55	$0,30
Total South America - West Africa [Annual]		**$10.988.583,42**	**$9.747.869,29**	**$5.618.890,68**	**$1.573.000,00**	**$11.841.117,62**	**$4.866.695,53**	**$2.624.155,35**	**$1.294.113,83**	**$6.908.745,10**	**$1.275.829,74**	**$64.890.663,92**	**-$32.537.818,18**	**$2.567,69**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	$114.792,76	$16.142,89	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.416,37	$9.490,98	$437.821,89	-$241.342,21	$2.328,84	$1,83
	Feeder 1 voyage owned container vessel	$0,00	$16.142,89	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.416,37	$9.490,98	$392.760,94	-$196.281,27	$2.089,15	$1,64
	Total Feeder 1 [Annual]	**$2.335.945,54**	**$839.430,08**	**$2.504.752,54**	**$1.573.000,00**	**$5.188.705,95**	**$3.716.277,45**	**$308.724,16**	**$435.442,17**	**$1.737.651,39**	**$493.530,85**	**$20.729.323,20**	**-$10.512.380,04**	**$2.120,43**	**$1,70**
	Feeder 2 voyage chartered container vessel	$259.038,62	$21.606,56	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$115.836,32	$35.086,33	$1.371.660,60	-$719.607,40	$1.973,61	$5,77
	Feeder 2 voyage owned container vessel	$0,00	$21.606,56	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$115.836,32	$35.086,33	$1.395.579,51	-$743.526,31	$2.008,03	$5,87
	Total Feeder 2 [Annual]	**$5.501.303,65**	**$1.123.541,24**	**$4.686.738,68**	**$1.573.000,00**	**$25.485.943,60**	**$15.787.405,30**	**$19.295,26**	**$1.332.441,02**	**$6.023.488,83**	**$1.824.489,03**	**$69.468.477,03**	**-$35.561.710,67**	**$1.922,20**	**$5,83**
Total Inter West Africa [Annual]		**$7.837.249,19**	**$1.962.971,32**	**$7.191.491,22**	**$3.146.000,00**	**$30.674.649,55**	**$19.503.682,76**	**$328.019,42**	**$1.767.883,19**	**$7.761.140,22**	**$2.318.019,88**	**$90.197.800,23**	**-$46.074.090,71**	**$1.964,41**	**$4,28**
Grand Total [Annual]		**$86.281.995,37**	**$74.037.868,15**	**$48.663.367,32**	**$9.438.000,00**	**$123.583.099,39**	**$75.861.641,92**	**$18.491.508,69**	**$16.274.760,55**	**$76.997.420,07**	**$14.000.000,00**	**$622.904.303,19**	**-$204.534.682,20**	**$2.246,19**	**$0,71**

Figure 460: Results sensitivity analysis: 20% decrease in bunker price scenario 3, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	2.054	781	2.410	1.035	214	1.042
14 ton TEU capacity [14 ton TEU]	1.522	570	1.788	760	146	765
Amount of reefer plugs	287	123	333	155	50	156
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	193,5	139,3	202,0	159,3	98,2	159,6
B [m]	32,3	25,3	33,7	26,5	17,9	26,6
T [m]	9,2	7,4	9,6	7,8	5,3	7,8
D [m]	16,9	12,5	17,8	13,6	8,3	13,7
LBD [m³]	95.702,4	40.590,8	110.279,7	52.107,3	12.874,3	52.419,8
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [ton]	38.312	17.505	43.607	21.990	6.134	22.111
Displacement Volume [m³]	37.377	17.079	42.544	21.454	5.985	21.571
DWT [ton]	29.692	12.926	34.067	16.468	4.246	16.564
Gross Tonnage [m³]	22.131	9.370	25.509	12.035	2.965	12.107
Wsm [ton]	11.606	5.532	13.119	6.864	2.051	6.900
Wst [ton]	8.207	3.793	9.324	4.749	1.349	4.774
Vs (design) [kn]	20,2	17,3	20,6	18,4	14,7	18,4
Vs (Max)	20,3	17,4	20,7	18,5	14,7	18,5
LCB [m]	-1,23	-1,71	-1,18	-1,49	-2,42	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,4	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,9	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,9	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,4	7,2
Pb (MCR) [kW]	19.500	7.600	22.400	10.500	2.500	10.500
Cad [-]	488	467	491	473	426	475
Fuel consumption design condition [ton/h]	3,71	1,44	4,26	2,00	0,48	2,00
Generator power [kW]	2.075	1.086	2.568	1.276	661	1.282
Operational costs [$/day]	$3.193,02	$2.438,61	$3.407,99	$2.733,33	$1.744,39	$2.737,14
Average capital costs [$/day]	$8.630,83	$4.489,25	$9.600,47	$5.480,40	$2.143,25	$5.494,74
Average charter price [$/day]	$8.924,70	$7.177,89	$9.413,20	$7.526,43	$6.399,85	$7.536,03
Capacity fuel tanks [m³]	2.841	1.227	3.263	1.567	399	1.576
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	36.198	14.859	41.821	19.258	4.497	19.377
Displacement outbound [ton]	30.437	15.244	34.686	18.275	6.059	18.359
Pb inbound [kW]	2.858	1.647	4.059	2.208	815	1.933
Pb outbound [kW]	2.546	1.675	3.583	2.132	994	1.865
Fuel consumption inbound [ton/h]	0,543	0,313	0,771	0,420	0,155	0,367
Fuel consumption outbound [ton/h]	0,484	0,318	0,681	0,405	0,189	0,354

U.3.4 Scenario 4

Figure 461: Results sensitivity analysis: 20% decrease in bunker price scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.496	1.853	129.792	96.339	6	12	124,81	25.415	18	9	9	651	810	1.460	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$0,00
	SWAX 2 voyage owned container vessel	2.496	1.853	129.792	96.339	6	12	124,81	25.415	18	9	9	651	810	1.460	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$1.658.488,14
Total Asia - West Africa [Annual]		**2.496**	**1.853**	**129.792**	**96.339**	**6**	**12**	**124,81**	**1.321.580**	**18**	**9**	**9**	**33.826**	**42.102**	**75.928**	**98.332**	**95.628**	**2.704**	**98.332**	**2.704**	**95.628**	**196.664**	**98.332**	**98.332**	**$128.359.754,75**	**$1.160.770,13**	**$129.520.524,89**	**$32.720.357,65**
Europe - West Africa	WEWA voyage chartered container vessel	2.387	1.771	124.124	92.100	9	12	75,92	10.801	11	5	6	284	407	691	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$0,00
	WEWA voyage owned container vessel	2.387	1.771	124.124	92.100	9	12	75,92	10.801	11	5	6	284	407	691	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$978.061,03
Total Europe - West Africa [Annual]		**2.387**	**1.771**	**124.124**	**92.100**	**9**	**12**	**75,92**	**561.652**	**11**	**6**	**5**	**14.767**	**21.182**	**35.950**	**85.436**	**83.824**	**1.612**	**85.436**	**1.612**	**83.824**	**170.872**	**85.436**	**85.436**	**$150.590.236,79**	**$885.363,73**	**$151.475.600,53**	**$21.061.583,33**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$452.911,15
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**55,14**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.152.097,66**
Inter West Africa	Feeder 3 voyage chartered container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$0,00
	Feeder 3 voyage owned container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$67.130,63
	Total Feeder 3 [Annual]	**204**	**138**	**10.608**	**7.201**	**4**	**11**	**17,64**	**23.556**	**3**	**2**	**1**	**845**	**382**	**1.227**	**7.384**	**7.072**	**312**	**7.384**	**312**	**7.072**	**14.768**	**7.384**	**7.384**	**$6.466.919,44**	**$90.113,23**	**$6.557.032,67**	**$1.549.120,33**
	Feeder 4 voyage chartered container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$0,00
	Feeder 4 voyage owned container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$109.694,49
	Total Feeder 4 [Annual]	**287**	**201**	**14.924**	**10.429**	**4**	**11**	**25,22**	**100.516**	**4**	**2**	**2**	**1.732**	**965**	**2.697**	**14.300**	**13.364**	**936**	**14.300**	**936**	**13.364**	**28.600**	**14.300**	**14.300**	**$19.877.940,37**	**$270.339,69**	**$20.148.280,07**	**$1.871.718,99**
	Feeder 5 voyage chartered container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$0,00
	Feeder 5 voyage owned container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$312.905,11
	Total Feeder 5 [Annual]	**1.036**	**761**	**53.872**	**39.558**	**5**	**11**	**38,08**	**31.772**	**6**	**3**	**3**	**2.200**	**551**	**2.751**	**35.932**	**35.932**	**0**	**35.932**	**0**	**35.932**	**71.864**	**35.932**	**35.932**	**$33.924.244,60**	**$0,00**	**$33.924.244,60**	**$6.107.396,33**
	Feeder 6 voyage chartered container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$0,00
	Feeder 6 voyage owned container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$383.088,03
	Total feeder 6 [Annual]	**1.040**	**764**	**54.080**	**39.714**	**5**	**11**	**46,57**	**253.396**	**7**	**4**	**3**	**4.634**	**3.882**	**8.517**	**45.448**	**45.084**	**364**	**45.448**	**364**	**45.084**	**90.896**	**45.448**	**45.448**	**$47.525.710,41**	**$100.313,47**	**$47.626.023,88**	**$8.143.755,09**
Total Inter West Africa [Annual]				**133.484**	**96.901**				**409.240**	**20**	**11**	**9**	**9.411**	**5.780**	**15.191**	**103.064**	**101.452**	**1.612**	**103.064**	**1.612**	**101.452**	**206.128**	**103.064**	**103.064**	**$107.794.814,82**	**$460.766,39**	**$108.255.581,22**	**$17.671.990,74**
Grand Total [Annual]				**441.220**	**324.859**				**2.765.412**	**57**	**30**	**27**	**68.425**	**78.234**	**146.659**	**312.104**	**306.176**	**5.928**	**312.104**	**5.928**	**306.176**	**624.208**	**312.104**	**312.104**	**$419.097.652,11**	**$2.506.900,26**	**$421.604.552,37**	**$79.606.029,39**

Figure 462: Results sensitivity analysis: 20% decrease in bunker price scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$1.189.618,33	$726.573,41	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$3.680.286,36	-$1.189.507,03	$1.946,21	$0,08
	SWAX 2 voyage owned container vessel	$0,00	$726.573,41	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$4.149.156,17	-$1.658.376,85	$2.194,16	$0,09
Total Asia - West Africa [Annual]		**$31.310.028,79**	**$37.781.817,31**	**$6.703.315,01**	**$1.573.000,00**	**$24.559.268,94**	**$15.520.772,85**	**$11.383.402,99**	**$4.590.364,12**	**$22.991.933,13**	**$4.410.863,05**	**$193.545.123,84**	**-$64.024.598,95**	**$1.968,28**	**$0,08**
Europe - West Africa	WEWA voyage chartered container vessel	$712.297,33	$344.009,48	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.239.527,47	-$326.535,16	$1.971,71	$0,18
	WEWA voyage owned container vessel	$0,00	$344.009,48	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.505.291,18	-$592.298,86	$2.133,47	$0,20
Total Europe - West Africa [Annual]		**$17.121.495,56**	**$17.888.492,70**	**$9.933.614,96**	**$1.573.000,00**	**$39.958.349,38**	**$22.027.881,22**	**$3.902.849,89**	**$6.070.273,06**	**$26.229.117,26**	**$3.832.389,20**	**$169.599.046,58**	**-$18.123.446,05**	**$1.985,10**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$415.013,01	$187.459,02	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.264.705,89	-$642.535,78	$2.602,28	$0,29
	ECSA voyage owned container vessel	$0,00	$187.459,02	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.302.604,03	-$680.433,92	$2.680,26	$0,29
Total South America - West Africa [Annual]		**$10.988.583,42**	**$9.747.869,29**	**$5.618.890,68**	**$1.573.000,00**	**$11.412.278,79**	**$5.018.600,95**	**$1.395.397,34**	**$1.294.113,83**	**$6.990.256,49**	**$1.133.622,13**	**$63.324.710,59**	**-$30.971.864,84**	**$2.505,73**	**$0,29**
Inter West Africa	Feeder 3 voyage chartered container vessel	$112.671,04	$11.741,97	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$299.039,77	-$172.942,98	$2.105,91	$4,65
	Feeder 3 voyage owned container vessel	$0,00	$11.741,97	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$253.499,36	-$127.402,57	$1.785,21	$3,94
	Total Feeder 3 [Annual]	**$2.330.937,01**	**$610.582,68**	**$3.334.721,73**	**$1.573.000,00**	**$842.734,24**	**$454.976,03**	**$1.579.694,78**	**$253.005,70**	**$711.235,82**	**$331.222,93**	**$13.571.231,24**	**-$7.014.198,58**	**$1.837,92**	**$4,18**
	Feeder 4 voyage chartered container vessel	$163.958,07	$25.805,41	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$524.526,71	-$137.059,78	$1.907,37	$0,99
	Feeder 4 voyage owned container vessel	$0,00	$25.805,41	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$470.263,14	-$82.796,21	$1.710,05	$0,88
	Total Feeder 4 [Annual]	**$4.745.015,62**	**$1.341.881,36**	**$3.375.792,78**	**$1.573.000,00**	**$3.763.089,74**	**$2.106.936,44**	**$3.506.715,55**	**$829.920,04**	**$1.610.780,73**	**$641.452,85**	**$25.366.304,09**	**-$5.218.024,03**	**$1.773,87**	**$0,94**
	Feeder 5 voyage chartered container vessel	$286.683,85	$26.322,81	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$905.973,07	-$253.583,75	$1.311,10	$2,15
	Feeder 5 voyage owned container vessel	$0,00	$26.322,81	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$932.194,32	-$279.805,01	$1.349,05	$2,21
	Total Feeder 5 [Annual]	**$8.242.940,12**	**$1.368.785,88**	**$4.683.027,44**	**$1.573.000,00**	**$5.204.211,99**	**$3.269.905,53**	**$9.451.135,53**	**$1.336.471,74**	**$3.704.705,17**	**$1.611.796,07**	**$46.553.375,81**	**-$12.629.131,21**	**$1.295,60**	**$2,18**
	Feeder 6 voyage chartered container vessel	$350.798,19	$81.498,37	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.209.340,91	-$293.455,83	$1.383,69	$0,28
	Feeder 6 voyage owned container vessel	$0,00	$81.498,37	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.241.630,74	-$325.745,67	$1.420,63	$0,29
	Total feeder 6 [Annual]	**$8.248.950,36**	**$4.237.915,43**	**$4.685.501,60**	**$1.573.000,00**	**$8.501.988,26**	**$5.625.449,13**	**$9.685.781,42**	**$2.049.180,43**	**$6.246.750,97**	**$2.038.653,78**	**$61.036.926,47**	**-$13.410.902,59**	**$1.343,01**	**$0,29**
Total Inter West Africa [Annual]		**$23.567.843,12**	**$7.559.165,34**	**$16.079.043,55**	**$6.292.000,00**	**$18.312.024,23**	**$11.457.267,12**	**$24.223.327,28**	**$4.468.577,91**	**$12.273.472,69**	**$4.623.125,62**	**$146.527.837,61**	**-$38.272.256,40**	**$1.421,72**	**$1,57**
Grand Total [Annual]		**$82.987.950,89**	**$72.977.344,65**	**$38.334.864,20**	**$11.011.000,00**	**$94.241.921,34**	**$54.024.522,15**	**$40.904.977,51**	**$16.423.328,92**	**$68.484.779,58**	**$14.000.000,00**	**$572.996.718,62**	**-$151.392.166,24**	**$1.835,92**	**$0,65**

Figure 463: Results sensitivity analysis: 20% decrease in bunker price scenario 4, specifications container vessels

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.496	2.387	1.035	204	287	1.036	1.040
14 ton TEU capacity [14 ton TEU]	1.853	1.771	760	138	201	761	764
Amount of reefer plugs	344	330	155	48	59	156	156
Amount of ship cranes	3	3	2	2	2	2	2
Lpp [m]	204,0	201,5	159,3	96,9	106,3	159,3	159,5
B [m]	34,0	33,6	26,5	17,6	19,3	26,6	26,6
T [m]	9,7	9,6	7,8	5,2	5,7	7,8	7,8
D [m]	18,0	17,8	13,6	8,2	9,1	13,6	13,7
LBD [m³]	113.763,3	109.345,6	52.107,3	12.339,2	16.702,7	52.151,9	52.330,5
B/T [-]	3,5	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.864	43.270	21.990	5.901	7.781	22.007	22.076
Displacement Volume [m³]	43.769	42.215	21.454	5.757	7.591	21.471	21.538
DWT [t]	35.110	33.787	16.468	4.075	5.465	16.482	16.537
Gross Tonnage [m³]	26.316	25.292	12.035	2.842	3.849	12.045	12.087
Wsm [t]	13.476	13.023	6.864	1.977	2.568	6.869	6.889
Wst [t]	9.589	9.253	4.749	1.299	1.706	4.752	4.767
Vs (design) [kn]	20,7	20,5	18,4	14,6	15,2	18,4	18,4
Vs (Max)	20,8	20,6	18,5	14,6	15,2	18,5	18,5
LCB [m]	-1,16	-1,18	-1,49	-2,45	-2,24	-1,49	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Ta [m]	8,9	8,8	7,7	5,8	6,1	7,7	7,7
Tf [m]	7,9	7,8	6,7	4,8	5,1	6,7	6,7
Tav (in ballast) [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Pb (MCR) [kW]	23.100	21.900	10.500	2.350	3.150	10.500	10.500
Cad [-]	492	492	473	432	438	474	475
Fuel consumption design condition [t/h]	4,39	4,16	2,00	0,45	0,60	2,00	2,00
Generator power [kW]	2.687	2.536	1.276	653	715	1.277	1.280
Operational costs [$/day]	$3.458,67	$3.382,10	$2.733,33	$1.724,52	$1.848,65	$2.733,87	$2.736,05
Average capital costs [$/day]	$9.829,12	$9.499,91	$5.480,40	$2.080,40	$2.500,12	$5.482,45	$5.490,65
Average charter price [$/day]	$9.531,21	$9.381,64	$7.526,43	$6.386,13	$6.500,02	$7.527,80	$7.533,29
Capacity fuel tanks [m³]	3.364	3.236	1.567	383	515	1.568	1.573
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	43.364	41.443	19.258	4.306	5.528	19.279	16.235
Displacement outbound [t]	35.712	34.412	18.275	5.855	7.547	18.287	18.335
Pb inbound [kW]	3.195	4.023	2.208	779	909	1.933	1.720
Pb outbound [kW]	2.807	3.554	2.132	956	1.119	1.866	1.865
Fuel consumption inbound [t/h]	0,607	0,764	0,420	0,148	0,173	0,367	0,327
Fuel consumption outbound [t/h]	0,533	0,675	0,405	0,182	0,213	0,355	0,354

U.4 20% increase in bunker price

U.4.1 Scenario 1

Figure 464: Results sensitivity analysis: 20% increase in bunker price scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$0,00
	FEWA voyage owned container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$1.489.141,86
	Total FEWA [Annual]	**2.092**	**1.551**	**108.784**	**80.627**	**15**	**11**	**124,78**	**1.101.880**	**18**	**9**	**9**	**22.834**	**31.920**	**54.754**	**86.476**	**86.476**	**0**	**86.476**	**0**	**86.476**	**172.952**	**86.476**	**86.476**	**$135.884.346,25**	**$0,00**	**$135.884.346,25**	**$29.053.450,83**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**148.564**	**109.645**				**2.223.208**	**34**	**17**	**17**	**39.892**	**49.431**	**89.323**	**117.676**	**117.572**	**104**	**117.676**	**104**	**117.572**	**235.352**	**117.676**	**117.676**	**$191.628.944,18**	**$52.114,15**	**$191.681.058,33**	**$42.236.286,35**
Europe - West Africa	WEWA voyage chartered container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$0,00
	WEWA voyage owned container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$1.091.206,24
Total Europe - West Africa [Annual]		**2.537**	**1.883**	**131.924**	**97.933**	**9**	**11**	**81,13**	**561.652**	**12**	**6**	**6**	**12.996**	**18.594**	**31.591**	**92.664**	**88.504**	**4.160**	**92.664**	**4.160**	**88.504**	**185.328**	**92.664**	**92.664**	**$156.148.243,93**	**$2.311.783,09**	**$158.460.027,02**	**$22.116.834,82**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**402.480**	**296.618**				**3.341.884**	**62**	**32**	**30**	**66.394**	**78.247**	**144.641**	**283.764**	**278.616**	**5.148**	**283.764**	**5.148**	**278.616**	**567.528**	**283.764**	**283.764**	**$426.084.658,71**	**$2.642.622,85**	**$428.727.281,56**	**$80.469.174,19**

Figure 465: Results sensitivity analysis: 20% increase in bunker price scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.120.123,02	$785.935,30	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$4.098.121,86	-$1.484.961,36	$2.464,29	$0,12
	FEWA voyage owned container vessel	$0,00	$785.935,30	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$4.467.140,70	-$1.853.980,20	$2.686,19	$0,13
	Total FEWA [Annual]	**$29.488.927,28**	**$40.868.635,75**	**$16.008.617,04**	**$1.573.000,00**	**$32.398.072,74**	**$19.756.720,18**	**$9.598.565,17**	**$5.145.111,82**	**$25.240.770,56**	**$4.266.446,77**	**$213.398.318,15**	**-$77.513.971,89**	**$2.467,72**	**$0,12**
	SWAX voyage chartered container vessel	$790.694,05	$496.186,50	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$2.055.970,60	-$982.956,91	$3.426,62	$0,16
	SWAX voyage owned container vessel	$0,00	$496.186,50	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$2.021.225,97	-$948.212,28	$3.368,71	$0,16
	Total SWAX [Annual]	**$20.895.324,36**	**$25.801.698,17**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.275.836,35**	**$1.539.307,31**	**$99.872.540,65**	**-$44.075.828,58**	**$3.201,04**	**$0,16**
Total Asia - West Africa [Annual]		**$50.384.251,64**	**$66.670.333,92**	**$25.942.503,86**	**$3.146.000,00**	**$38.574.495,02**	**$28.082.366,79**	**$9.709.919,56**	**$7.202.340,66**	**$35.516.606,91**	**$5.805.754,08**	**$313.270.858,80**	**-$121.589.800,47**	**$2.662,15**	**$0,14**
Europe - West Africa	WEWA voyage chartered container vessel	$777.795,08	$453.448,58	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.639.631,65	-$592.323,44	$2.042,44	$0,19
	WEWA voyage owned container vessel	$0,00	$453.448,58	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.953.042,81	-$905.734,60	$2.218,32	$0,21
Total Europe - West Africa [Annual]		**$20.996.562,37**	**$23.579.325,96**	**$10.100.620,76**	**$1.573.000,00**	**$44.579.974,52**	**$24.603.082,09**	**$6.204.933,19**	**$6.339.408,46**	**$27.263.413,99**	**$4.571.742,72**	**$191.928.898,88**	**-$33.468.871,86**	**$2.071,23**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$284.058,43	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.405.253,54	-$766.704,00	$2.816,14	$0,31
	ECSA voyage owned container vessel	$0,00	$284.058,43	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.448.145,27	-$809.595,73	$2.902,09	$0,32
Total South America - West Africa [Annual]		**$11.044.678,96**	**$14.771.038,41**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.987.352,91**	**$1.280.190,58**	**$70.753.972,31**	**-$37.549.396,29**	**$2.726,76**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$23.922,87	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$453.973,15	-$253.182,02	$2.304,43	$1,81
	Feeder 1 voyage owned container vessel	$0,00	$23.922,87	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$407.985,58	-$207.194,44	$2.070,99	$1,62
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$1.243.989,27**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.373,86**	**$505.405,90**	**$21.521.865,76**	**-$11.080.726,62**	**$2.100,92**	**$1,69**
	Feeder 2 voyage chartered container vessel	$263.930,29	$32.609,76	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.416.236,71	-$744.304,38	$1.977,98	$5,78
	Feeder 2 voyage owned container vessel	$0,00	$32.609,76	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.444.481,03	-$772.548,70	$2.017,43	$5,90
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.695.707,52**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.836.906,73**	**$71.700.366,03**	**-$36.759.884,98**	**$1.925,77**	**$5,85**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$2.939.696,79**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.226,14**	**$2.342.312,63**	**$93.222.231,78**	**-$47.840.611,60**	**$1.963,57**	**$4,29**
Grand Total [Annual]		**$90.292.292,49**	**$107.960.395,08**	**$48.892.227,12**	**$9.438.000,00**	**$126.878.243,09**	**$77.731.284,98**	**$19.079.275,37**	**$16.686.469,48**	**$77.748.599,96**	**$14.000.000,00**	**$669.175.961,77**	**-$240.448.680,21**	**$2.358,21**	**$0,71**

Figure 466: Results sensitivity analysis: 20% increase in bunker price scenario 1, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	2.092	765	2.537	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.551	558	1.883	781	142	789
Amount of reefer plugs	292	121	349	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	194,5	138,5	204,9	160,4	97,6	160,9
B [m]	32,4	25,2	34,1	26,7	17,7	26,8
T [m]	9,3	7,4	9,8	7,9	5,2	7,9
D [m]	17,0	12,4	18,1	13,8	8,2	13,8
LBD [m³]	97.271,3	39.852,4	115.419,4	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	38.885	17.214	45.460	22.471	6.018	22.659
Displacement Volume [m³]	37.937	16.795	44.351	21.923	5.871	22.106
DWT [t]	30.163	12.698	35.605	16.851	4.160	17.000
Gross Tonnage [m³]	22.494	9.199	26.700	12.324	2.904	12.437
Wsm [t]	11.770	5.445	13.645	7.006	2.014	7.061
Wst [t]	8.328	3.731	9.714	4.851	1.324	4.891
Vs (design) [kn]	20,2	17,2	20,7	18,5	14,6	18,5
Vs (Max)	20,3	17,3	20,8	18,6	14,6	18,6
LCB [m]	-1,22	-1,72	-1,16	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,3	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,8	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,8	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,3	7,2
Pb (MCR) [kW]	19.700	7.400	23.300	10.800	2.400	10.900
Cad [-]	487	466	492	474	429	473
Fuel consumption design condition [t/h]	3,74	1,41	4,43	2,05	0,46	2,07
Generator power [kW]	2.127	1.074	2.744	1.297	657	1.306
Operational costs [$/day]	$3.211,94	$2.418,33	$3.480,65	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$8.722,27	$4.423,16	$9.970,07	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$8.976,84	$7.155,93	$9.587,47	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	2.886	1.205	3.412	1.604	391	1.618
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	36.840	14.579	43.477	19.727	4.401	19.916
Displacement outbound [t]	30.891	15.053	36.202	18.610	5.957	18.741
Pb inbound [kW]	2.892	1.629	3.200	2.239	797	1.979
Pb outbound [kW]	2.572	1.664	2.832	2.153	975	1.900
Fuel consumption inbound [t/h]	0,549	0,309	0,608	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,489	0,316	0,538	0,409	0,185	0,361

U.4.2 Scenario 2

Figure 467: Results sensitivity analysis: 20% increase in bunker price scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.219	1.645	115.388	85.566	16	11	126,35	21.223	19	10	9	461	631	1.092	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$0,00
	FEWA 2 voyage owned container vessel	2.219	1.645	115.388	85.566	16	11	126,35	21.223	19	10	9	461	631	1.092	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$1.565.290,33
	Total FEWA [Annual]	**2.219**	**1.645**	**115.388**	**85.566**	**16**	**11**	**126,35**	**1.103.596**	**19**	**10**	**9**	**23.968**	**32.831**	**56.798**	**90.012**	**89.492**	**520**	**90.012**	**520**	**89.492**	**180.024**	**90.012**	**90.012**	**$141.574.371,76**	**$286.609,91**	**$141.860.981,67**	**$33.602.693,47**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**155.168**	**114.584**				**2.224.924**		**18**	**17**	**41.025**	**50.341**	**91.366**	**121.212**	**120.588**	**624**	**121.212**	**624**	**120.588**	**242.424**	**121.212**	**121.212**	**$197.318.969,69**	**$338.724,05**	**$197.657.693,75**	**$46.785.528,98**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$0,00
	WEWA 2 voyage owned container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$1.147.946,27
Total Europe - West Africa [Annual]		**2.612**	**1.939**	**135.818**	**100.845**	**10**	**12**	**83,76**	**563.004**	**12**	**6**	**6**	**13.522**	**21.416**	**34.937**	**97.552**	**90.584**	**6.968**	**97.552**	**6.968**	**90.584**	**195.104**	**97.552**	**97.552**	**$160.317.375,54**	**$4.082.510,56**	**$164.399.886,10**	**$22.585.311,72**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**412.978**	**304.469**				**3.344.952**	**28**	**33**	**30**	**68.052**	**81.979**	**150.032**	**292.188**	**283.712**	**8.476**	**292.188**	**8.476**	**283.712**	**584.376**	**292.188**	**292.188**	**$435.943.815,83**	**$4.699.960,23**	**$440.643.776,06**	**$85.486.893,72**

Figure 468: Results sensitivity analysis: 20% increase in bunker price scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$1.156.285,19	$815.271,84	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$514.646,66	$82.939,75	$4.239.795,03	-$1.511.699,23	$2.449,33	$0,12
	FEWA 2 voyage owned container vessel	$0,00	$815.271,84	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$514.646,66	$82.939,75	$4.648.800,17	-$1.920.704,37	$2.685,62	$0,13
	Total FEWA [Annual]	**$30.061.402,26**	**$42.394.135,90**	**$17.327.232,83**	**$1.573.000,00**	**$33.181.282,48**	**$19.839.508,08**	**$9.598.565,17**	**$5.354.294,06**	**$26.761.626,13**	**$4.312.867,06**	**$224.006.607,44**	**-$82.145.625,77**	**$2.488,63**	**$0,12**
	SWAX voyage chartered container vessel	$790.694,05	$496.186,50	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.289,31	$28.748,61	$2.054.794,22	-$981.780,53	$3.424,66	$0,16
	SWAX voyage owned container vessel	$0,00	$496.186,50	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.289,31	$28.748,61	$2.020.049,59	-$947.035,90	$3.366,75	$0,16
	Total SWAX [Annual]	**$20.895.324,36**	**$25.801.698,17**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.259.043,90**	**$1.494.927,92**	**$99.811.368,81**	**-$44.014.656,74**	**$3.199,08**	**$0,16**
Total Asia - West Africa [Annual]		**$50.956.726,62**	**$68.195.834,08**	**$27.261.119,65**	**$3.146.000,00**	**$39.357.704,76**	**$28.165.154,69**	**$9.709.919,56**	**$7.411.522,90**	**$37.020.670,03**	**$5.807.794,98**	**$323.817.976,26**	**-$126.160.282,51**	**$2.671,50**	**$0,14**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$811.619,29	$501.483,03	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$3.827.703,09	-$666.166,82	$2.040,35	$0,19
	WEWA 2 voyage owned container vessel	$0,00	$501.483,03	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$4.164.030,07	-$1.002.493,80	$2.219,63	$0,21
Total Europe - West Africa [Annual]		**$21.221.593,11**	**$26.077.117,45**	**$11.315.547,60**	**$1.573.000,00**	**$45.557.094,76**	**$25.767.157,30**	**$6.204.933,19**	**$6.577.002,82**	**$29.090.363,22**	**$4.674.141,31**	**$200.643.262,47**	**-$36.243.376,38**	**$2.056,78**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$284.058,43	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.404.649,92	-$766.100,38	$2.814,93	$0,31
	ECSA voyage owned container vessel	$0,00	$284.058,43	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.447.541,65	-$808.992,11	$2.900,89	$0,32
Total South America - West Africa [Annual]		**$11.044.678,96**	**$14.771.038,41**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.992.873,56**	**$1.243.281,72**	**$70.722.584,11**	**-$37.518.008,08**	**$2.725,55**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$23.922,87	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.612,06	$9.439,13	$453.740,11	-$252.948,98	$2.303,25	$1,81
	Feeder 1 voyage owned container vessel	$0,00	$23.922,87	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.612,06	$9.439,13	$407.752,54	-$206.961,40	$2.069,81	$1,62
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$1.243.989,27**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.799.827,01**	**$490.834,67**	**$21.509.747,67**	**-$11.068.608,54**	**$2.099,74**	**$1,68**
	Feeder 2 voyage chartered container vessel	$263.930,29	$32.609,76	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.415.218,26	-$743.285,93	$1.976,56	$5,78
	Feeder 2 voyage owned container vessel	$0,00	$32.609,76	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.443.462,58	-$771.530,25	$2.016,01	$5,89
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.695.707,52**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.783.947,32**	**$71.647.406,62**	**-$36.706.925,57**	**$1.924,35**	**$5,85**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$2.939.696,79**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.983.679,29**	**$2.274.781,99**	**$93.157.154,30**	**-$47.775.534,11**	**$1.962,19**	**$4,29**
Grand Total [Annual]		**$91.089.798,21**	**$111.983.686,72**	**$51.425.769,76**	**$9.438.000,00**	**$128.638.573,07**	**$78.978.148,10**	**$19.079.275,37**	**$17.133.246,09**	**$81.087.586,11**	**$14.000.000,00**	**$688.340.977,14**	**-$247.697.201,07**	**$2.355,82**	**$0,70**

Figure 469: Results sensitivity analysis: 20% increase in bunker price scenario 2, specifications container vessels

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	2.219	765	2.612	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.645	558	1.939	781	142	789
Amount of reefer plugs	308	121	359	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	197,6	138,5	206,5	160,4	97,6	160,9
B [m]	32,9	25,2	34,4	26,7	17,7	26,8
T [m]	9,4	7,4	9,8	7,9	5,2	7,9
D [m]	17,4	12,4	18,3	13,8	8,2	13,8
LBD [m³]	102.491,5	39.852,4	118.436,1	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	40.786	17.214	46.544	22.471	6.018	22.659
Displacement Volume [m³]	39.791	16.795	45.408	21.923	5.871	22.106
DWT [t]	31.732	12.698	36.507	16.851	4.160	17.000
Gross Tonnage [m³]	23.704	9.199	27.399	12.324	2.904	12.437
Wsm [t]	12.314	5.445	13.953	7.006	2.014	7.061
Wst [t]	8.729	3.731	9.943	4.851	1.324	4.891
Vs (design) [kn]	20,4	17,2	20,8	18,5	14,6	18,5
Vs (Max)	20,5	17,3	20,9	18,6	14,6	18,6
LCB [m]	-1,20	-1,72	-1,15	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,2	6,7	8,5	7,2	5,3	7,2
Ta [m]	8,7	7,2	9,0	7,7	5,8	7,7
Tf [m]	7,7	6,2	8,0	6,7	4,8	6,7
Tav (in ballast) [m]	8,2	6,7	8,5	7,2	5,3	7,2
Pb (MCR) [kW]	20.900	7.400	24.000	10.800	2.400	10.900
Cad [-]	488	466	492	474	429	473
Fuel consumption design condition [t/h]	3,97	1,41	4,56	2,05	0,46	2,07
Generator power [kW]	2.303	1.074	2.847	1.297	657	1.306
Operational costs [$/day]	$3.295,96	$2.418,33	$3.527,75	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$9.092,12	$4.423,16	$10.178,01	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$9.151,11	$7.155,93	$9.690,23	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	3.038	1.205	3.499	1.604	391	1.618
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	38.886	14.579	44.411	19.727	4.401	19.916
Displacement outbound [t]	32.406	15.053	37.096	18.610	5.957	18.741
Pb inbound [kW]	3.419	1.629	3.707	2.239	797	1.979
Pb outbound [kW]	3.028	1.664	3.288	2.153	975	1.900
Fuel consumption inbound [t/h]	0,650	0,309	0,704	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,575	0,316	0,625	0,409	0,185	0,361

U.4.3 Scenario 3

Figure 470: Results sensitivity analysis: 20% decrease in bunker price scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$0,00
	FEWA voyage owned container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$1.474.146,56
	Total FEWA [Annual]	**2.054**	**1.522**	**106.808**	**79.149**	**15**	**11**	**124,68**	**1.101.880**	**18**	**9**	**9**	**22.581**	**31.616**	**54.197**	**85.904**	**84.240**	**1.664**	**85.904**	**1.664**	**84.240**	**171.808**	**85.904**	**85.904**	**$132.332.913,09**	**$788.177,25**	**$133.121.090,34**	**$28.750.376,75**
	SWAX voyage chartered container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$0,00
	SWAX voyage owned container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$766.641,09
	Total SWAX [Annual]	**781**	**570**	**40.612**	**29.641**	**11**	**11**	**110,66**	**1.121.328**	**16**	**8**	**8**	**17.209**	**17.618**	**34.827**	**32.396**	**30.368**	**2.028**	**32.396**	**2.028**	**30.368**	**64.792**	**32.396**	**32.396**	**$54.475.771,55**	**$1.040.918,33**	**$55.516.689,88**	**$13.378.461,25**
Total Asia - West Africa [Annual]				**147.420**	**108.790**				**2.223.208**		**17**	**17**	**39.790**	**49.234**	**89.024**	**118.300**	**114.608**	**3.692**	**118.300**	**3.692**	**114.608**	**236.600**	**118.300**	**118.300**	**$186.808.684,65**	**$1.829.095,58**	**$188.637.780,23**	**$42.128.838,00**
Europe - West Africa	WEWA voyage chartered container vessel	2.410	1.788	125.320	92.994	9	11	80,41	10.801	12	6	6	245	349	594	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$0,00
	WEWA voyage owned container vessel	2.410	1.788	125.320	92.994	9	11	80,41	10.801	12	6	6	245	349	594	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$1.045.984,79
Total Europe - West Africa [Annual]		**2.410**	**1.788**	**125.320**	**92.994**	**9**	**11**	**80,41**	**561.652**	**12**	**6**	**6**	**12.732**	**18.158**	**30.889**	**87.828**	**86.216**	**1.612**	**87.828**	**1.612**	**86.216**	**175.656**	**87.828**	**87.828**	**$152.214.367,16**	**$1.040.918,33**	**$153.255.285,49**	**$21.299.066,11**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$451.606,04
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**54,98**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.151.663,35**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$0,00
	Feeder 1 voyage owned container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$69.731,82
	Total Feeder 1 [Annual]	**214**	**146**	**11.128**	**7.590**	**3**	**11**	**17,94**	**66.300**	**3**	**2**	**1**	**1.037**	**650**	**1.687**	**9.776**	**9.256**	**520**	**9.776**	**520**	**9.256**	**19.552**	**9.776**	**9.776**	**$10.061.247,43**	**$155.695,73**	**$10.216.943,16**	**$1.595.863,07**
	Feeder 2 voyage chartered container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$0,00
	Feeder 2 voyage owned container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$282.957,53
	Total Feeder 2 [Annual]	**1.042**	**765**	**54.184**	**39.791**	**5**	**11**	**34,37**	**17.784**	**5**	**3**	**2**	**1.929**	**329**	**2.258**	**36.140**	**36.140**	**0**	**36.140**	**0**	**36.140**	**72.280**	**36.140**	**36.140**	**$33.906.766,36**	**$0,00**	**$33.906.766,36**	**$6.110.830,42**
Total Inter West Africa [Annual]				**65.312**	**47.381**				**84.084**	**8**	**5**	**3**	**2.966**	**979**	**3.945**	**45.916**	**45.396**	**520**	**45.916**	**520**	**45.396**	**91.832**	**45.916**	**45.916**	**$43.968.013,79**	**$155.695,73**	**$44.123.709,52**	**$7.706.693,48**
Grand Total [Annual]				**391.872**	**288.684**				**3.341.884**	**28**	**32**	**30**	**65.907**	**77.540**	**143.447**	**277.316**	**271.492**	**5.824**	**277.316**	**5.824**	**271.492**	**554.632**	**277.316**	**277.316**	**$415.343.911,35**	**$3.025.709,64**	**$418.369.620,99**	**$79.286.260,94**

Figure 471: Results sensitivity analysis: 20% decrease in bunker price scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.112.692,40	$777.931,81	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$4.075.450,63	-$1.515.429,66	$2.466,98	$0,12
	FEWA voyage owned container vessel	$0,00	$777.931,81	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$4.436.904,80	-$1.876.883,83	$2.685,78	$0,13
	Total FEWA [Annual]	**$29.317.635,56**	**$40.452.454,35**	**$15.938.103,48**	**$1.573.000,00**	**$32.083.314,38**	**$19.702.834,62**	**$9.356.635,68**	**$5.041.804,12**	**$25.578.510,48**	**$4.336.771,05**	**$212.131.440,46**	**-$79.010.350,12**	**$2.469,40**	**$0,12**
	SWAX voyage chartered container vessel	$794.309,50	$499.898,64	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.362,41	$31.451,48	$2.086.304,71	-$1.018.676,06	$3.348,80	$0,16
	SWAX voyage owned container vessel	$0,00	$499.898,64	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.362,41	$31.451,48	$2.058.636,30	-$991.007,65	$3.304,39	$0,15
	Total SWAX [Annual]	**$20.959.433,54**	**$25.994.729,27**	**$9.955.659,43**	**$1.573.000,00**	**$6.423.407,69**	**$8.549.951,81**	**$170.717,65**	**$2.045.962,80**	**$10.834.845,23**	**$1.635.477,22**	**$101.521.645,87**	**-$46.004.955,99**	**$3.133,77**	**$0,15**
Total Asia - West Africa [Annual]		**$50.277.069,10**	**$66.447.183,61**	**$25.893.762,91**	**$3.146.000,00**	**$38.506.722,07**	**$28.252.786,43**	**$9.527.353,33**	**$7.087.766,92**	**$36.413.355,70**	**$5.972.248,27**	**$313.653.086,34**	**-$125.015.306,11**	**$2.651,34**	**$0,14**
Europe - West Africa	WEWA voyage chartered container vessel	$756.897,07	$443.376,79	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$503.175,39	$85.267,35	$3.509.260,59	-$562.043,56	$2.077,71	$0,19
	WEWA voyage owned container vessel	$0,00	$443.376,79	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$503.175,39	$85.267,35	$3.798.348,31	-$851.131,28	$2.248,87	$0,21
Total Europe - West Africa [Annual]		**$20.614.912,38**	**$23.055.593,27**	**$9.959.222,52**	**$1.573.000,00**	**$42.560.610,16**	**$23.238.477,20**	**$6.011.980,59**	**$6.124.996,61**	**$26.165.120,38**	**$4.433.902,12**	**$185.036.881,34**	**-$31.781.595,84**	**$2.106,81**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$413.817,11	$281.188,54	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.387.362,33	-$765.192,22	$2.854,66	$0,31
	ECSA voyage owned container vessel	$0,00	$281.188,54	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.425.151,26	-$802.981,15	$2.932,41	$0,32
Total South America - West Africa [Annual]		**$10.988.583,42**	**$14.621.803,94**	**$5.618.890,68**	**$1.573.000,00**	**$11.841.117,62**	**$4.866.695,53**	**$2.624.155,35**	**$1.294.113,83**	**$6.908.745,10**	**$1.275.829,74**	**$69.764.598,57**	**-$37.411.752,82**	**$2.760,55**	**$0,32**
Inter West Africa	Feeder 1 voyage chartered container vessel	$114.792,76	$24.214,33	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.478,37	$9.490,98	$445.955,33	-$249.475,65	$2.372,10	$1,86
	Feeder 1 voyage owned container vessel	$0,00	$24.214,33	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.478,37	$9.490,98	$400.894,38	-$204.414,71	$2.132,42	$1,67
	Total Feeder 1 [Annual]	**$2.335.945,54**	**$1.259.145,13**	**$2.504.752,54**	**$1.573.000,00**	**$5.188.705,95**	**$3.716.277,45**	**$308.724,16**	**$435.442,17**	**$1.740.875,08**	**$493.530,85**	**$21.152.261,93**	**-$10.935.318,77**	**$2.163,69**	**$1,74**
	Feeder 2 voyage chartered container vessel	$259.038,62	$32.409,84	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$116.061,20	$35.086,33	$1.382.688,75	-$730.635,55	$1.989,48	$5,82
	Feeder 2 voyage owned container vessel	$0,00	$32.409,84	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$116.061,20	$35.086,33	$1.406.607,66	-$754.554,46	$2.023,90	$5,92
	Total Feeder 2 [Annual]	**$5.501.303,65**	**$1.685.311,85**	**$4.686.738,68**	**$1.573.000,00**	**$25.485.943,60**	**$15.787.405,30**	**$19.295,26**	**$1.332.441,02**	**$6.035.182,20**	**$1.824.489,03**	**$70.041.941,02**	**-$36.135.174,66**	**$1.938,07**	**$5,88**
Total Inter West Africa [Annual]		**$7.837.249,19**	**$2.944.456,98**	**$7.191.491,22**	**$3.146.000,00**	**$30.674.649,55**	**$19.503.682,76**	**$328.019,42**	**$1.767.883,19**	**$7.776.057,28**	**$2.318.019,88**	**$91.194.202,95**	**-$47.070.493,43**	**$1.986,11**	**$4,32**
Grand Total [Annual]		**$89.717.814,10**	**$107.069.037,80**	**$48.663.367,32**	**$9.438.000,00**	**$123.583.099,39**	**$75.861.641,92**	**$18.491.508,69**	**$16.274.760,55**	**$77.263.278,47**	**$14.000.000,00**	**$659.648.769,19**	**-$241.279.148,20**	**$2.378,69**	**$0,71**

Figure 472: Results sensitivity analysis: 20% decrease in bunker price scenario 3, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	2.054	781	2.410	1.035	214	1.042
14 ton TEU capacity [14 ton TEU]	1.522	570	1.788	760	146	765
Amount of reefer plugs	287	123	333	155	50	156
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	193,5	139,3	202,0	159,3	98,2	159,6
B [m]	32,3	25,3	33,7	26,5	17,9	26,6
T [m]	9,2	7,4	9,6	7,8	5,3	7,8
D [m]	16,9	12,5	17,8	13,6	8,3	13,7
LBD [m³]	95.702,4	40.590,8	110.279,7	52.107,3	12.874,3	52.419,8
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [ton]	38.312	17.505	43.607	21.990	6.134	22.111
Displacement Volume [m³]	37.377	17.079	42.544	21.454	5.985	21.571
DWT [ton]	29.692	12.926	34.067	16.468	4.246	16.564
Gross Tonnage [m³]	22.131	9.370	25.509	12.035	2.965	12.107
Wsm [ton]	11.606	5.532	13.119	6.864	2.051	6.900
Wst [ton]	8.207	3.793	9.324	4.749	1.349	4.774
Vs (design) [kn]	20,2	17,3	20,6	18,4	14,7	18,4
Vs (Max)	20,3	17,4	20,7	18,5	14,7	18,5
LCB [m]	-1,23	-1,71	-1,18	-1,49	-2,42	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,4	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,9	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,9	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,4	7,2
Pb (MCR) [kW]	19.500	7.600	22.400	10.500	2.500	10.500
Cad [-]	488	467	491	473	426	475
Fuel consumption design condition [ton/h]	3,71	1,44	4,26	2,00	0,48	2,00
Generator power [kW]	2.075	1.086	2.568	1.276	661	1.282
Operational costs [$/day]	$3.193,02	$2.438,61	$3.407,99	$2.733,33	$1.744,39	$2.737,14
Average capital costs [$/day]	$8.630,83	$4.489,25	$9.600,47	$5.480,40	$2.143,25	$5.494,74
Average charter price [$/day]	$8.924,70	$7.177,89	$9.413,20	$7.526,43	$6.399,85	$7.536,03
Capacity fuel tanks [m³]	2.841	1.227	3.263	1.567	399	1.576
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	36.198	14.859	41.821	19.258	4.497	19.377
Displacement outbound [ton]	30.437	15.244	34.686	18.275	6.059	18.359
Pb inbound [kW]	2.858	1.647	4.059	2.208	815	1.933
Pb outbound [kW]	2.546	1.675	3.583	2.132	994	1.865
Fuel consumption inbound [ton/h]	0,543	0,313	0,771	0,420	0,155	0,367
Fuel consumption outbound [ton/h]	0,484	0,318	0,681	0,405	0,189	0,354

U.4.4 Scenario 4

Figure 473: Results sensitivity analysis: 20% decrease in bunker price scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$0,00
	SWAX 2 voyage owned container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$1.714.105,61
Total Asia - West Africa [Annual]		**2.496**	**1.853**	**129.792**	**96.339**	**6**	**11**	**129,00**	**1.321.580**	**19**	**10**	**9**	**31.026**	**38.604**	**69.631**	**98.332**	**95.628**	**2.704**	**98.332**	**2.704**	**95.628**	**196.664**	**98.332**	**98.332**	**$128.359.754,75**	**$1.160.770,13**	**$129.520.524,89**	**$36.322.464,41**
Europe - West Africa	WEWA voyage chartered container vessel	2.387	1.771	124.124	92.100	9	11	79,33	10.801	12	6	6	243	347	589	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$0,00
	WEWA voyage owned container vessel	2.387	1.771	124.124	92.100	9	11	79,33	10.801	12	6	6	243	347	589	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$1.021.981,02
Total Europe - West Africa [Annual]		**2.387**	**1.771**	**124.124**	**92.100**	**9**	**11**	**79,33**	**561.652**	**12**	**6**	**6**	**12.631**	**18.021**	**30.652**	**85.436**	**83.824**	**1.612**	**85.436**	**1.612**	**83.824**	**170.872**	**85.436**	**85.436**	**$150.590.236,79**	**$885.363,73**	**$151.475.600,53**	**$21.073.114,27**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$452.911,15
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**55,14**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.152.097,66**
Inter West Africa	Feeder 3 voyage chartered container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$0,00
	Feeder 3 voyage owned container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$67.130,63
	Total Feeder 3 [Annual]	**204**	**138**	**10.608**	**7.201**	**4**	**11**	**17,64**	**23.556**	**3**	**2**	**1**	**845**	**382**	**1.227**	**7.384**	**7.072**	**312**	**7.384**	**312**	**7.072**	**14.768**	**7.384**	**7.384**	**$6.466.919,44**	**$90.113,23**	**$6.557.032,67**	**$1.549.120,33**
	Feeder 4 voyage chartered container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$0,00
	Feeder 4 voyage owned container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$109.694,49
	Total Feeder 4 [Annual]	**287**	**201**	**14.924**	**10.429**	**4**	**11**	**25,22**	**100.516**	**4**	**2**	**2**	**1.732**	**965**	**2.697**	**14.300**	**13.364**	**936**	**14.300**	**936**	**13.364**	**28.600**	**14.300**	**14.300**	**$19.877.940,37**	**$270.339,69**	**$20.148.280,07**	**$1.871.718,99**
	Feeder 5 voyage chartered container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$0,00
	Feeder 5 voyage owned container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$312.905,11
	Total Feeder 5 [Annual]	**1.036**	**761**	**53.872**	**39.558**	**5**	**11**	**38,08**	**31.772**	**6**	**3**	**3**	**2.200**	**551**	**2.751**	**35.932**	**35.932**	**0**	**35.932**	**0**	**35.932**	**71.864**	**35.932**	**35.932**	**$33.924.244,60**	**$0,00**	**$33.924.244,60**	**$6.107.396,33**
	Feeder 6 voyage chartered container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$0,00
	Feeder 6 voyage owned container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$383.088,03
	Total feeder 6 [Annual]	**1.040**	**764**	**54.080**	**39.714**	**5**	**11**	**46,57**	**253.396**	**7**	**4**	**3**	**4.634**	**3.882**	**8.517**	**45.448**	**45.084**	**364**	**45.448**	**364**	**45.084**	**90.896**	**45.448**	**45.448**	**$47.525.710,41**	**$100.313,47**	**$47.626.023,88**	**$8.143.755,09**
Total Inter West Africa [Annual]				**133.484**	**96.901**				**409.240**	**20**	**11**	**9**	**9.411**	**5.780**	**15.191**	**103.064**	**101.452**	**1.612**	**103.064**	**1.612**	**101.452**	**206.128**	**103.064**	**103.064**	**$107.794.814,82**	**$460.766,39**	**$108.255.581,22**	**$17.671.990,74**
Grand Total [Annual]				**441.220**	**324.859**				**2.765.412**	**59**	**31**	**28**	**63.488**	**71.575**	**135.064**	**312.104**	**306.176**	**5.928**	**312.104**	**5.928**	**306.176**	**624.208**	**312.104**	**312.104**	**$419.097.652,11**	**$2.506.900,26**	**$421.604.552,37**	**$83.219.667,08**

Figure 474: Results sensitivity analysis: 20% decrease in bunker price scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$1.229.512,23	$999.467,41	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$3.993.074,25	-$1.502.294,93	$2.111,62	$0,08
	SWAX 2 voyage owned container vessel	$0,00	$999.467,41	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$4.477.667,63	-$1.986.888,30	$2.367,88	$0,09
Total Asia - West Africa [Annual]		**$31.310.028,79**	**$51.972.305,08**	**$6.703.315,01**	**$1.573.000,00**	**$24.559.268,94**	**$15.520.772,85**	**$11.383.402,99**	**$4.590.364,12**	**$22.991.933,13**	**$4.410.863,05**	**$211.337.718,37**	**-$81.817.193,48**	**$2.149,23**	**$0,09**
Europe - West Africa	WEWA voyage chartered container vessel	$744.283,16	$439.973,37	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.367.477,20	-$454.484,88	$2.049,59	$0,19
	WEWA voyage owned container vessel	$0,00	$439.973,37	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.645.175,06	-$732.182,75	$2.218,61	$0,21
Total Europe - West Africa [Annual]		**$20.545.794,67**	**$22.878.615,11**	**$9.933.614,96**	**$1.573.000,00**	**$39.958.349,38**	**$22.027.881,22**	**$3.902.849,89**	**$6.070.273,06**	**$26.229.117,26**	**$3.832.389,20**	**$178.024.999,04**	**-$26.549.398,51**	**$2.083,72**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$415.013,01	$281.188,54	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.358.435,40	-$736.265,29	$2.795,13	$0,31
	ECSA voyage owned container vessel	$0,00	$281.188,54	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.396.333,54	-$774.163,43	$2.873,11	$0,32
Total South America - West Africa [Annual]		**$10.988.583,42**	**$14.621.803,94**	**$5.618.890,68**	**$1.573.000,00**	**$11.412.278,79**	**$5.018.600,95**	**$1.395.397,34**	**$1.294.113,83**	**$6.990.256,49**	**$1.133.622,13**	**$68.198.645,23**	**-$35.845.799,49**	**$2.698,59**	**$0,31**
Inter West Africa	Feeder 3 voyage chartered container vessel	$112.671,04	$17.612,96	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$304.910,75	-$178.813,97	$2.147,26	$4,74
	Feeder 3 voyage owned container vessel	$0,00	$17.612,96	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$259.370,34	-$133.273,56	$1.826,55	$4,03
	Total Feeder 3 [Annual]	**$2.330.937,01**	**$915.874,02**	**$3.334.721,73**	**$1.573.000,00**	**$842.734,24**	**$454.976,03**	**$1.579.694,78**	**$253.005,70**	**$711.235,82**	**$331.222,93**	**$13.876.522,58**	**-$7.319.489,92**	**$1.879,27**	**$4,27**
	Feeder 4 voyage chartered container vessel	$163.958,07	$38.708,12	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$537.429,41	-$149.962,49	$1.954,29	$1,01
	Feeder 4 voyage owned container vessel	$0,00	$38.708,12	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$483.165,84	-$95.698,92	$1.756,97	$0,91
	Total Feeder 4 [Annual]	**$4.745.015,62**	**$2.012.822,04**	**$3.375.792,78**	**$1.573.000,00**	**$3.763.089,74**	**$2.106.936,44**	**$3.506.715,55**	**$829.920,04**	**$1.610.780,73**	**$641.452,85**	**$26.037.244,77**	**-$5.888.964,71**	**$1.820,79**	**$0,96**
	Feeder 5 voyage chartered container vessel	$286.683,85	$39.484,21	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$919.134,47	-$266.745,15	$1.330,15	$2,18
	Feeder 5 voyage owned container vessel	$0,00	$39.484,21	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$945.355,73	-$292.966,41	$1.368,10	$2,24
	Total Feeder 5 [Annual]	**$8.242.940,12**	**$2.053.178,81**	**$4.683.027,44**	**$1.573.000,00**	**$5.204.211,99**	**$3.269.905,53**	**$9.451.135,53**	**$1.336.471,74**	**$3.704.705,17**	**$1.611.796,07**	**$47.237.768,74**	**-$13.313.524,15**	**$1.314,64**	**$2,21**
	Feeder 6 voyage chartered container vessel	$350.798,19	$122.247,56	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.250.090,09	-$334.205,02	$1.430,31	$0,29
	Feeder 6 voyage owned container vessel	$0,00	$122.247,56	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.282.379,93	-$366.494,85	$1.467,25	$0,30
	Total feeder 6 [Annual]	**$8.248.950,36**	**$6.356.873,15**	**$4.685.501,60**	**$1.573.000,00**	**$8.501.988,26**	**$5.625.449,13**	**$9.685.781,42**	**$2.049.180,43**	**$6.246.750,97**	**$2.038.653,78**	**$63.155.884,18**	**-$15.529.860,30**	**$1.389,63**	**$0,30**
Total Inter West Africa [Annual]		**$23.567.843,12**	**$11.338.748,02**	**$16.079.043,55**	**$6.292.000,00**	**$18.312.024,23**	**$11.457.267,12**	**$24.223.327,28**	**$4.468.577,91**	**$12.273.472,69**	**$4.623.125,62**	**$150.307.420,29**	**-$42.051.839,07**	**$1.458,39**	**$1,60**
Grand Total [Annual]		**$86.412.250,00**	**$100.811.472,16**	**$38.334.864,20**	**$11.011.000,00**	**$94.241.921,34**	**$54.024.522,15**	**$40.904.977,51**	**$16.423.328,92**	**$68.484.779,58**	**$14.000.000,00**	**$607.868.782,93**	**-$186.264.230,56**	**$1.947,65**	**$0,65**

Figure 475: Results sensitivity analysis: 20% decrease in bunker price scenario 4, specifications container vessels

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.496	2.387	1.035	204	287	1.036	1.040
14 ton TEU capacity [14 ton TEU]	1.853	1.771	760	138	201	761	764
Amount of reefer plugs	344	330	155	48	59	156	156
Amount of ship cranes	3	3	2	2	2	2	2
Lpp [m]	204,0	201,5	159,3	96,9	106,3	159,3	159,5
B [m]	34,0	33,6	26,5	17,6	19,3	26,6	26,6
T [m]	9,7	9,6	7,8	5,2	5,7	7,8	7,8
D [m]	18,0	17,8	13,6	8,2	9,1	13,6	13,7
LBD [m³]	113.763,3	109.345,6	52.107,3	12.339,2	16.702,7	52.151,9	52.330,5
B/T [-]	3,5	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.864	43.270	21.990	5.901	7.781	22.007	22.076
Displacement Volume [m³]	43.769	42.215	21.454	5.757	7.591	21.471	21.538
DWT [t]	35.110	33.787	16.468	4.075	5.465	16.482	16.537
Gross Tonnage [m³]	26.316	25.292	12.035	2.842	3.849	12.045	12.087
Wsm [t]	13.476	13.023	6.864	1.977	2.568	6.869	6.889
Wst [t]	9.589	9.253	4.749	1.299	1.706	4.752	4.767
Vs (design) [kn]	20,7	20,5	18,4	14,6	15,2	18,4	18,4
Vs (Max)	20,8	20,6	18,5	14,6	15,2	18,5	18,5
LCB [m]	-1,16	-1,18	-1,49	-2,45	-2,24	-1,49	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Ta [m]	8,9	8,8	7,7	5,8	6,1	7,7	7,7
Tf [m]	7,9	7,8	6,7	4,8	5,1	6,7	6,7
Tav (in ballast) [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Pb (MCR) [kW]	23.100	21.900	10.500	2.350	3.150	10.500	10.500
Cad [-]	492	492	473	432	438	474	475
Fuel consumption design condition [t/h]	4,39	4,16	2,00	0,45	0,60	2,00	2,00
Generator power [kW]	2.687	2.536	1.276	653	715	1.277	1.280
Operational costs [$/day]	$3.458,67	$3.382,10	$2.733,33	$1.724,52	$1.848,65	$2.733,87	$2.736,05
Average capital costs [$/day]	$9.829,12	$9.499,91	$5.480,40	$2.080,40	$2.500,12	$5.482,45	$5.490,65
Average charter price [$/day]	$9.531,21	$9.381,64	$7.526,43	$6.386,13	$6.500,02	$7.527,80	$7.533,29
Capacity fuel tanks [m³]	3.364	3.236	1.567	383	515	1.568	1.573
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	43.364	41.443	19.258	4.306	5.528	19.279	16.235
Displacement outbound [t]	35.712	34.412	18.275	5.855	7.547	18.287	18.335
Pb inbound [kW]	3.195	4.023	2.208	779	909	1.933	1.720
Pb outbound [kW]	2.807	3.554	2.132	956	1.119	1.866	1.865
Fuel consumption inbound [t/h]	0,607	0,764	0,420	0,148	0,173	0,367	0,327
Fuel consumption outbound [t/h]	0,533	0,675	0,405	0,182	0,213	0,355	0,354

U.5 20% decrease in time charter rates

U.5.1 Scenario 1

Figure 476: Results sensitivity analysis: 20% increase in time charter rates scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$0,00
	FEWA voyage owned container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$1.489.141,86
	Total FEWA [Annual]	**2.092**	**1.551**	**108.784**	**80.627**	**15**	**11**	**124,78**	**1.101.880**	**18**	**9**	**9**	**22.834**	**31.920**	**54.754**	**86.476**	**86.476**	**0**	**86.476**	**0**	**86.476**	**172.952**	**86.476**	**86.476**	**$135.884.346,25**	**$0,00**	**$135.884.346,25**	**$29.053.450,83**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**148.564**	**109.645**				**2.223.208**	**34**	**17**	**17**	**39.892**	**49.431**	**89.323**	**117.676**	**117.572**	**104**	**117.676**	**104**	**117.572**	**235.352**	**117.676**	**117.676**	**$191.628.944,18**	**$52.114,15**	**$191.681.058,33**	**$42.236.286,35**
Europe - West Africa	WEWA voyage chartered container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$0,00
	WEWA voyage owned container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$1.091.206,24
Total Europe - West Africa [Annual]		**2.537**	**1.883**	**131.924**	**97.933**	**9**	**11**	**81,13**	**561.652**	**12**	**6**	**6**	**12.996**	**18.594**	**31.591**	**92.664**	**88.504**	**4.160**	**92.664**	**4.160**	**88.504**	**185.328**	**92.664**	**92.664**	**$156.148.243,93**	**$2.311.783,09**	**$158.460.027,02**	**$22.116.834,82**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**402.480**	**296.618**				**3.341.884**	**62**	**32**	**30**	**66.394**	**78.247**	**144.641**	**283.764**	**278.616**	**5.148**	**283.764**	**5.148**	**278.616**	**567.528**	**283.764**	**283.764**	**$426.084.658,71**	**$2.642.622,85**	**$428.727.281,56**	**$80.469.174,19**

Figure 477: Results sensitivity analysis: 20% increase in time charter rates scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$896.098,41	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$3.743.108,04	-$1.129.947,54	$2.250,82	$0,11
	FEWA voyage owned container vessel	$0,00	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$4.336.151,49	-$1.722.990,98	$2.607,43	$0,12
	Total FEWA [Annual]	**$23.591.141,83**	**$34.057.196,45**	**$16.008.617,04**	**$1.573.000,00**	**$32.398.072,74**	**$19.756.720,18**	**$9.598.565,17**	**$5.145.111,82**	**$25.240.770,56**	**$4.266.446,77**	**$200.689.093,40**	**-$64.804.747,15**	**$2.320,75**	**$0,11**
	SWAX voyage chartered container vessel	$632.555,24	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$1.815.134,04	-$742.120,35	$3.025,22	$0,14
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$1.938.528,22	-$865.514,53	$3.230,88	$0,15
	Total SWAX [Annual]	**$16.716.259,49**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.275.836,35**	**$1.539.307,31**	**$91.393.192,75**	**-$35.596.480,68**	**$2.929,27**	**$0,15**
Total Asia - West Africa [Annual]		**$40.307.401,32**	**$55.558.611,60**	**$25.942.503,86**	**$3.146.000,00**	**$38.574.495,02**	**$28.082.366,79**	**$9.709.919,56**	**$7.202.340,66**	**$35.516.606,91**	**$5.805.754,08**	**$292.082.286,15**	**-$100.401.227,82**	**$2.482,09**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$622.236,06	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.408.497,87	-$361.189,66	$1.912,74	$0,18
	WEWA voyage owned container vessel	$0,00	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.877.468,05	-$830.159,84	$2.175,91	$0,20
Total Europe - West Africa [Annual]		**$16.797.249,89**	**$19.649.438,30**	**$10.100.620,76**	**$1.573.000,00**	**$44.579.974,52**	**$24.603.082,09**	**$6.204.933,19**	**$6.339.408,46**	**$27.263.413,99**	**$4.571.742,72**	**$183.799.698,74**	**-$25.339.671,73**	**$1.983,51**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$333.282,37	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.274.589,87	-$636.040,33	$2.554,29	$0,28
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.400.802,20	-$762.252,66	$2.807,22	$0,31
Total South America - West Africa [Annual]		**$8.835.743,16**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.987.352,91**	**$1.280.190,58**	**$66.083.196,79**	**-$32.878.620,76**	**$2.546,75**	**$0,29**
Inter West Africa	Feeder 1 voyage chartered container vessel	$92.118,38	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$426.956,41	-$226.165,28	$2.167,29	$1,70
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$403.998,43	-$203.207,30	$2.050,75	$1,61
	Total Feeder 1 [Annual]	**$1.866.753,02**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.373,86**	**$505.405,90**	**$20.847.845,96**	**-$10.406.706,82**	**$2.035,13**	**$1,64**
	Feeder 2 voyage chartered container vessel	$211.144,23	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.358.015,69	-$686.083,36	$1.896,67	$5,55
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.439.046,07	-$767.113,74	$2.009,84	$5,88
	Total Feeder 2 [Annual]	**$4.426.686,60**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.836.906,73**	**$70.311.076,46**	**-$35.370.595,41**	**$1.888,46**	**$5,74**
Total Inter West Africa [Annual]		**$6.293.439,62**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.226,14**	**$2.342.312,63**	**$91.158.922,41**	**-$45.777.302,23**	**$1.920,11**	**$4,20**
Grand Total [Annual]		**$72.233.833,99**	**$89.966.995,90**	**$48.892.227,12**	**$9.438.000,00**	**$126.878.243,09**	**$77.731.284,98**	**$19.079.275,37**	**$16.686.469,48**	**$77.748.599,96**	**$14.000.000,00**	**$633.124.104,10**	**-$204.396.822,54**	**$2.231,16**	**$0,69**

Figure 478: Results sensitivity analysis: 20% increase in time charter rates scenario 1, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	2.092	765	2.537	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.551	558	1.883	781	142	789
Amount of reefer plugs	292	121	349	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	194,5	138,5	204,9	160,4	97,6	160,9
B [m]	32,4	25,2	34,1	26,7	17,7	26,8
T [m]	9,3	7,4	9,8	7,9	5,2	7,9
D [m]	17,0	12,4	18,1	13,8	8,2	13,8
LBD [m³]	97.271,3	39.852,4	115.419,4	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	38.885	17.214	45.460	22.471	6.018	22.659
Displacement Volume [m³]	37.937	16.795	44.351	21.923	5.871	22.106
DWT [t]	30.163	12.698	35.605	16.851	4.160	17.000
Gross Tonnage [m³]	22.494	9.199	26.700	12.324	2.904	12.437
Wsm [t]	11.770	5.445	13.645	7.006	2.014	7.061
Wst [t]	8.328	3.731	9.714	4.851	1.324	4.891
Vs (design) [kn]	20,2	17,2	20,7	18,5	14,6	18,5
Vs (Max)	20,3	17,3	20,8	18,6	14,6	18,6
LCB [m]	-1,22	-1,72	-1,16	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,3	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,8	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,8	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,3	7,2
Pb (MCR) [kW]	19.700	7.400	23.300	10.800	2.400	10.900
Cad [-]	487	466	492	474	429	473
Fuel consumption design condition [t/h]	3,74	1,41	4,43	2,05	0,46	2,07
Generator power [kW]	2.127	1.074	2.744	1.297	657	1.306
Operational costs [$/day]	$3.211,94	$2.418,33	$3.480,65	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$8.722,27	$4.423,16	$9.970,07	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$8.976,84	$7.155,93	$9.587,47	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	2.886	1.205	3.412	1.604	391	1.618
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	36.840	14.579	43.477	19.727	4.401	19.916
Displacement outbound [t]	30.891	15.053	36.202	18.610	5.957	18.741
Pb inbound [kW]	2.892	1.629	3.200	2.239	797	1.979
Pb outbound [kW]	2.572	1.664	2.832	2.153	975	1.900
Fuel consumption inbound [t/h]	0,549	0,309	0,608	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,489	0,316	0,538	0,409	0,185	0,361

U.5.2 Scenario 2

Figure 479: Results sensitivity analysis: 20% increase in time charter rates scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$0,00
	FEWA 2 voyage owned container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$1.521.991,24
	Total FEWA [Annual]	**2.219**	**1.645**	**115.388**	**85.566**	**16**	**12**	**122,86**	**1.103.596**	**18**	**9**	**9**	**26.017**	**35.711**	**61.728**	**90.012**	**89.492**	**520**	**90.012**	**520**	**89.492**	**180.024**	**90.012**	**90.012**	**$141.574.371,76**	**$286.609,91**	**$141.860.981,67**	**$30.272.549,93**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**155.168**	**114.584**				**2.224.924**		**17**	**17**	**43.074**	**53.222**	**96.297**	**121.212**	**120.588**	**624**	**121.212**	**624**	**120.588**	**242.424**	**121.212**	**121.212**	**$197.318.969,69**	**$338.724,05**	**$197.657.693,75**	**$43.455.385,45**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$0,00
	WEWA 2 voyage owned container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$1.147.946,27
Total Europe - West Africa [Annual]		**2.612**	**1.939**	**135.818**	**100.845**	**10**	**12**	**83,76**	**563.004**	**12**	**6**	**6**	**13.522**	**21.416**	**34.937**	**97.552**	**90.584**	**6.968**	**97.552**	**6.968**	**90.584**	**195.104**	**97.552**	**97.552**	**$160.317.375,54**	**$4.082.510,56**	**$164.399.886,10**	**$22.585.311,72**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**412.978**	**304.469**				**3.344.952**	**28**	**32**	**30**	**70.102**	**84.860**	**154.962**	**292.188**	**283.712**	**8.476**	**292.188**	**8.476**	**283.712**	**584.376**	**292.188**	**292.188**	**$435.943.815,83**	**$4.699.960,23**	**$440.643.776,06**	**$82.156.750,18**

Figure 480: Results sensitivity analysis: 20% increase in time charter rates scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transhipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$899.440,00	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$510.689,25	$82.939,75	$3.902.087,80	-$1.173.992,00	$2.254,24	$0,11
	FEWA 2 voyage owned container vessel	$0,00	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$510.689,25	$82.939,75	$4.524.639,03	-$1.796.543,23	$2.613,89	$0,12
	Total FEWA [Annual]	**$24.049.121,81**	**$38.395.094,93**	**$17.327.232,83**	**$1.573.000,00**	**$33.181.282,48**	**$19.839.508,08**	**$9.598.565,17**	**$5.354.294,06**	**$26.555.840,95**	**$4.312.867,06**	**$210.459.357,30**	**-$68.598.375,63**	**$2.338,13**	**$0,11**
	SWAX voyage chartered container vessel	$632.555,24	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.076,66	$28.748,61	$1.813.745,01	-$740.731,32	$3.022,91	$0,14
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.076,66	$28.748,61	$1.937.139,19	-$864.125,50	$3.228,57	$0,15
	Total SWAX [Annual]	**$16.716.259,49**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.247.986,19**	**$1.494.927,92**	**$91.320.963,21**	**-$35.524.251,13**	**$2.926,95**	**$0,14**
Total Asia - West Africa [Annual]		**$40.765.381,30**	**$59.896.510,07**	**$27.261.119,65**	**$3.146.000,00**	**$39.357.704,76**	**$28.165.154,69**	**$9.709.919,56**	**$7.411.522,90**	**$36.803.827,14**	**$5.807.794,98**	**$301.780.320,50**	**-$104.122.626,76**	**$2.489,69**	**$0,13**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$649.295,43	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$3.581.798,73	-$420.262,45	$1.909,27	$0,18
	WEWA 2 voyage owned container vessel	$0,00	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$4.080.449,56	-$918.913,29	$2.175,08	$0,20
Total Europe - West Africa [Annual]		**$16.977.274,49**	**$21.730.931,20**	**$11.315.547,60**	**$1.573.000,00**	**$45.557.094,76**	**$25.767.157,30**	**$6.204.933,19**	**$6.577.002,82**	**$29.090.363,22**	**$4.674.141,31**	**$192.052.757,61**	**-$27.652.871,51**	**$1.968,72**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$333.282,37	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.273.986,25	-$635.436,71	$2.553,08	$0,28
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.400.198,58	-$761.649,04	$2.806,01	$0,31
Total South America - West Africa [Annual]		**$8.835.743,16**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.992.873,56**	**$1.243.281,72**	**$66.051.808,58**	**-$32.847.232,55**	**$2.545,55**	**$0,29**
Inter West Africa	Feeder 1 voyage chartered container vessel	$92.118,38	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,77	$9.439,13	$426.676,09	-$225.884,95	$2.165,87	$1,70
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,77	$9.439,13	$403.718,11	-$202.926,97	$2.049,33	$1,61
	Total Feeder 1 [Annual]	**$1.866.753,02**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.368,20**	**$490.834,67**	**$20.833.269,06**	**-$10.392.129,93**	**$2.033,70**	**$1,64**
	Feeder 2 voyage chartered container vessel	$211.144,23	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.356.997,24	-$685.064,91	$1.895,25	$5,54
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.438.027,62	-$766.095,29	$2.008,42	$5,87
	Total Feeder 2 [Annual]	**$4.426.686,60**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.783.947,32**	**$70.258.117,05**	**-$35.317.636,00**	**$1.887,04**	**$5,74**
Total Inter West Africa [Annual]		**$6.293.439,62**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.220,48**	**$2.274.781,99**	**$91.091.386,12**	**-$45.709.765,93**	**$1.918,68**	**$4,20**
Grand Total [Annual]		**$72.871.838,57**	**$96.386.387,27**	**$51.425.769,76**	**$9.438.000,00**	**$128.638.573,07**	**$78.978.148,10**	**$19.079.275,37**	**$17.133.246,09**	**$80.868.284,41**	**$14.000.000,00**	**$650.976.272,82**	**-$210.332.496,75**	**$2.227,94**	**$0,69**

Figure 481: Results sensitivity analysis: 20% increase in time charter rates scenario 2, specifications container vessels

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	2.219	765	2.612	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.645	558	1.939	781	142	789
Amount of reefer plugs	308	121	359	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	197,6	138,5	206,5	160,4	97,6	160,9
B [m]	32,9	25,2	34,4	26,7	17,7	26,8
T [m]	9,4	7,4	9,8	7,9	5,2	7,9
D [m]	17,4	12,4	18,3	13,8	8,2	13,8
LBD [m³]	102.491,5	39.852,4	118.436,1	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	40.786	17.214	46.544	22.471	6.018	22.659
Displacement Volume [m³]	39.791	16.795	45.408	21.923	5.871	22.106
DWT [t]	31.732	12.698	36.507	16.851	4.160	17.000
Gross Tonnage [m³]	23.704	9.199	27.399	12.324	2.904	12.437
Wsm [t]	12.314	5.445	13.953	7.006	2.014	7.061
Wst [t]	8.729	3.731	9.943	4.851	1.324	4.891
Vs (design) [kn]	20,4	17,2	20,8	18,5	14,6	18,5
Vs (Max)	20,5	17,3	20,9	18,6	14,6	18,6
LCB [m]	-1,20	-1,72	-1,15	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,2	6,7	8,5	7,2	5,3	7,2
Ta [m]	8,7	7,2	9,0	7,7	5,8	7,7
Tf [m]	7,7	6,2	8,0	6,7	4,8	6,7
Tav (in ballast) [m]	8,2	6,7	8,5	7,2	5,3	7,2
Pb (MCR) [kW]	20.900	7.400	24.000	10.800	2.400	10.900
Cad [-]	488	466	492	474	429	473
Fuel consumption design condition [t/h]	3,97	1,41	4,56	2,05	0,46	2,07
Generator power [kW]	2.303	1.074	2.847	1.297	657	1.306
Operational costs [$/day]	$3.295,96	$2.418,33	$3.527,75	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$9.092,12	$4.423,16	$10.178,01	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$9.151,11	$7.155,93	$9.690,23	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	3.038	1.205	3.499	1.604	391	1.618
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	38.886	14.579	44.411	19.727	4.401	19.916
Displacement outbound [t]	32.406	15.053	37.096	18.610	5.957	18.741
Pb inbound [kW]	3.419	1.629	3.707	2.239	797	1.979
Pb outbound [kW]	3.028	1.664	3.288	2.153	975	1.900
Fuel consumption inbound [t/h]	0,650	0,309	0,704	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,575	0,316	0,625	0,409	0,185	0,361

U.5.3 Scenario 3

Figure 482: Results sensitivity analysis: 20% increase in time charter rates scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$0,00
	FEWA voyage owned container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$1.474.146,56
	Total FEWA [Annual]	**2.054**	**1.522**	**106.808**	**79.149**	**15**	**11**	**124,68**	**1.101.880**	**18**	**9**	**9**	**22.581**	**31.616**	**54.197**	**85.904**	**84.240**	**1.664**	**85.904**	**1.664**	**84.240**	**171.808**	**85.904**	**85.904**	**$132.332.913,09**	**$788.177,25**	**$133.121.090,34**	**$28.750.376,75**
	SWAX voyage chartered container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$0,00
	SWAX voyage owned container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$766.641,09
	Total SWAX [Annual]	**781**	**570**	**40.612**	**29.641**	**11**	**11**	**110,66**	**1.121.328**	**16**	**8**	**8**	**17.209**	**17.618**	**34.827**	**32.396**	**30.368**	**2.028**	**32.396**	**2.028**	**30.368**	**64.792**	**32.396**	**32.396**	**$54.475.771,55**	**$1.040.918,33**	**$55.516.689,88**	**$13.378.461,25**
Total Asia - West Africa [Annual]				**147.420**	**108.790**				**2.223.208**		**17**	**17**	**39.790**	**49.234**	**89.024**	**118.300**	**114.608**	**3.692**	**118.300**	**3.692**	**114.608**	**236.600**	**118.300**	**118.300**	**$186.808.684,65**	**$1.829.095,58**	**$188.637.780,23**	**$42.128.838,00**
Europe - West Africa	WEWA voyage chartered container vessel	2.410	1.788	125.320	92.994	9	11	80,41	10.801	12	6	6	245	349	594	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$0,00
	WEWA voyage owned container vessel	2.410	1.788	125.320	92.994	9	11	80,41	10.801	12	6	6	245	349	594	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$1.045.984,79
Total Europe - West Africa [Annual]		**2.410**	**1.788**	**125.320**	**92.994**	**9**	**11**	**80,41**	**561.652**	**12**	**6**	**6**	**12.732**	**18.158**	**30.889**	**87.828**	**86.216**	**1.612**	**87.828**	**1.612**	**86.216**	**175.656**	**87.828**	**87.828**	**$152.214.367,16**	**$1.040.918,33**	**$153.255.285,49**	**$21.299.066,11**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$451.606,04
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**54,98**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.151.663,35**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$0,00
	Feeder 1 voyage owned container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$69.731,82
	Total Feeder 1 [Annual]	**214**	**146**	**11.128**	**7.590**	**3**	**11**	**17,94**	**66.300**	**3**	**2**	**1**	**1.037**	**650**	**1.687**	**9.776**	**9.256**	**520**	**9.776**	**520**	**9.256**	**19.552**	**9.776**	**9.776**	**$10.061.247,43**	**$155.695,73**	**$10.216.943,16**	**$1.595.863,07**
	Feeder 2 voyage chartered container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$0,00
	Feeder 2 voyage owned container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$282.957,53
	Total Feeder 2 [Annual]	**1.042**	**765**	**54.184**	**39.791**	**5**	**11**	**34,37**	**17.784**	**5**	**3**	**2**	**1.929**	**329**	**2.258**	**36.140**	**36.140**	**0**	**36.140**	**0**	**36.140**	**72.280**	**36.140**	**36.140**	**$33.906.766,36**	**$0,00**	**$33.906.766,36**	**$6.110.830,42**
Total Inter West Africa [Annual]				**65.312**	**47.381**				**84.084**	**8**	**5**	**3**	**2.966**	**979**	**3.945**	**45.916**	**45.396**	**520**	**45.916**	**520**	**45.396**	**91.832**	**45.916**	**45.916**	**$43.968.013,79**	**$155.695,73**	**$44.123.709,52**	**$7.706.693,48**
Grand Total [Annual]				**391.872**	**288.684**				**3.341.884**	**28**	**32**	**30**	**65.907**	**77.540**	**143.447**	**277.316**	**271.492**	**5.824**	**277.316**	**5.824**	**271.492**	**554.632**	**277.316**	**277.316**	**$415.343.911,35**	**$3.025.709,64**	**$418.369.620,99**	**$79.286.260,94**

Figure 483: Results sensitivity analysis: 20% increase in time charter rates scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$890.153,92	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$3.723.256,85	-$1.163.235,88	$2.253,79	$0,11
	FEWA voyage owned container vessel	$0,00	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$4.307.249,49	-$1.747.228,53	$2.607,29	$0,12
	Total FEWA [Annual]	**$23.454.108,45**	**$33.710.378,62**	**$15.938.103,48**	**$1.573.000,00**	**$32.083.314,38**	**$19.702.834,62**	**$9.356.635,68**	**$5.041.804,12**	**$25.578.510,48**	**$4.336.771,05**	**$199.525.837,63**	**-$66.404.747,28**	**$2.322,66**	**$0,11**
	SWAX voyage chartered container vessel	$635.447,60	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.362,41	$31.451,48	$1.844.126,37	-$776.497,72	$2.960,07	$0,14
	SWAX voyage owned container vessel	$0,00	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.362,41	$31.451,48	$1.975.319,86	-$907.691,21	$3.170,66	$0,15
	Total SWAX [Annual]	**$16.767.546,84**	**$21.662.274,39**	**$9.955.659,43**	**$1.573.000,00**	**$6.423.407,69**	**$8.549.951,81**	**$170.717,65**	**$2.045.962,80**	**$10.834.845,23**	**$1.635.477,22**	**$92.997.304,29**	**-$37.480.614,40**	**$2.870,64**	**$0,14**
Total Asia - West Africa [Annual]		**$40.221.655,28**	**$55.372.653,01**	**$25.893.762,91**	**$3.146.000,00**	**$38.506.722,07**	**$28.252.786,43**	**$9.527.353,33**	**$7.087.766,92**	**$36.413.355,70**	**$5.972.248,27**	**$292.523.141,91**	**-$103.885.361,69**	**$2.472,72**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$605.517,66	$369.480,66	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$503.175,39	$85.267,35	$3.283.985,04	-$336.768,01	$1.944,34	$0,18
	WEWA voyage owned container vessel	$0,00	$369.480,66	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$503.175,39	$85.267,35	$3.724.452,17	-$777.235,15	$2.205,12	$0,20
Total Europe - West Africa [Annual]		**$16.491.929,90**	**$19.212.994,39**	**$9.959.222,52**	**$1.573.000,00**	**$42.560.610,16**	**$23.238.477,20**	**$6.011.980,59**	**$6.124.996,61**	**$26.165.120,38**	**$4.433.902,12**	**$177.071.299,98**	**-$23.816.014,49**	**$2.016,11**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$331.053,68	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.257.734,15	-$635.564,04	$2.587,93	$0,28
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.378.286,51	-$756.116,40	$2.835,98	$0,31
Total South America - West Africa [Annual]		**$8.790.866,74**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.841.117,62**	**$4.866.695,53**	**$2.624.155,35**	**$1.294.113,83**	**$6.908.745,10**	**$1.275.829,74**	**$65.129.914,56**	**-$32.777.068,82**	**$2.577,16**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	$91.834,21	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.478,37	$9.490,98	$418.961,05	-$222.481,38	$2.228,52	$1,75
	Feeder 1 voyage owned container vessel	$0,00	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.478,37	$9.490,98	$396.858,66	-$200.378,98	$2.110,95	$1,66
	Total Feeder 1 [Annual]	**$1.868.756,43**	**$1.049.287,61**	**$2.504.752,54**	**$1.573.000,00**	**$5.188.705,95**	**$3.716.277,45**	**$308.724,16**	**$435.442,17**	**$1.740.875,08**	**$493.530,85**	**$20.475.215,30**	**-$10.258.272,14**	**$2.094,44**	**$1,69**
	Feeder 2 voyage chartered container vessel	$207.230,89	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$116.061,20	$35.086,33	$1.325.479,39	-$673.426,19	$1.907,16	$5,58
	Feeder 2 voyage owned container vessel	$0,00	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$116.061,20	$35.086,33	$1.401.206,02	-$749.152,82	$2.016,12	$5,90
	Total Feeder 2 [Annual]	**$4.401.042,92**	**$1.404.426,55**	**$4.686.738,68**	**$1.573.000,00**	**$25.485.943,60**	**$15.787.405,30**	**$19.295,26**	**$1.332.441,02**	**$6.035.182,20**	**$1.824.489,03**	**$68.660.794,98**	**-$34.754.028,62**	**$1.899,86**	**$5,77**
Total Inter West Africa [Annual]		**$6.269.799,36**	**$2.453.714,15**	**$7.191.491,22**	**$3.146.000,00**	**$30.674.649,55**	**$19.503.682,76**	**$328.019,42**	**$1.767.883,19**	**$7.776.057,28**	**$2.318.019,88**	**$89.136.010,28**	**-$45.012.300,76**	**$1.941,28**	**$4,24**
Grand Total [Annual]		**$71.774.251,28**	**$89.224.198,17**	**$48.663.367,32**	**$9.438.000,00**	**$123.583.099,39**	**$75.861.641,92**	**$18.491.508,69**	**$16.274.760,55**	**$77.263.278,47**	**$14.000.000,00**	**$623.860.366,74**	**-$205.490.745,75**	**$2.249,64**	**$0,69**

Figure 484: Results sensitivity analysis: 20% increase in time charter rates scenario 3, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	2.054	781	2.410	1.035	214	1.042
14 ton TEU capacity [14 ton TEU]	1.522	570	1.788	760	146	765
Amount of reefer plugs	287	123	333	155	50	156
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	193,5	139,3	202,0	159,3	98,2	159,6
B [m]	32,3	25,3	33,7	26,5	17,9	26,6
T [m]	9,2	7,4	9,6	7,8	5,3	7,8
D [m]	16,9	12,5	17,8	13,6	8,3	13,7
LBD [m³]	95.702,4	40.590,8	110.279,7	52.107,3	12.874,3	52.419,8
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [ton]	38.312	17.505	43.607	21.990	6.134	22.111
Displacement Volume [m³]	37.377	17.079	42.544	21.454	5.985	21.571
DWT [ton]	29.692	12.926	34.067	16.468	4.246	16.564
Gross Tonnage [m³]	22.131	9.370	25.509	12.035	2.965	12.107
Wsm [ton]	11.606	5.532	13.119	6.864	2.051	6.900
Wst [ton]	8.207	3.793	9.324	4.749	1.349	4.774
Vs (design) [kn]	20,2	17,3	20,6	18,4	14,7	18,4
Vs (Max)	20,3	17,4	20,7	18,5	14,7	18,5
LCB [m]	-1,23	-1,71	-1,18	-1,49	-2,42	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,4	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,9	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,9	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,4	7,2
Pb (MCR) [kW]	19.500	7.600	22.400	10.500	2.500	10.500
Cad [-]	488	467	491	473	426	475
Fuel consumption design condition [ton/h]	3,71	1,44	4,26	2,00	0,48	2,00
Generator power [kW]	2.075	1.086	2.568	1.276	661	1.282
Operational costs [$/day]	$3.193,02	$2.438,61	$3.407,99	$2.733,33	$1.744,39	$2.737,14
Average capital costs [$/day]	$8.630,83	$4.489,25	$9.600,47	$5.480,40	$2.143,25	$5.494,74
Average charter price [$/day]	$8.924,70	$7.177,89	$9.413,20	$7.526,43	$6.399,85	$7.536,03
Capacity fuel tanks [m³]	2.841	1.227	3.263	1.567	399	1.576
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	36.198	14.859	41.821	19.258	4.497	19.377
Displacement outbound [ton]	30.437	15.244	34.686	18.275	6.059	18.359
Pb inbound [kW]	2.858	1.647	4.059	2.208	815	1.933
Pb outbound [kW]	2.546	1.675	3.583	2.132	994	1.865
Fuel consumption inbound [ton/h]	0,543	0,313	0,771	0,420	0,155	0,367
Fuel consumption outbound [ton/h]	0,484	0,318	0,681	0,405	0,189	0,354

U.5.4 Scenario 4

Figure 485: Results sensitivity analysis: 20% increase in time charter rates scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$0,00
	SWAX 2 voyage owned container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$1.714.105,61
Total Asia - West Africa [Annual]		**2.496**	**1.853**	**129.792**	**96.339**	**6**	**11**	**129,00**	**1.321.580**	**19**	**10**	**9**	**31.026**	**38.604**	**69.631**	**98.332**	**95.628**	**2.704**	**98.332**	**2.704**	**95.628**	**196.664**	**98.332**	**98.332**	**$128.359.754,75**	**$1.160.770,13**	**$129.520.524,89**	**$36.322.464,41**
Europe - West Africa	WEWA voyage chartered container vessel	2.387	1.771	124.124	92.100	9	11	79,33	10.801	12	6	6	243	347	589	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$0,00
	WEWA voyage owned container vessel	2.387	1.771	124.124	92.100	9	11	79,33	10.801	12	6	6	243	347	589	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$1.021.981,02
Total Europe - West Africa [Annual]		**2.387**	**1.771**	**124.124**	**92.100**	**9**	**11**	**79,33**	**561.652**	**12**	**6**	**6**	**12.631**	**18.021**	**30.652**	**85.436**	**83.824**	**1.612**	**85.436**	**1.612**	**83.824**	**170.872**	**85.436**	**85.436**	**$150.590.236,79**	**$885.363,73**	**$151.475.600,53**	**$21.073.114,27**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$452.911,15
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**55,14**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.152.097,66**
Inter West Africa	Feeder 3 voyage chartered container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$0,00
	Feeder 3 voyage owned container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$67.130,63
	Total Feeder 3 [Annual]	**204**	**138**	**10.608**	**7.201**	**4**	**11**	**17,64**	**23.556**	**3**	**2**	**1**	**845**	**382**	**1.227**	**7.384**	**7.072**	**312**	**7.384**	**312**	**7.072**	**14.768**	**7.384**	**7.384**	**$6.466.919,44**	**$90.113,23**	**$6.557.032,67**	**$1.549.120,33**
	Feeder 4 voyage chartered container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$0,00
	Feeder 4 voyage owned container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$109.694,49
	Total Feeder 4 [Annual]	**287**	**201**	**14.924**	**10.429**	**4**	**11**	**25,22**	**100.516**	**4**	**2**	**2**	**1.732**	**965**	**2.697**	**14.300**	**13.364**	**936**	**14.300**	**936**	**13.364**	**28.600**	**14.300**	**14.300**	**$19.877.940,37**	**$270.339,69**	**$20.148.280,07**	**$1.871.718,99**
	Feeder 5 voyage chartered container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$0,00
	Feeder 5 voyage owned container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$312.905,11
	Total Feeder 5 [Annual]	**1.036**	**761**	**53.872**	**39.558**	**5**	**11**	**38,08**	**31.772**	**6**	**3**	**3**	**2.200**	**551**	**2.751**	**35.932**	**35.932**	**0**	**35.932**	**0**	**35.932**	**71.864**	**35.932**	**35.932**	**$33.924.244,60**	**$0,00**	**$33.924.244,60**	**$6.107.396,33**
	Feeder 6 voyage chartered container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$0,00
	Feeder 6 voyage owned container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$383.088,03
	Total feeder 6 [Annual]	**1.040**	**764**	**54.080**	**39.714**	**5**	**11**	**46,57**	**253.396**	**7**	**4**	**3**	**4.634**	**3.882**	**8.517**	**45.448**	**45.084**	**364**	**45.448**	**364**	**45.084**	**90.896**	**45.448**	**45.448**	**$47.525.710,41**	**$100.313,47**	**$47.626.023,88**	**$8.143.755,09**
Total Inter West Africa [Annual]				**133.484**	**96.901**				**409.240**	**20**	**11**	**9**	**9.411**	**5.780**	**15.191**	**103.064**	**101.452**	**1.612**	**103.064**	**1.612**	**101.452**	**206.128**	**103.064**	**103.064**	**$107.794.814,82**	**$460.766,39**	**$108.255.581,22**	**$17.671.990,74**
Grand Total [Annual]				**441.220**	**324.859**				**2.765.412**	**59**	**31**	**28**	**63.488**	**71.575**	**135.064**	**312.104**	**306.176**	**5.928**	**312.104**	**5.928**	**306.176**	**624.208**	**312.104**	**312.104**	**$419.097.652,11**	**$2.506.900,26**	**$421.604.552,37**	**$83.219.667,08**

Figure 486: Results sensitivity analysis: 20% increase in time charter rates scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$983.609,78	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$3.580.593,90	-$1.089.814,58	$1.893,49	$0,07
	SWAX 2 voyage owned container vessel	$0,00	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$4.311.089,73	-$1.820.310,40	$2.279,79	$0,09
Total Asia - West Africa [Annual]		**$25.048.023,03**	**$43.310.254,24**	**$6.703.315,01**	**$1.573.000,00**	**$24.559.268,94**	**$15.520.772,85**	**$11.383.402,99**	**$4.590.364,12**	**$22.991.933,13**	**$4.410.863,05**	**$196.413.661,76**	**-$66.893.136,88**	**$1.997,45**	**$0,08**
Europe - West Africa	WEWA voyage chartered container vessel	$595.426,53	$366.644,47	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.145.291,67	-$232.299,35	$1.914,36	$0,18
	WEWA voyage owned container vessel	$0,00	$366.644,47	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.571.846,17	-$658.853,85	$2.173,98	$0,20
Total Europe - West Africa [Annual]		**$16.436.635,73**	**$19.065.512,59**	**$9.933.614,96**	**$1.573.000,00**	**$39.958.349,38**	**$22.027.881,22**	**$3.902.849,89**	**$6.070.273,06**	**$26.229.117,26**	**$3.832.389,20**	**$170.102.737,59**	**-$18.627.137,06**	**$1.991,00**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$332.010,41	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.228.568,04	-$606.397,93	$2.527,92	$0,28
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.349.468,78	-$727.298,67	$2.776,68	$0,31
Total South America - West Africa [Annual]		**$8.790.866,74**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.412.278,79**	**$5.018.600,95**	**$1.395.397,34**	**$1.294.113,83**	**$6.990.256,49**	**$1.133.622,13**	**$63.563.961,23**	**-$31.211.115,48**	**$2.515,19**	**$0,29**
Inter West Africa	Feeder 3 voyage chartered container vessel	$90.136,83	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$279.441,05	-$153.344,27	$1.967,89	$4,34
	Feeder 3 voyage owned container vessel	$0,00	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$256.434,85	-$130.338,07	$1.805,88	$3,99
	Total Feeder 3 [Annual]	**$1.864.749,61**	**$763.228,35**	**$3.334.721,73**	**$1.573.000,00**	**$842.734,24**	**$454.976,03**	**$1.579.694,78**	**$253.005,70**	**$711.235,82**	**$331.222,93**	**$13.257.689,51**	**-$6.700.656,84**	**$1.795,46**	**$4,11**
	Feeder 4 voyage chartered container vessel	$131.166,45	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$498.186,45	-$110.719,52	$1.811,59	$0,94
	Feeder 4 voyage owned container vessel	$0,00	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$476.714,49	-$89.247,56	$1.733,51	$0,90
	Total Feeder 4 [Annual]	**$3.796.012,50**	**$1.677.351,70**	**$3.375.792,78**	**$1.573.000,00**	**$3.763.089,74**	**$2.106.936,44**	**$3.506.715,55**	**$829.920,04**	**$1.610.780,73**	**$641.452,85**	**$24.752.771,31**	**-$4.604.491,24**	**$1.730,96**	**$0,92**
	Feeder 5 voyage chartered container vessel	$229.347,08	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$855.217,00	-$202.827,68	$1.237,65	$2,03
	Feeder 5 voyage owned container vessel	$0,00	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$938.775,03	-$286.385,71	$1.358,57	$2,22
	Total Feeder 5 [Annual]	**$6.594.352,10**	**$1.710.982,35**	**$4.683.027,44**	**$1.573.000,00**	**$5.204.211,99**	**$3.269.905,53**	**$9.451.135,53**	**$1.336.471,74**	**$3.704.705,17**	**$1.611.796,07**	**$45.246.984,25**	**-$11.322.739,65**	**$1.259,24**	**$2,12**
	Feeder 6 voyage chartered container vessel	$280.638,56	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.159.555,86	-$243.670,79	$1.326,72	$0,27
	Feeder 6 voyage owned container vessel	$0,00	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.262.005,33	-$346.120,26	$1.443,94	$0,30
	Total feeder 6 [Annual]	**$6.599.160,29**	**$5.297.394,29**	**$4.685.501,60**	**$1.573.000,00**	**$8.501.988,26**	**$5.625.449,13**	**$9.685.781,42**	**$2.049.180,43**	**$6.246.750,97**	**$2.038.653,78**	**$60.446.615,25**	**-$12.820.591,37**	**$1.330,02**	**$0,29**
Total Inter West Africa [Annual]		**$18.854.274,49**	**$9.448.956,68**	**$16.079.043,55**	**$6.292.000,00**	**$18.312.024,23**	**$11.457.267,12**	**$24.223.327,28**	**$4.468.577,91**	**$12.273.472,69**	**$4.623.125,62**	**$143.704.060,33**	**-$35.448.479,11**	**$1.394,32**	**$1,54**
Grand Total [Annual]		**$69.129.800,00**	**$84.009.560,13**	**$38.334.864,20**	**$11.011.000,00**	**$94.241.921,34**	**$54.024.522,15**	**$40.904.977,51**	**$16.423.328,92**	**$68.484.779,58**	**$14.000.000,00**	**$573.784.420,90**	**-$152.179.868,53**	**$1.838,44**	**$0,63**

Figure 487: Results sensitivity analysis: 20% increase in time charter rates scenario 4, specifications container vessels

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.496	2.387	1.035	204	287	1.036	1.040
14 ton TEU capacity [14 ton TEU]	1.853	1.771	760	138	201	761	764
Amount of reefer plugs	344	330	155	48	59	156	156
Amount of ship cranes	3	3	2	2	2	2	2
Lpp [m]	204,0	201,5	159,3	96,9	106,3	159,3	159,5
B [m]	34,0	33,6	26,5	17,6	19,3	26,6	26,6
T [m]	9,7	9,6	7,8	5,2	5,7	7,8	7,8
D [m]	18,0	17,8	13,6	8,2	9,1	13,6	13,7
LBD [m³]	113.763,3	109.345,6	52.107,3	12.339,2	16.702,7	52.151,9	52.330,5
B/T [-]	3,5	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.864	43.270	21.990	5.901	7.781	22.007	22.076
Displacement Volume [m³]	43.769	42.215	21.454	5.757	7.591	21.471	21.538
DWT [t]	35.110	33.787	16.468	4.075	5.465	16.482	16.537
Gross Tonnage [m³]	26.316	25.292	12.035	2.842	3.849	12.045	12.087
Wsm [t]	13.476	13.023	6.864	1.977	2.568	6.869	6.889
Wst [t]	9.589	9.253	4.749	1.299	1.706	4.752	4.767
Vs (design) [kn]	20,7	20,5	18,4	14,6	15,2	18,4	18,4
Vs (Max)	20,8	20,6	18,5	14,6	15,2	18,5	18,5
LCB [m]	-1,16	-1,18	-1,49	-2,45	-2,24	-1,49	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Ta [m]	8,9	8,8	7,7	5,8	6,1	7,7	7,7
Tf [m]	7,9	7,8	6,7	4,8	5,1	6,7	6,7
Tav (in ballast) [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Pb (MCR) [kW]	23.100	21.900	10.500	2.350	3.150	10.500	10.500
Cad [-]	492	492	473	432	438	474	475
Fuel consumption design condition [t/h]	4,39	4,16	2,00	0,45	0,60	2,00	2,00
Generator power [kW]	2.687	2.536	1.276	653	715	1.277	1.280
Operational costs [$/day]	$3.458,67	$3.382,10	$2.733,33	$1.724,52	$1.848,65	$2.733,87	$2.736,05
Average capital costs [$/day]	$9.829,12	$9.499,91	$5.480,40	$2.080,40	$2.500,12	$5.482,45	$5.490,65
Average charter price [$/day]	$9.531,21	$9.381,64	$7.526,43	$6.386,13	$6.500,02	$7.527,80	$7.533,29
Capacity fuel tanks [m³]	3.364	3.236	1.567	383	515	1.568	1.573
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	43.364	41.443	19.258	4.306	5.528	19.279	16.235
Displacement outbound [t]	35.712	34.412	18.275	5.855	7.547	18.287	18.335
Pb inbound [kW]	3.195	4.023	2.208	779	909	1.933	1.720
Pb outbound [kW]	2.807	3.554	2.132	956	1.119	1.866	1.865
Fuel consumption inbound [t/h]	0,607	0,764	0,420	0,148	0,173	0,367	0,327
Fuel consumption outbound [t/h]	0,533	0,675	0,405	0,182	0,213	0,355	0,354

U.6 20% increase in time charter rates

U.6.1 Scenario 1

Figure 488: Results sensitivity analysis: 20% increase in time charter rates scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$0,00
	FEWA voyage owned container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.613.160,50	$0,00	$2.613.160,50	$1.489.141,86
	Total FEWA [Annual]	**2.092**	**1.551**	**108.784**	**80.627**	**15**	**11**	**124,78**	**1.101.880**	**18**	**9**	**9**	**22.834**	**31.920**	**54.754**	**86.476**	**86.476**	**0**	**86.476**	**0**	**86.476**	**172.952**	**86.476**	**86.476**	**$135.884.346,25**	**$0,00**	**$135.884.346,25**	**$29.053.450,83**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**148.564**	**109.645**				**2.223.208**	**34**	**17**	**17**	**39.892**	**49.431**	**89.323**	**117.676**	**117.572**	**104**	**117.676**	**104**	**117.572**	**235.352**	**117.676**	**117.676**	**$191.628.944,18**	**$52.114,15**	**$191.681.058,33**	**$42.236.286,35**
Europe - West Africa	WEWA voyage chartered container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$0,00
	WEWA voyage owned container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.002.850,84	$44.457,37	$3.047.308,21	$1.091.206,24
Total Europe - West Africa [Annual]		**2.537**	**1.883**	**131.924**	**97.933**	**9**	**11**	**81,13**	**561.652**	**12**	**6**	**6**	**12.996**	**18.594**	**31.591**	**92.664**	**88.504**	**4.160**	**92.664**	**4.160**	**88.504**	**185.328**	**92.664**	**92.664**	**$156.148.243,93**	**$2.311.783,09**	**$158.460.027,02**	**$22.116.834,82**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**402.480**	**296.618**				**3.341.884**	**62**	**32**	**30**	**66.394**	**78.247**	**144.641**	**283.764**	**278.616**	**5.148**	**283.764**	**5.148**	**278.616**	**567.528**	**283.764**	**283.764**	**$426.084.658,71**	**$2.642.622,85**	**$428.727.281,56**	**$80.469.174,19**

Figure 489: Results sensitivity analysis: 20% increase in time charter rates scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.344.147,62	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$4.191.157,25	-$1.577.996,75	$2.520,24	$0,12
	FEWA voyage owned container vessel	$0,00	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$98.944,46	$485.399,43	$82.047,05	$4.336.151,49	-$1.722.990,98	$2.607,43	$0,12
	Total FEWA [Annual]	**$35.386.712,74**	**$34.057.196,45**	**$16.008.617,04**	**$1.573.000,00**	**$32.398.072,74**	**$19.756.720,18**	**$9.598.565,17**	**$5.145.111,82**	**$25.240.770,56**	**$4.266.446,77**	**$212.484.664,31**	**-$76.600.318,06**	**$2.457,15**	**$0,12**
	SWAX voyage chartered container vessel	$948.832,86	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$2.131.411,66	-$1.058.397,97	$3.552,35	$0,16
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.612,24	$29.602,06	$1.938.528,22	-$865.514,53	$3.230,88	$0,15
	Total SWAX [Annual]	**$25.074.389,23**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.275.836,35**	**$1.539.307,31**	**$99.751.322,49**	**-$43.954.610,42**	**$3.197,16**	**$0,16**
Total Asia - West Africa [Annual]		**$60.461.101,97**	**$55.558.611,60**	**$25.942.503,86**	**$3.146.000,00**	**$38.574.495,02**	**$28.082.366,79**	**$9.709.919,56**	**$7.202.340,66**	**$35.516.606,91**	**$5.805.754,08**	**$312.235.986,81**	**-$120.554.928,48**	**$2.653,35**	**$0,14**
Europe - West Africa	WEWA voyage chartered container vessel	$933.354,10	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.719.615,90	-$672.307,69	$2.087,33	$0,19
	WEWA voyage owned container vessel	$0,00	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$121.911,70	$524.296,42	$87.918,13	$3.877.468,05	-$830.159,84	$2.175,91	$0,20
Total Europe - West Africa [Annual]		**$25.195.874,84**	**$19.649.438,30**	**$10.100.620,76**	**$1.573.000,00**	**$44.579.974,52**	**$24.603.082,09**	**$6.204.933,19**	**$6.339.408,46**	**$27.263.413,99**	**$4.571.742,72**	**$192.198.323,69**	**-$33.738.296,67**	**$2.074,14**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$499.923,56	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.441.231,06	-$802.681,52	$2.888,24	$0,32
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.372,17	$24.619,05	$1.400.802,20	-$762.252,66	$2.807,22	$0,31
Total South America - West Africa [Annual]		**$13.253.614,75**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.987.352,91**	**$1.280.190,58**	**$70.501.068,37**	**-$37.296.492,34**	**$2.717,01**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	$138.177,57	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$473.015,60	-$272.224,47	$2.401,09	$1,88
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,88	$9.719,34	$403.998,43	-$203.207,30	$2.050,75	$1,61
	Total Feeder 1 [Annual]	**$2.800.129,53**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.373,86**	**$505.405,90**	**$21.781.222,47**	**-$11.340.083,33**	**$2.126,24**	**$1,70**
	Feeder 2 voyage chartered container vessel	$316.716,35	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.463.587,80	-$791.655,48	$2.044,12	$5,98
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$35.325,13	$1.439.046,07	-$767.113,74	$2.009,84	$5,88
	Total Feeder 2 [Annual]	**$6.640.029,89**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.836.906,73**	**$72.524.419,75**	**-$37.583.938,70**	**$1.947,91**	**$5,92**
Total Inter West Africa [Annual]		**$9.440.159,43**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.226,14**	**$2.342.312,63**	**$94.305.642,22**	**-$48.924.022,03**	**$1.986,39**	**$4,34**
Grand Total [Annual]		**$108.350.750,98**	**$89.966.995,90**	**$48.892.227,12**	**$9.438.000,00**	**$126.878.243,09**	**$77.731.284,98**	**$19.079.275,37**	**$16.686.469,48**	**$77.748.599,96**	**$14.000.000,00**	**$669.241.021,09**	**-$240.513.739,53**	**$2.358,44**	**$0,71**

Figure 490: Results sensitivity analysis: 20% increase in time charter rates scenario 1, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	2.092	765	2.537	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.551	558	1.883	781	142	789
Amount of reefer plugs	292	121	349	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	194,5	138,5	204,9	160,4	97,6	160,9
B [m]	32,4	25,2	34,1	26,7	17,7	26,8
T [m]	9,3	7,4	9,8	7,9	5,2	7,9
D [m]	17,0	12,4	18,1	13,8	8,2	13,8
LBD [m³]	97.271,3	39.852,4	115.419,4	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	38.885	17.214	45.460	22.471	6.018	22.659
Displacement Volume [m³]	37.937	16.795	44.351	21.923	5.871	22.106
DWT [t]	30.163	12.698	35.605	16.851	4.160	17.000
Gross Tonnage [m³]	22.494	9.199	26.700	12.324	2.904	12.437
Wsm [t]	11.770	5.445	13.645	7.006	2.014	7.061
Wst [t]	8.328	3.731	9.714	4.851	1.324	4.891
Vs (design) [kn]	20,2	17,2	20,7	18,5	14,6	18,5
Vs (Max)	20,3	17,3	20,8	18,6	14,6	18,6
LCB [m]	-1,22	-1,72	-1,16	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,3	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,8	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,8	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,3	7,2
Pb (MCR) [kW]	19.700	7.400	23.300	10.800	2.400	10.900
Cad [-]	487	466	492	474	429	473
Fuel consumption design condition [t/h]	3,74	1,41	4,43	2,05	0,46	2,07
Generator power [kW]	2.127	1.074	2.744	1.297	657	1.306
Operational costs [$/day]	$3.211,94	$2.418,33	$3.480,65	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$8.722,27	$4.423,16	$9.970,07	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$8.976,84	$7.155,93	$9.587,47	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	2.886	1.205	3.412	1.604	391	1.618
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	36.840	14.579	43.477	19.727	4.401	19.916
Displacement outbound [t]	30.891	15.053	36.202	18.610	5.957	18.741
Pb inbound [kW]	2.892	1.629	3.200	2.239	797	1.979
Pb outbound [kW]	2.572	1.664	2.832	2.153	975	1.900
Fuel consumption inbound [t/h]	0,549	0,309	0,608	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,489	0,316	0,538	0,409	0,185	0,361

U.6.2 Scenario 2

Figure 491: Results sensitivity analysis: 20% increase in time charter rates scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$0,00
	FEWA 2 voyage owned container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.722.584,07	$5.511,73	$2.728.095,80	$1.521.991,24
	Total FEWA [Annual]	**2.219**	**1.645**	**115.388**	**85.566**	**16**	**12**	**122,86**	**1.103.596**	**18**	**9**	**9**	**26.017**	**35.711**	**61.728**	**90.012**	**89.492**	**520**	**90.012**	**520**	**89.492**	**180.024**	**90.012**	**90.012**	**$141.574.371,76**	**$286.609,91**	**$141.860.981,67**	**$30.272.549,93**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.072.011,50	$1.002,20	$1.073.013,69	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$55.744.597,93**	**$52.114,15**	**$55.796.712,08**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**155.168**	**114.584**				**2.224.924**		**17**	**17**	**43.074**	**53.222**	**96.297**	**121.212**	**120.588**	**624**	**121.212**	**624**	**120.588**	**242.424**	**121.212**	**121.212**	**$197.318.969,69**	**$338.724,05**	**$197.657.693,75**	**$43.455.385,45**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$0,00
	WEWA 2 voyage owned container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.083.026,45	$78.509,82	$3.161.536,27	$1.147.946,27
Total Europe - West Africa [Annual]		**2.612**	**1.939**	**135.818**	**100.845**	**10**	**12**	**83,76**	**563.004**	**12**	**6**	**6**	**13.522**	**21.416**	**34.937**	**97.552**	**90.584**	**6.968**	**97.552**	**6.968**	**90.584**	**195.104**	**97.552**	**97.552**	**$160.317.375,54**	**$4.082.510,56**	**$164.399.886,10**	**$22.585.311,72**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$638.549,54	$0,00	$638.549,54	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$33.204.576,03**	**$0,00**	**$33.204.576,03**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$195.431,03	$5.360,11	$200.791,14	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$10.162.413,52**	**$278.725,62**	**$10.441.139,14**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$671.932,33	$0,00	$671.932,33	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$34.940.481,05**	**$0,00**	**$34.940.481,05**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$45.102.894,57**	**$278.725,62**	**$45.381.620,19**	**$7.816.589,19**
Grand Total [Annual]				**412.978**	**304.469**				**3.344.952**	**28**	**32**	**30**	**70.102**	**84.860**	**154.962**	**292.188**	**283.712**	**8.476**	**292.188**	**8.476**	**283.712**	**584.376**	**292.188**	**292.188**	**$435.943.815,83**	**$4.699.960,23**	**$440.643.776,06**	**$82.156.750,18**

Figure 492: Results sensitivity analysis: 20% increase in time charter rates scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$1.349.160,01	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$510.689,25	$82.939,75	$4.351.807,81	-$1.623.712,00	$2.514,04	$0,12
	FEWA 2 voyage owned container vessel	$0,00	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$102.967,19	$510.689,25	$82.939,75	$4.524.639,03	-$1.796.543,23	$2.613,89	$0,12
	Total FEWA [Annual]	**$36.073.682,72**	**$38.395.094,93**	**$17.327.232,83**	**$1.573.000,00**	**$33.181.282,48**	**$19.839.508,08**	**$9.598.565,17**	**$5.354.294,06**	**$26.555.840,95**	**$4.312.867,06**	**$222.483.918,20**	**-$80.622.936,53**	**$2.471,71**	**$0,12**
	SWAX voyage chartered container vessel	$948.832,86	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.076,66	$28.748,61	$2.130.022,63	-$1.057.008,94	$3.550,04	$0,16
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$39.562,09	$197.076,66	$28.748,61	$1.937.139,19	-$864.125,50	$3.228,57	$0,15
	Total SWAX [Annual]	**$25.074.389,23**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.057.228,85**	**$10.247.986,19**	**$1.494.927,92**	**$99.679.092,95**	**-$43.882.380,88**	**$3.194,84**	**$0,16**
Total Asia - West Africa [Annual]		**$61.148.071,95**	**$59.896.510,07**	**$27.261.119,65**	**$3.146.000,00**	**$39.357.704,76**	**$28.165.154,69**	**$9.709.919,56**	**$7.411.522,90**	**$36.803.827,14**	**$5.807.794,98**	**$322.163.011,15**	**-$124.505.317,41**	**$2.657,85**	**$0,14**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$973.943,14	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$3.906.446,44	-$744.910,17	$2.082,33	$0,19
	WEWA 2 voyage owned container vessel	$0,00	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$126.480,82	$559.430,06	$89.887,33	$4.080.449,56	-$918.913,29	$2.175,08	$0,20
Total Europe - West Africa [Annual]		**$25.465.911,74**	**$21.730.931,20**	**$11.315.547,60**	**$1.573.000,00**	**$45.557.094,76**	**$25.767.157,30**	**$6.204.933,19**	**$6.577.002,82**	**$29.090.363,22**	**$4.674.141,31**	**$200.541.394,86**	**-$36.141.508,76**	**$2.055,74**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$499.923,56	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.440.627,44	-$802.077,90	$2.887,03	$0,32
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$25.541,98	$134.478,34	$23.909,26	$1.400.198,58	-$761.649,04	$2.806,01	$0,31
Total South America - West Africa [Annual]		**$13.253.614,75**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.328.183,04**	**$6.992.873,56**	**$1.243.281,72**	**$70.469.680,16**	**-$37.265.104,14**	**$2.715,80**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	$138.177,57	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,77	$9.439,13	$472.735,28	-$271.944,14	$2.399,67	$1,88
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$8.547,14	$34.564,77	$9.439,13	$403.718,11	-$202.926,97	$2.049,33	$1,61
	Total Feeder 1 [Annual]	**$2.800.129,53**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$444.451,36**	**$1.797.368,20**	**$490.834,67**	**$21.766.645,58**	**-$11.325.506,44**	**$2.124,82**	**$1,70**
	Feeder 2 voyage chartered container vessel	$316.716,35	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.462.569,35	-$790.637,03	$2.042,69	$5,97
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$26.386,27	$118.920,24	$34.306,68	$1.438.027,62	-$766.095,29	$2.008,42	$5,87
	Total Feeder 2 [Annual]	**$6.640.029,89**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.372.085,96**	**$6.183.852,29**	**$1.783.947,32**	**$72.471.460,35**	**-$37.530.979,30**	**$1.946,48**	**$5,91**
Total Inter West Africa [Annual]		**$9.440.159,43**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.816.537,32**	**$7.981.220,48**	**$2.274.781,99**	**$94.238.105,93**	**-$48.856.485,74**	**$1.984,96**	**$4,33**
Grand Total [Annual]		**$109.307.757,86**	**$96.386.387,27**	**$51.425.769,76**	**$9.438.000,00**	**$128.638.573,07**	**$78.978.148,10**	**$19.079.275,37**	**$17.133.246,09**	**$80.868.284,41**	**$14.000.000,00**	**$687.412.192,10**	**-$246.768.416,04**	**$2.352,64**	**$0,71**

Figure 493: Results sensitivity analysis: 20% increase in time charter rates scenario 2, specifications container vessels

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	2.219	765	2.612	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.645	558	1.939	781	142	789
Amount of reefer plugs	308	121	359	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	197,6	138,5	206,5	160,4	97,6	160,9
B [m]	32,9	25,2	34,4	26,7	17,7	26,8
T [m]	9,4	7,4	9,8	7,9	5,2	7,9
D [m]	17,4	12,4	18,3	13,8	8,2	13,8
LBD [m³]	102.491,5	39.852,4	118.436,1	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	40.786	17.214	46.544	22.471	6.018	22.659
Displacement Volume [m³]	39.791	16.795	45.408	21.923	5.871	22.106
DWT [t]	31.732	12.698	36.507	16.851	4.160	17.000
Gross Tonnage [m³]	23.704	9.199	27.399	12.324	2.904	12.437
Wsm [t]	12.314	5.445	13.953	7.006	2.014	7.061
Wst [t]	8.729	3.731	9.943	4.851	1.324	4.891
Vs (design) [kn]	20,4	17,2	20,8	18,5	14,6	18,5
Vs (Max)	20,5	17,3	20,9	18,6	14,6	18,6
LCB [m]	-1,20	-1,72	-1,15	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,2	6,7	8,5	7,2	5,3	7,2
Ta [m]	8,7	7,2	9,0	7,7	5,8	7,7
Tf [m]	7,7	6,2	8,0	6,7	4,8	6,7
Tav (in ballast) [m]	8,2	6,7	8,5	7,2	5,3	7,2
Pb (MCR) [kW]	20.900	7.400	24.000	10.800	2.400	10.900
Cad [-]	488	466	492	474	429	473
Fuel consumption design condition [t/h]	3,97	1,41	4,56	2,05	0,46	2,07
Generator power [kW]	2.303	1.074	2.847	1.297	657	1.306
Operational costs [$/day]	$3.295,96	$2.418,33	$3.527,75	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$9.092,12	$4.423,16	$10.178,01	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$9.151,11	$7.155,93	$9.690,23	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	3.038	1.205	3.499	1.604	391	1.618
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	38.886	14.579	44.411	19.727	4.401	19.916
Displacement outbound [t]	32.406	15.053	37.096	18.610	5.957	18.741
Pb inbound [kW]	3.419	1.629	3.707	2.239	797	1.979
Pb outbound [kW]	3.028	1.664	3.288	2.153	975	1.900
Fuel consumption inbound [t/h]	0,650	0,309	0,704	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,575	0,316	0,625	0,409	0,185	0,361

U.6.3 Scenario 3

Figure 494: Results sensitivity analysis: 20% increase in time charter rates scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]
Asia - West Africa	FEWA voyage chartered container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042
	FEWA voyage owned container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042
	Total FEWA [Annual]	**2.054**	**1.522**	**106.808**	**79.149**	**15**	**11**	**124,68**	**1.101.880**	**18**	**9**	**9**	**22.581**	**31.616**	**54.197**
	SWAX voyage chartered container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670
	SWAX voyage owned container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670
	Total SWAX [Annual]	**781**	**570**	**40.612**	**29.641**	**11**	**11**	**110,66**	**1.121.328**	**16**	**8**	**8**	**17.209**	**17.618**	**34.827**
Total Asia - West Africa [Annual]				**147.420**	**108.790**				**2.223.208**		**17**	**17**	**39.790**	**49.234**	**89.024**
Europe - West Africa	WEWA voyage chartered container vessel	2.410	1.788	125.320	92.994	9	11	80,41	10.801	12	6	6	245	349	594
	WEWA voyage owned container vessel	2.410	1.788	125.320	92.994	9	11	80,41	10.801	12	6	6	245	349	594
Total Europe - West Africa [Annual]		**2.410**	**1.788**	**125.320**	**92.994**	**9**	**11**	**80,41**	**561.652**	**12**	**6**	**6**	**12.732**	**18.158**	**30.889**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**54,98**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32
	Feeder 1 voyage owned container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32
	Total Feeder 1 [Annual]	**214**	**146**	**11.128**	**7.590**	**3**	**11**	**17,94**	**66.300**	**3**	**2**	**1**	**1.037**	**650**	**1.687**
	Feeder 2 voyage chartered container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43
	Feeder 2 voyage owned container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43
	Total Feeder 2 [Annual]	**1.042**	**765**	**54.184**	**39.791**	**5**	**11**	**34,37**	**17.784**	**5**	**3**	**2**	**1.929**	**329**	**2.258**
Total Inter West Africa [Annual]				**65.312**	**47.381**				**84.084**	**8**	**5**	**3**	**2.966**	**979**	**3.945**
Grand Total [Annual]				**391.872**	**288.684**				**3.341.884**	**28**	**32**	**30**	**65.907**	**77.540**	**143.447**

Trade	Service voyage	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$0,00
	FEWA voyage owned container vessel	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.544.863,71	$15.157,25	$2.560.020,97	$1.474.146,56
	Total FEWA [Annual]	**85.904**	**84.240**	**1.664**	**85.904**	**1.664**	**84.240**	**171.808**	**85.904**	**85.904**	**$132.332.913,09**	**$788.177,25**	**$133.121.090,34**	**$28.750.376,75**
	SWAX voyage chartered container vessel	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$0,00
	SWAX voyage owned container vessel	623	584	39	623	39	584	1.246	623	623	$1.047.610,99	$20.017,66	$1.067.628,65	$766.641,09
	Total SWAX [Annual]	**32.396**	**30.368**	**2.028**	**32.396**	**2.028**	**30.368**	**64.792**	**32.396**	**32.396**	**$54.475.771,55**	**$1.040.918,33**	**$55.516.689,88**	**$13.378.461,25**
Total Asia - West Africa [Annual]		**118.300**	**114.608**	**3.692**	**118.300**	**3.692**	**114.608**	**236.600**	**118.300**	**118.300**	**$186.808.684,65**	**$1.829.095,58**	**$188.637.780,23**	**$42.128.838,00**
Europe - West Africa	WEWA voyage chartered container vessel	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$0,00
	WEWA voyage owned container vessel	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.927.199,37	$20.017,66	$2.947.217,03	$1.045.984,79
Total Europe - West Africa [Annual]		**87.828**	**86.216**	**1.612**	**87.828**	**1.612**	**86.216**	**175.656**	**87.828**	**87.828**	**$152.214.367,16**	**$1.040.918,33**	**$153.255.285,49**	**$21.299.066,11**
South America - West Africa	ECSA voyage chartered container vessel	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$451.606,04
Total South America - West Africa [Annual]		**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.151.663,35**
Inter West Africa	Feeder 1 voyage chartered container vessel	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$0,00
	Feeder 1 voyage owned container vessel	188	178	10	188	10	178	376	188	188	$193.485,53	$2.994,15	$196.479,68	$69.731,82
	Total Feeder 1 [Annual]	**9.776**	**9.256**	**520**	**9.776**	**520**	**9.256**	**19.552**	**9.776**	**9.776**	**$10.061.247,43**	**$155.695,73**	**$10.216.943,16**	**$1.595.863,07**
	Feeder 2 voyage chartered container vessel	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$0,00
	Feeder 2 voyage owned container vessel	695	695	0	695	0	695	1.390	695	695	$652.053,20	$0,00	$652.053,20	$282.957,53
	Total Feeder 2 [Annual]	**36.140**	**36.140**	**0**	**36.140**	**0**	**36.140**	**72.280**	**36.140**	**36.140**	**$33.906.766,36**	**$0,00**	**$33.906.766,36**	**$6.110.830,42**
Total Inter West Africa [Annual]		**45.916**	**45.396**	**520**	**45.916**	**520**	**45.396**	**91.832**	**45.916**	**45.916**	**$43.968.013,79**	**$155.695,73**	**$44.123.709,52**	**$7.706.693,48**
Grand Total [Annual]		**277.316**	**271.492**	**5.824**	**277.316**	**5.824**	**271.492**	**554.632**	**277.316**	**277.316**	**$415.343.911,35**	**$3.025.709,64**	**$418.369.620,99**	**$79.286.260,94**

Figure 495: Results sensitivity analysis: 20% increase in time charter rates scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.335.230,88	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$4.168.333,81	-$1.608.312,84	$2.523,20	$0,12
	FEWA voyage owned container vessel	$0,00	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$96.957,77	$491.894,43	$83.399,44	$4.307.249,49	-$1.747.228,53	$2.607,29	$0,12
	Total FEWA [Annual]	**$35.181.162,67**	**$33.710.378,62**	**$15.938.103,48**	**$1.573.000,00**	**$32.083.314,38**	**$19.702.834,62**	**$9.356.635,68**	**$5.041.804,12**	**$25.578.510,48**	**$4.336.771,05**	**$211.252.891,85**	**-$78.131.801,51**	**$2.459,17**	**$0,12**
	SWAX voyage chartered container vessel	$953.171,40	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.361,38	$31.451,48	$2.161.849,14	-$1.094.220,49	$3.470,06	$0,16
	SWAX voyage owned container vessel	$0,00	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$39.345,44	$208.361,38	$31.451,48	$1.975.318,83	-$907.690,18	$3.170,66	$0,15
	Total SWAX [Annual]	**$25.151.320,25**	**$21.662.274,39**	**$9.955.659,43**	**$1.573.000,00**	**$6.423.407,69**	**$8.549.951,81**	**$170.717,65**	**$2.045.962,80**	**$10.834.791,53**	**$1.635.477,22**	**$101.381.024,01**	**-$45.864.334,13**	**$3.129,43**	**$0,15**
Total Asia - West Africa [Annual]		**$60.332.482,92**	**$55.372.653,01**	**$25.893.762,91**	**$3.146.000,00**	**$38.506.722,07**	**$28.252.786,43**	**$9.527.353,33**	**$7.087.766,92**	**$36.413.302,01**	**$5.972.248,27**	**$312.633.915,86**	**-$123.996.135,63**	**$2.642,72**	**$0,14**
Europe - West Africa	WEWA voyage chartered container vessel	$869.764,37	$433.387,14	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$498.350,63	$85.267,35	$3.607.313,47	-$660.096,44	$2.135,77	$0,20
	WEWA voyage owned container vessel	$0,00	$433.387,14	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$117.788,40	$498.350,63	$85.267,35	$3.739.182,76	-$791.965,73	$2.213,84	$0,20
Total Europe - West Africa [Annual]		**$20.614.912,38**	**$22.536.131,41**	**$9.959.222,52**	**$1.573.000,00**	**$42.560.610,16**	**$23.238.477,20**	**$6.011.980,59**	**$6.124.996,61**	**$25.914.232,73**	**$4.433.902,12**	**$184.254.912,61**	**-$30.999.627,12**	**$2.097,91**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$496.580,53	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.423.261,00	-$801.090,89	$2.928,52	$0,32
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$24.886,80	$132.860,48	$24.535,19	$1.378.286,51	-$756.116,40	$2.835,98	$0,31
Total South America - West Africa [Annual]		**$13.186.300,10**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.841.117,62**	**$4.866.695,53**	**$2.624.155,35**	**$1.294.113,83**	**$6.908.745,10**	**$1.275.829,74**	**$69.525.347,93**	**-$37.172.502,18**	**$2.751,08**	**$0,32**
Inter West Africa	Feeder 1 voyage chartered container vessel	$137.751,32	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.416,37	$9.490,98	$464.816,17	-$268.336,49	$2.472,43	$1,94
	Feeder 1 voyage owned container vessel	$0,00	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$8.373,89	$33.416,37	$9.490,98	$396.796,67	-$200.316,99	$2.110,62	$1,66
	Total Feeder 1 [Annual]	**$2.803.134,65**	**$1.049.287,61**	**$2.504.752,54**	**$1.573.000,00**	**$5.188.705,95**	**$3.716.277,45**	**$308.724,16**	**$435.442,17**	**$1.737.651,39**	**$493.530,85**	**$21.406.369,83**	**-$11.189.426,67**	**$2.189,69**	**$1,75**
	Feeder 2 voyage chartered container vessel	$310.846,34	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$115.836,32	$35.086,33	$1.428.869,96	-$776.816,76	$2.055,93	$6,01
	Feeder 2 voyage owned container vessel	$0,00	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$25.623,87	$115.836,32	$35.086,33	$1.400.981,15	-$748.927,95	$2.015,80	$5,89
	Total Feeder 2 [Annual]	**$6.601.564,38**	**$1.404.426,55**	**$4.686.738,68**	**$1.573.000,00**	**$25.485.943,60**	**$15.787.405,30**	**$19.295,26**	**$1.332.441,02**	**$6.023.488,83**	**$1.824.489,03**	**$70.849.623,07**	**-$36.942.856,71**	**$1.960,42**	**$5,94**
Total Inter West Africa [Annual]		**$9.404.699,03**	**$2.453.714,15**	**$7.191.491,22**	**$3.146.000,00**	**$30.674.649,55**	**$19.503.682,76**	**$328.019,42**	**$1.767.883,19**	**$7.761.140,22**	**$2.318.019,88**	**$92.255.992,90**	**-$48.132.283,38**	**$2.009,23**	**$4,37**
Grand Total [Annual]		**$103.538.394,44**	**$92.547.335,19**	**$48.663.367,32**	**$9.438.000,00**	**$123.583.099,39**	**$75.861.641,92**	**$18.491.508,69**	**$16.274.760,55**	**$76.997.420,07**	**$14.000.000,00**	**$658.670.169,30**	**-$240.300.548,31**	**$2.375,16**	**$0,73**

Figure 496: Results sensitivity analysis: 20% increase in time charter rates scenario 3, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	2.054	781	2.410	1.035	214	1.042
14 ton TEU capacity [14 ton TEU]	1.522	570	1.788	760	146	765
Amount of reefer plugs	287	123	333	155	50	156
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	193,5	139,3	202,0	159,3	98,2	159,6
B [m]	32,3	25,3	33,7	26,5	17,9	26,6
T [m]	9,2	7,4	9,6	7,8	5,3	7,8
D [m]	16,9	12,5	17,8	13,6	8,3	13,7
LBD [m³]	95.702,4	40.590,8	110.279,7	52.107,3	12.874,3	52.419,8
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [ton]	38.312	17.505	43.607	21.990	6.134	22.111
Displacement Volume [m³]	37.377	17.079	42.544	21.454	5.985	21.571
DWT [ton]	29.692	12.926	34.067	16.468	4.246	16.564
Gross Tonnage [m³]	22.131	9.370	25.509	12.035	2.965	12.107
Wsm [ton]	11.606	5.532	13.119	6.864	2.051	6.900
Wst [ton]	8.207	3.793	9.324	4.749	1.349	4.774
Vs (design) [kn]	20,2	17,3	20,6	18,4	14,7	18,4
Vs (Max)	20,3	17,4	20,7	18,5	14,7	18,5
LCB [m]	-1,23	-1,71	-1,18	-1,49	-2,42	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,4	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,9	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,9	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,4	7,2
Pb (MCR) [kW]	19.500	7.600	22.400	10.500	2.500	10.500
Cad [-]	488	467	491	473	426	475
Fuel consumption design condition [ton/h]	3,71	1,44	4,26	2,00	0,48	2,00
Generator power [kW]	2.075	1.086	2.568	1.276	661	1.282
Operational costs [$/day]	$3.193,02	$2.438,61	$3.407,99	$2.733,33	$1.744,39	$2.737,14
Average capital costs [$/day]	$8.630,83	$4.489,25	$9.600,47	$5.480,40	$2.143,25	$5.494,74
Average charter price [$/day]	$8.924,70	$7.177,89	$9.413,20	$7.526,43	$6.399,85	$7.536,03
Capacity fuel tanks [m³]	2.841	1.227	3.263	1.567	399	1.576
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	36.198	14.859	41.821	19.258	4.497	19.377
Displacement outbound [ton]	30.437	15.244	34.686	18.275	6.059	18.359
Pb inbound [kW]	2.858	1.647	4.059	2.208	815	1.933
Pb outbound [kW]	2.546	1.675	3.583	2.132	994	1.865
Fuel consumption inbound [ton/h]	0,543	0,313	0,771	0,420	0,155	0,367
Fuel consumption outbound [ton/h]	0,484	0,318	0,681	0,405	0,189	0,354

U.6.4 Scenario 4

Figure 497: Results sensitivity analysis: 20% increase in time charter rates scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$0,00
	SWAX 2 voyage owned container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.468.456,82	$22.322,50	$2.490.779,32	$1.714.105,61
Total Asia - West Africa [Annual]		**2.496**	**1.853**	**129.792**	**96.339**	**6**	**11**	**129,00**	**1.321.580**	**19**	**10**	**9**	**31.026**	**38.604**	**69.631**	**98.332**	**95.628**	**2.704**	**98.332**	**2.704**	**95.628**	**196.664**	**98.332**	**98.332**	**$128.359.754,75**	**$1.160.770,13**	**$129.520.524,89**	**$36.322.464,41**
Europe - West Africa	WEWA voyage chartered container vessel	2.387	1.771	124.124	92.100	9	11	79,33	10.801	12	6	6	243	347	589	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$0,00
	WEWA voyage owned container vessel	2.387	1.771	124.124	92.100	9	11	79,33	10.801	12	6	6	243	347	589	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.895.966,09	$17.026,23	$2.912.992,32	$1.021.981,02
Total Europe - West Africa [Annual]		**2.387**	**1.771**	**124.124**	**92.100**	**9**	**11**	**79,33**	**561.652**	**12**	**6**	**6**	**12.631**	**18.021**	**30.652**	**85.436**	**83.824**	**1.612**	**85.436**	**1.612**	**83.824**	**170.872**	**85.436**	**85.436**	**$150.590.236,79**	**$885.363,73**	**$151.475.600,53**	**$21.073.114,27**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$622.170,11	$0,00	$622.170,11	$452.911,15
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**55,14**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$32.352.845,75**	**$0,00**	**$32.352.845,75**	**$8.152.097,66**
Inter West Africa	Feeder 3 voyage chartered container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$0,00
	Feeder 3 voyage owned container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$67.130,63
	Total Feeder 3 [Annual]	**204**	**138**	**10.608**	**7.201**	**4**	**11**	**17,64**	**23.556**	**3**	**2**	**1**	**845**	**382**	**1.227**	**7.384**	**7.072**	**312**	**7.384**	**312**	**7.072**	**14.768**	**7.384**	**7.384**	**$6.466.919,44**	**$90.113,23**	**$6.557.032,67**	**$1.549.120,33**
	Feeder 4 voyage chartered container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$0,00
	Feeder 4 voyage owned container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$382.268,08	$5.198,84	$387.466,92	$109.694,49
	Total Feeder 4 [Annual]	**287**	**201**	**14.924**	**10.429**	**4**	**11**	**25,22**	**100.516**	**4**	**2**	**2**	**1.732**	**965**	**2.697**	**14.300**	**13.364**	**936**	**14.300**	**936**	**13.364**	**28.600**	**14.300**	**14.300**	**$19.877.940,37**	**$270.339,69**	**$20.148.280,07**	**$1.871.718,99**
	Feeder 5 voyage chartered container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$0,00
	Feeder 5 voyage owned container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$652.389,32	$0,00	$652.389,32	$312.905,11
	Total Feeder 5 [Annual]	**1.036**	**761**	**53.872**	**39.558**	**5**	**11**	**38,08**	**31.772**	**6**	**3**	**3**	**2.200**	**551**	**2.751**	**35.932**	**35.932**	**0**	**35.932**	**0**	**35.932**	**71.864**	**35.932**	**35.932**	**$33.924.244,60**	**$0,00**	**$33.924.244,60**	**$6.107.396,33**
	Feeder 6 voyage chartered container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$0,00
	Feeder 6 voyage owned container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$913.955,97	$1.929,11	$915.885,07	$383.088,03
	Total feeder 6 [Annual]	**1.040**	**764**	**54.080**	**39.714**	**5**	**11**	**46,57**	**253.396**	**7**	**4**	**3**	**4.634**	**3.882**	**8.517**	**45.448**	**45.084**	**364**	**45.448**	**364**	**45.084**	**90.896**	**45.448**	**45.448**	**$47.525.710,41**	**$100.313,47**	**$47.626.023,88**	**$8.143.755,09**
Total Inter West Africa [Annual]				**133.484**	**96.901**				**409.240**	**20**	**11**	**9**	**9.411**	**5.780**	**15.191**	**103.064**	**101.452**	**1.612**	**103.064**	**1.612**	**101.452**	**206.128**	**103.064**	**103.064**	**$107.794.814,82**	**$460.766,39**	**$108.255.581,22**	**$17.671.990,74**
Grand Total [Annual]				**441.220**	**324.859**				**2.765.412**	**59**	**31**	**28**	**63.488**	**71.575**	**135.064**	**312.104**	**306.176**	**5.928**	**312.104**	**5.928**	**306.176**	**624.208**	**312.104**	**312.104**	**$419.097.652,11**	**$2.506.900,26**	**$421.604.552,37**	**$83.219.667,08**

Figure 498: Results sensitivity analysis: 20% increase in time charter rates scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$1.475.414,67	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$4.072.398,79	-$1.581.619,47	$2.153,57	$0,08
	SWAX 2 voyage owned container vessel	$0,00	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$88.276,23	$442.152,56	$84.824,29	$4.311.089,73	-$1.820.310,40	$2.279,79	$0,09
Total Asia - West Africa [Annual]		**$37.572.034,55**	**$43.310.254,24**	**$6.703.315,01**	**$1.573.000,00**	**$24.559.268,94**	**$15.520.772,85**	**$11.383.402,99**	**$4.590.364,12**	**$22.991.933,13**	**$4.410.863,05**	**$208.937.673,28**	**-$79.417.148,39**	**$2.124,82**	**$0,09**
Europe - West Africa	WEWA voyage chartered container vessel	$854.756,79	$430.011,84	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.467.989,31	-$554.996,99	$2.110,77	$0,20
	WEWA voyage owned container vessel	$0,00	$430.011,84	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$116.736,02	$504.406,10	$73.699,79	$3.591.293,55	-$678.301,23	$2.185,81	$0,20
Total Europe - West Africa [Annual]		**$20.545.794,67**	**$22.360.615,88**	**$9.933.614,96**	**$1.573.000,00**	**$39.958.349,38**	**$22.027.881,22**	**$3.902.849,89**	**$6.070.273,06**	**$26.229.117,26**	**$3.832.389,20**	**$177.495.468,87**	**-$26.019.868,34**	**$2.077,53**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$498.015,62	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.394.573,25	-$772.403,14	$2.869,49	$0,32
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.886,80	$134.428,01	$21.800,43	$1.349.468,78	-$727.298,67	$2.776,68	$0,31
Total South America - West Africa [Annual]		**$13.186.300,10**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.412.278,79**	**$5.018.600,95**	**$1.395.397,34**	**$1.294.113,83**	**$6.990.256,49**	**$1.133.622,13**	**$67.959.394,60**	**-$35.606.548,85**	**$2.689,12**	**$0,31**
Inter West Africa	Feeder 3 voyage chartered container vessel	$135.205,24	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$324.509,47	-$198.412,68	$2.285,28	$5,04
	Feeder 3 voyage owned container vessel	$0,00	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.865,49	$13.677,61	$6.369,67	$256.434,85	-$130.338,07	$1.805,88	$3,99
	Total Feeder 3 [Annual]	**$2.797.124,41**	**$763.228,35**	**$3.334.721,73**	**$1.573.000,00**	**$842.734,24**	**$454.976,03**	**$1.579.694,78**	**$253.005,70**	**$711.235,82**	**$331.222,93**	**$14.190.064,32**	**-$7.633.031,65**	**$1.921,73**	**$4,34**
	Feeder 4 voyage chartered container vessel	$196.749,68	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$563.769,67	-$176.302,75	$2.050,07	$1,06
	Feeder 4 voyage owned container vessel	$0,00	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$15.960,00	$30.976,55	$12.335,63	$476.714,49	-$89.247,56	$1.733,51	$0,90
	Total Feeder 4 [Annual]	**$5.694.018,75**	**$1.677.351,70**	**$3.375.792,78**	**$1.573.000,00**	**$3.763.089,74**	**$2.106.936,44**	**$3.506.715,55**	**$829.920,04**	**$1.610.780,73**	**$641.452,85**	**$26.650.777,56**	**-$6.502.497,49**	**$1.863,69**	**$0,98**
	Feeder 5 voyage chartered container vessel	$344.020,62	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$969.890,54	-$317.501,22	$1.403,60	$2,30
	Feeder 5 voyage owned container vessel	$0,00	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$25.701,38	$71.244,33	$30.996,08	$938.775,03	-$286.385,71	$1.358,57	$2,22
	Total Feeder 5 [Annual]	**$9.891.528,15**	**$1.710.982,35**	**$4.683.027,44**	**$1.573.000,00**	**$5.204.211,99**	**$3.269.905,53**	**$9.451.135,53**	**$1.336.471,74**	**$3.704.705,17**	**$1.611.796,07**	**$48.544.160,30**	**-$14.619.915,70**	**$1.351,00**	**$2,26**
	Feeder 6 voyage chartered container vessel	$420.957,83	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.299.875,14	-$383.990,06	$1.487,27	$0,31
	Feeder 6 voyage owned container vessel	$0,00	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$39.407,32	$120.129,83	$39.204,88	$1.262.005,33	-$346.120,26	$1.443,94	$0,30
	Total feeder 6 [Annual]	**$9.898.740,43**	**$5.297.394,29**	**$4.685.501,60**	**$1.573.000,00**	**$8.501.988,26**	**$5.625.449,13**	**$9.685.781,42**	**$2.049.180,43**	**$6.246.750,97**	**$2.038.653,78**	**$63.746.195,40**	**-$16.120.171,52**	**$1.402,62**	**$0,30**
Total Inter West Africa [Annual]		**$28.281.411,74**	**$9.448.956,68**	**$16.079.043,55**	**$6.292.000,00**	**$18.312.024,23**	**$11.457.267,12**	**$24.223.327,28**	**$4.468.577,91**	**$12.273.472,69**	**$4.623.125,62**	**$153.131.197,57**	**-$44.875.616,36**	**$1.485,79**	**$1,63**
Grand Total [Annual]		**$99.585.541,06**	**$87.304.663,42**	**$38.334.864,20**	**$11.011.000,00**	**$94.241.921,34**	**$54.024.522,15**	**$40.904.977,51**	**$16.423.328,92**	**$68.484.779,58**	**$14.000.000,00**	**$607.523.734,31**	**-$185.919.181,94**	**$1.946,54**	**$0,67**

Figure 499: Results sensitivity analysis: 20% increase in time charter rates scenario 4, specifications container vessels

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.496	2.387	1.035	204	287	1.036	1.040
14 ton TEU capacity [14 ton TEU]	1.853	1.771	760	138	201	761	764
Amount of reefer plugs	344	330	155	48	59	156	156
Amount of ship cranes	3	3	2	2	2	2	2
Lpp [m]	204,0	201,5	159,3	96,9	106,3	159,3	159,5
B [m]	34,0	33,6	26,5	17,6	19,3	26,6	26,6
T [m]	9,7	9,6	7,8	5,2	5,7	7,8	7,8
D [m]	18,0	17,8	13,6	8,2	9,1	13,6	13,7
LBD [m³]	113.763,3	109.345,6	52.107,3	12.339,2	16.702,7	52.151,9	52.330,5
B/T [-]	3,5	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.864	43.270	21.990	5.901	7.781	22.007	22.076
Displacement Volume [m³]	43.769	42.215	21.454	5.757	7.591	21.471	21.538
DWT [t]	35.110	33.787	16.468	4.075	5.465	16.482	16.537
Gross Tonnage [m³]	26.316	25.292	12.035	2.842	3.849	12.045	12.087
Wsm [t]	13.476	13.023	6.864	1.977	2.568	6.869	6.889
Wst [t]	9.589	9.253	4.749	1.299	1.706	4.752	4.767
Vs (design) [kn]	20,7	20,5	18,4	14,6	15,2	18,4	18,4
Vs (Max)	20,8	20,6	18,5	14,6	15,2	18,5	18,5
LCB [m]	-1,16	-1,18	-1,49	-2,45	-2,24	-1,49	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Ta [m]	8,9	8,8	7,7	5,8	6,1	7,7	7,7
Tf [m]	7,9	7,8	6,7	4,8	5,1	6,7	6,7
Tav (in ballast) [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Pb (MCR) [kW]	23.100	21.900	10.500	2.350	3.150	10.500	10.500
Cad [-]	492	492	473	432	438	474	475
Fuel consumption design condition [t/h]	4,39	4,16	2,00	0,45	0,60	2,00	2,00
Generator power [kW]	2.687	2.536	1.276	653	715	1.277	1.280
Operational costs [$/day]	$3.458,67	$3.382,10	$2.733,33	$1.724,52	$1.848,65	$2.733,87	$2.736,05
Average capital costs [$/day]	$9.829,12	$9.499,91	$5.480,40	$2.080,40	$2.500,12	$5.482,45	$5.490,65
Average charter price [$/day]	$9.531,21	$9.381,64	$7.526,43	$6.386,13	$6.500,02	$7.527,80	$7.533,29
Capacity fuel tanks [m³]	3.364	3.236	1.567	383	515	1.568	1.573
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	43.364	41.443	19.258	4.306	5.528	19.279	16.235
Displacement outbound [t]	35.712	34.412	18.275	5.855	7.547	18.287	18.335
Pb inbound [kW]	3.195	4.023	2.208	779	909	1.933	1.720
Pb outbound [kW]	2.807	3.554	2.132	956	1.119	1.866	1.865
Fuel consumption inbound [t/h]	0,607	0,764	0,420	0,148	0,173	0,367	0,327
Fuel consumption outbound [t/h]	0,533	0,675	0,405	0,182	0,213	0,355	0,354

U.7 20% decrease in net freight rates

U.7.1 Scenario 1

Figure 500: Results sensitivity analysis: 20% increase in net freight rates scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.090.528,40	$0,00	$2.090.528,40	$0,00
	FEWA voyage owned container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$2.090.528,40	$0,00	$2.090.528,40	$1.489.141,86
	Total FEWA [Annual]	**2.092**	**1.551**	**108.784**	**80.627**	**15**	**11**	**124,78**	**1.101.880**	**18**	**9**	**9**	**22.834**	**31.920**	**54.754**	**86.476**	**86.476**	**0**	**86.476**	**0**	**86.476**	**172.952**	**86.476**	**86.476**	**$108.707.477,00**	**$0,00**	**$108.707.477,00**	**$29.053.450,83**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$857.609,20	$801,76	$858.410,96	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$857.609,20	$801,76	$858.410,96	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$44.595.678,34**	**$41.691,32**	**$44.637.369,66**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**148.564**	**109.645**				**2.223.208**	**34**	**17**	**17**	**39.892**	**49.431**	**89.323**	**117.676**	**117.572**	**104**	**117.676**	**104**	**117.572**	**235.352**	**117.676**	**117.676**	**$153.303.155,34**	**$41.691,32**	**$153.344.846,66**	**$42.236.286,35**
Europe - West Africa	WEWA voyage chartered container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$2.402.280,68	$35.565,89	$2.437.846,57	$0,00
	WEWA voyage owned container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$2.402.280,68	$35.565,89	$2.437.846,57	$1.091.206,24
Total Europe - West Africa [Annual]		**2.537**	**1.883**	**131.924**	**97.933**	**9**	**11**	**81,13**	**561.652**	**12**	**6**	**6**	**12.996**	**18.594**	**31.591**	**92.664**	**88.504**	**4.160**	**92.664**	**4.160**	**88.504**	**185.328**	**92.664**	**92.664**	**$124.918.595,14**	**$1.849.426,47**	**$126.768.021,61**	**$22.116.834,82**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$510.839,63	$0,00	$510.839,63	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$510.839,63	$0,00	$510.839,63	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$26.563.660,82**	**$0,00**	**$26.563.660,82**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$156.344,82	$4.288,09	$160.632,91	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$156.344,82	$4.288,09	$160.632,91	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$8.129.930,81**	**$222.980,50**	**$8.352.911,31**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$537.545,86	$0,00	$537.545,86	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$537.545,86	$0,00	$537.545,86	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$27.952.384,84**	**$0,00**	**$27.952.384,84**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$36.082.315,65**	**$222.980,50**	**$36.305.296,15**	**$7.816.589,19**
Grand Total [Annual]				**402.480**	**296.618**				**3.341.884**	**62**	**32**	**30**	**66.394**	**78.247**	**144.641**	**283.764**	**278.616**	**5.148**	**283.764**	**5.148**	**278.616**	**567.528**	**283.764**	**283.764**	**$340.867.726,97**	**$2.114.098,28**	**$342.981.825,25**	**$80.469.174,19**

Figure 501: Results sensitivity analysis: 20% increase in net freight rates scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.120.123,02	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$79.155,57	$485.399,43	$82.047,05	$3.947.343,75	-$1.856.815,35	$2.373,63	$0,11
	FEWA voyage owned container vessel	$0,00	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$79.155,57	$485.399,43	$82.047,05	$4.316.362,60	-$2.225.834,19	$2.595,53	$0,12
	Total FEWA [Annual]	**$29.488.927,28**	**$34.057.196,45**	**$16.008.617,04**	**$1.573.000,00**	**$32.398.072,74**	**$19.756.720,18**	**$9.598.565,17**	**$4.116.089,45**	**$25.240.770,56**	**$4.266.446,77**	**$205.557.856,49**	**-$96.850.379,49**	**$2.377,05**	**$0,12**
	SWAX voyage chartered container vessel	$790.694,05	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$31.649,67	$197.612,24	$29.602,06	$1.965.360,43	-$1.106.949,48	$3.275,60	$0,15
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$31.649,67	$197.612,24	$29.602,06	$1.930.615,80	-$1.072.204,85	$3.217,69	$0,15
	Total SWAX [Annual]	**$20.895.324,36**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$1.645.783,08**	**$10.275.836,35**	**$1.539.307,31**	**$95.160.811,85**	**-$50.523.442,19**	**$3.050,03**	**$0,15**
Total Asia - West Africa [Annual]		**$50.384.251,64**	**$55.558.611,60**	**$25.942.503,86**	**$3.146.000,00**	**$38.574.495,02**	**$28.082.366,79**	**$9.709.919,56**	**$5.761.872,53**	**$35.516.606,91**	**$5.805.754,08**	**$300.718.668,34**	**-$147.373.821,68**	**$2.555,48**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$777.795,08	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$97.529,36	$524.296,42	$87.918,13	$3.539.674,55	-$1.101.827,98	$1.986,35	$0,18
	WEWA voyage owned container vessel	$0,00	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$97.529,36	$524.296,42	$87.918,13	$3.853.085,71	-$1.415.239,14	$2.162,23	$0,20
Total Europe - West Africa [Annual]		**$20.996.562,37**	**$19.649.438,30**	**$10.100.620,76**	**$1.573.000,00**	**$44.579.974,52**	**$24.603.082,09**	**$6.204.933,19**	**$5.071.526,77**	**$27.263.413,99**	**$4.571.742,72**	**$186.731.129,53**	**-$59.963.107,91**	**$2.015,14**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$20.433,59	$134.372,17	$24.619,05	$1.352.802,07	-$841.962,44	$2.711,03	$0,30
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$20.433,59	$134.372,17	$24.619,05	$1.395.693,80	-$884.854,17	$2.796,98	$0,31
Total South America - West Africa [Annual]		**$11.044.678,96**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.062.546,43**	**$6.987.352,91**	**$1.280.190,58**	**$68.026.495,97**	**-$41.462.835,15**	**$2.621,65**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$6.837,71	$34.564,88	$9.719,34	$448.276,58	-$287.643,67	$2.275,52	$1,78
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$6.837,71	$34.564,88	$9.719,34	$402.289,01	-$241.656,10	$2.042,08	$1,60
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$355.561,09**	**$1.797.373,86**	**$505.405,90**	**$21.225.643,94**	**-$12.872.732,63**	**$2.072,01**	**$1,66**
	Feeder 2 voyage chartered container vessel	$263.930,29	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$21.109,01	$118.920,24	$35.325,13	$1.405.524,49	-$867.978,63	$1.963,02	$5,74
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$21.109,01	$118.920,24	$35.325,13	$1.433.768,82	-$896.222,95	$2.002,47	$5,86
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.097.668,77**	**$6.183.852,29**	**$1.836.906,73**	**$71.143.330,91**	**-$43.190.946,07**	**$1.910,81**	**$5,81**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.453.229,86**	**$7.981.226,14**	**$2.342.312,63**	**$92.368.974,85**	**-$56.063.678,70**	**$1.945,59**	**$4,25**
Grand Total [Annual]		**$90.292.292,49**	**$89.966.995,90**	**$48.892.227,12**	**$9.438.000,00**	**$126.878.243,09**	**$77.731.284,98**	**$19.079.275,37**	**$13.349.175,59**	**$77.748.599,96**	**$14.000.000,00**	**$647.845.268,70**	**-$304.863.443,45**	**$2.283,04**	**$0,70**

Figure 502: Results sensitivity analysis: 20% increase in net freight rates scenario 1, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	2.092	765	2.537	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.551	558	1.883	781	142	789
Amount of reefer plugs	292	121	349	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	194,5	138,5	204,9	160,4	97,6	160,9
B [m]	32,4	25,2	34,1	26,7	17,7	26,8
T [m]	9,3	7,4	9,8	7,9	5,2	7,9
D [m]	17,0	12,4	18,1	13,8	8,2	13,8
LBD [m³]	97.271,3	39.852,4	115.419,4	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	38.885	17.214	45.460	22.471	6.018	22.659
Displacement Volume [m³]	37.937	16.795	44.351	21.923	5.871	22.106
DWT [t]	30.163	12.698	35.605	16.851	4.160	17.000
Gross Tonnage [m³]	22.494	9.199	26.700	12.324	2.904	12.437
Wsm [t]	11.770	5.445	13.645	7.006	2.014	7.061
Wst [t]	8.328	3.731	9.714	4.851	1.324	4.891
Vs (design) [kn]	20,2	17,2	20,7	18,5	14,6	18,5
Vs (Max)	20,3	17,3	20,8	18,6	14,6	18,6
LCB [m]	-1,22	-1,72	-1,16	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,3	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,8	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,8	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,3	7,2
Pb (MCR) [kW]	19.700	7.400	23.300	10.800	2.400	10.900
Cad [-]	487	466	492	474	429	473
Fuel consumption design condition [t/h]	3,74	1,41	4,43	2,05	0,46	2,07
Generator power [kW]	2.127	1.074	2.744	1.297	657	1.306
Operational costs [$/day]	$3.211,94	$2.418,33	$3.480,65	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$8.722,27	$4.423,16	$9.970,07	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$8.976,84	$7.155,93	$9.587,47	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	2.886	1.205	3.412	1.604	391	1.618
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	36.840	14.579	43.477	19.727	4.401	19.916
Displacement outbound [t]	30.891	15.053	36.202	18.610	5.957	18.741
Pb inbound [kW]	2.892	1.629	3.200	2.239	797	1.979
Pb outbound [kW]	2.572	1.664	2.832	2.153	975	1.900
Fuel consumption inbound [t/h]	0,549	0,309	0,608	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,489	0,316	0,538	0,409	0,185	0,361

U.7.2 Scenario 2

Figure 503: Results sensitivity analysis: 20% increase in net freight rates scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.178.067,26	$4.409,38	$2.182.476,64	$0,00
	FEWA 2 voyage owned container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$2.178.067,26	$4.409,38	$2.182.476,64	$1.521.991,24
	Total FEWA [Annual]	**2.219**	**1.645**	**115.388**	**85.566**	**16**	**12**	**122,86**	**1.103.596**	**18**	**9**	**9**	**26.017**	**35.711**	**61.728**	**90.012**	**89.492**	**520**	**90.012**	**520**	**89.492**	**180.024**	**90.012**	**90.012**	**$113.259.497,41**	**$229.287,93**	**$113.488.785,34**	**$30.272.549,93**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$857.609,20	$801,76	$858.410,96	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$857.609,20	$801,76	$858.410,96	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$44.595.678,34**	**$41.691,32**	**$44.637.369,66**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**155.168**	**114.584**				**2.224.924**		**17**	**17**	**43.074**	**53.222**	**96.297**	**121.212**	**120.588**	**624**	**121.212**	**624**	**120.588**	**242.424**	**121.212**	**121.212**	**$157.855.175,75**	**$270.979,24**	**$158.126.155,00**	**$43.455.385,45**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$2.466.421,16	$62.807,85	$2.529.229,02	$0,00
	WEWA 2 voyage owned container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$2.466.421,16	$62.807,85	$2.529.229,02	$1.147.946,27
Total Europe - West Africa [Annual]		**2.612**	**1.939**	**135.818**	**100.845**	**10**	**12**	**83,76**	**563.004**	**12**	**6**	**6**	**13.522**	**21.416**	**34.937**	**97.552**	**90.584**	**6.968**	**97.552**	**6.968**	**90.584**	**195.104**	**97.552**	**97.552**	**$128.253.900,43**	**$3.266.008,44**	**$131.519.908,88**	**$22.585.311,72**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$510.839,63	$0,00	$510.839,63	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$510.839,63	$0,00	$510.839,63	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$26.563.660,82**	**$0,00**	**$26.563.660,82**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$156.344,82	$4.288,09	$160.632,91	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$156.344,82	$4.288,09	$160.632,91	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$8.129.930,81**	**$222.980,50**	**$8.352.911,31**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$537.545,86	$0,00	$537.545,86	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$537.545,86	$0,00	$537.545,86	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$27.952.384,84**	**$0,00**	**$27.952.384,84**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$36.082.315,65**	**$222.980,50**	**$36.305.296,15**	**$7.816.589,19**
Grand Total [Annual]				**412.978**	**304.469**				**3.344.952**	**28**	**32**	**30**	**70.102**	**84.860**	**154.962**	**292.188**	**283.712**	**8.476**	**292.188**	**8.476**	**283.712**	**584.376**	**292.188**	**292.188**	**$348.755.052,67**	**$3.759.968,18**	**$352.515.020,85**	**$82.156.750,18**

Figure 504: Results sensitivity analysis: 20% increase in net freight rates scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transhipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$1.124.300,01	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$82.373,75	$510.689,25	$82.939,75	$4.106.354,37	-$1.923.877,72	$2.372,24	$0,11
	FEWA 2 voyage owned container vessel	$0,00	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$82.373,75	$510.689,25	$82.939,75	$4.504.045,60	-$2.321.568,96	$2.601,99	$0,12
	Total FEWA [Annual]	**$30.061.402,26**	**$38.395.094,93**	**$17.327.232,83**	**$1.573.000,00**	**$33.181.282,48**	**$19.839.508,08**	**$9.598.565,17**	**$4.283.435,24**	**$26.555.840,95**	**$4.312.867,06**	**$215.400.778,94**	**-$101.911.993,60**	**$2.393,02**	**$0,12**
	SWAX voyage chartered container vessel	$790.694,05	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$31.649,67	$197.076,66	$28.748,61	$1.963.971,40	-$1.105.560,45	$3.273,29	$0,15
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$31.649,67	$197.076,66	$28.748,61	$1.929.226,77	-$1.070.815,82	$3.215,38	$0,15
	Total SWAX [Annual]	**$20.895.324,36**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$1.645.783,08**	**$10.247.986,19**	**$1.494.927,92**	**$95.088.582,31**	**-$50.451.212,65**	**$3.047,71**	**$0,15**
Total Asia - West Africa [Annual]		**$50.956.726,62**	**$59.896.510,07**	**$27.261.119,65**	**$3.146.000,00**	**$39.357.704,76**	**$28.165.154,69**	**$9.709.919,56**	**$5.929.218,32**	**$36.803.827,14**	**$5.807.794,98**	**$310.489.361,25**	**-$152.363.206,25**	**$2.561,54**	**$0,13**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$811.619,29	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$101.184,66	$559.430,06	$89.887,33	$3.718.826,42	-$1.189.597,40	$1.982,32	$0,18
	WEWA 2 voyage owned container vessel	$0,00	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$101.184,66	$559.430,06	$89.887,33	$4.055.153,40	-$1.525.924,38	$2.161,60	$0,20
Total Europe - West Africa [Annual]		**$21.221.593,11**	**$21.730.931,20**	**$11.315.547,60**	**$1.573.000,00**	**$45.557.094,76**	**$25.767.157,30**	**$6.204.933,19**	**$5.261.602,26**	**$29.090.363,22**	**$4.674.141,31**	**$194.981.675,67**	**-$63.461.766,79**	**$1.998,75**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$20.433,59	$134.478,34	$23.909,26	$1.352.198,45	-$841.358,82	$2.709,82	$0,30
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$20.433,59	$134.478,34	$23.909,26	$1.395.090,18	-$884.250,55	$2.795,77	$0,31
Total South America - West Africa [Annual]		**$11.044.678,96**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.062.546,43**	**$6.992.873,56**	**$1.243.281,72**	**$67.995.107,77**	**-$41.431.446,94**	**$2.620,44**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$6.837,71	$34.564,77	$9.439,13	$447.996,26	-$287.363,35	$2.274,09	$1,78
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$6.837,71	$34.564,77	$9.439,13	$402.008,68	-$241.375,77	$2.040,65	$1,60
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$355.561,09**	**$1.797.368,20**	**$490.834,67**	**$21.211.067,05**	**-$12.858.155,74**	**$2.070,58**	**$1,66**
	Feeder 2 voyage chartered container vessel	$263.930,29	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$21.109,01	$118.920,24	$34.306,68	$1.404.506,04	-$866.960,18	$1.961,60	$5,74
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$21.109,01	$118.920,24	$34.306,68	$1.432.750,37	-$895.204,50	$2.001,05	$5,85
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.097.668,77**	**$6.183.852,29**	**$1.783.947,32**	**$71.090.371,51**	**-$43.137.986,67**	**$1.909,39**	**$5,80**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$1.453.229,86**	**$7.981.220,48**	**$2.274.781,99**	**$92.301.438,56**	**-$55.996.142,41**	**$1.944,17**	**$4,25**
Grand Total [Annual]		**$91.089.798,21**	**$96.386.387,27**	**$51.425.769,76**	**$9.438.000,00**	**$128.638.573,07**	**$78.978.148,10**	**$19.079.275,37**	**$13.706.596,87**	**$80.868.284,41**	**$14.000.000,00**	**$665.767.583,24**	**-$313.252.562,39**	**$2.278,56**	**$0,70**

Figure 505: Results sensitivity analysis: 20% increase in net freight rates scenario 2, specifications container vessels

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	2.219	765	2.612	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.645	558	1.939	781	142	789
Amount of reefer plugs	308	121	359	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	197,6	138,5	206,5	160,4	97,6	160,9
B [m]	32,9	25,2	34,4	26,7	17,7	26,8
T [m]	9,4	7,4	9,8	7,9	5,2	7,9
D [m]	17,4	12,4	18,3	13,8	8,2	13,8
LBD [m³]	102.491,5	39.852,4	118.436,1	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	40.786	17.214	46.544	22.471	6.018	22.659
Displacement Volume [m³]	39.791	16.795	45.408	21.923	5.871	22.106
DWT [t]	31.732	12.698	36.507	16.851	4.160	17.000
Gross Tonnage [m³]	23.704	9.199	27.399	12.324	2.904	12.437
Wsm [t]	12.314	5.445	13.953	7.006	2.014	7.061
Wst [t]	8.729	3.731	9.943	4.851	1.324	4.891
Vs (design) [kn]	20,4	17,2	20,8	18,5	14,6	18,5
Vs (Max)	20,5	17,3	20,9	18,6	14,6	18,6
LCB [m]	-1,20	-1,72	-1,15	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,2	6,7	8,5	7,2	5,3	7,2
Ta [m]	8,7	7,2	9,0	7,7	5,8	7,7
Tf [m]	7,7	6,2	8,0	6,7	4,8	6,7
Tav (in ballast) [m]	8,2	6,7	8,5	7,2	5,3	7,2
Pb (MCR) [kW]	20.900	7.400	24.000	10.800	2.400	10.900
Cad [-]	488	466	492	474	429	473
Fuel consumption design condition [t/h]	3,97	1,41	4,56	2,05	0,46	2,07
Generator power [kW]	2.303	1.074	2.847	1.297	657	1.306
Operational costs [$/day]	$3.295,96	$2.418,33	$3.527,75	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$9.092,12	$4.423,16	$10.178,01	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$9.151,11	$7.155,93	$9.690,23	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	3.038	1.205	3.499	1.604	391	1.618
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	38.886	14.579	44.411	19.727	4.401	19.916
Displacement outbound [t]	32.406	15.053	37.096	18.610	5.957	18.741
Pb inbound [kW]	3.419	1.629	3.707	2.239	797	1.979
Pb outbound [kW]	3.028	1.664	3.288	2.153	975	1.900
Fuel consumption inbound [t/h]	0,650	0,309	0,704	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,575	0,316	0,625	0,409	0,185	0,361

U.7.3 Scenario 3

Figure 506: Results sensitivity analysis: 20% increase in net freight rates scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.035.890,97	$12.125,80	$2.048.016,77	$0,00
	FEWA voyage owned container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$2.035.890,97	$12.125,80	$2.048.016,77	$1.474.146,56
	Total FEWA [Annual]	**2.054**	**1.522**	**106.808**	**79.149**	**15**	**11**	**124,68**	**1.101.880**	**18**	**9**	**9**	**22.581**	**31.616**	**54.197**	**85.904**	**84.240**	**1.664**	**85.904**	**1.664**	**84.240**	**171.808**	**85.904**	**85.904**	**$105.866.330,48**	**$630.541,80**	**$106.496.872,27**	**$28.750.376,75**
	SWAX voyage chartered container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$838.088,79	$16.014,13	$854.102,92	$0,00
	SWAX voyage owned container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$838.088,79	$16.014,13	$854.102,92	$766.641,09
	Total SWAX [Annual]	**781**	**570**	**40.612**	**29.641**	**11**	**11**	**110,66**	**1.121.328**	**16**	**8**	**8**	**17.209**	**17.618**	**34.827**	**32.396**	**30.368**	**2.028**	**32.396**	**2.028**	**30.368**	**64.792**	**32.396**	**32.396**	**$43.580.617,24**	**$832.734,66**	**$44.413.351,91**	**$13.378.461,25**
Total Asia - West Africa [Annual]				**147.420**	**108.790**				**2.223.208**		**17**	**17**	**39.790**	**49.234**	**89.024**	**118.300**	**114.608**	**3.692**	**118.300**	**3.692**	**114.608**	**236.600**	**118.300**	**118.300**	**$149.446.947,72**	**$1.463.276,46**	**$150.910.224,18**	**$42.128.838,00**
Europe - West Africa	WEWA voyage chartered container vessel	2.410	1.788	125.320	92.994	9	12	77,00	10.801	11	5	6	286	410	697	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.341.759,49	$16.014,13	$2.357.773,62	$0,00
	WEWA voyage owned container vessel	2.410	1.788	125.320	92.994	9	12	77,00	10.801	11	5	6	286	410	697	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$2.341.759,49	$16.014,13	$2.357.773,62	$1.001.633,66
Total Europe - West Africa [Annual]		**2.410**	**1.788**	**125.320**	**92.994**	**9**	**12**	**77,00**	**561.652**	**11**	**6**	**5**	**14.887**	**21.345**	**36.232**	**87.828**	**86.216**	**1.612**	**87.828**	**1.612**	**86.216**	**175.656**	**87.828**	**87.828**	**$121.771.493,73**	**$832.734,66**	**$122.604.228,40**	**$21.287.446,89**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$497.736,09	$0,00	$497.736,09	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$497.736,09	$0,00	$497.736,09	$451.606,04
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**54,98**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$25.882.276,60**	**$0,00**	**$25.882.276,60**	**$8.151.663,35**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$154.788,42	$2.395,32	$157.183,74	$0,00
	Feeder 1 voyage owned container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$154.788,42	$2.395,32	$157.183,74	$69.731,82
	Total Feeder 1 [Annual]	**214**	**146**	**11.128**	**7.590**	**3**	**11**	**17,94**	**66.300**	**3**	**2**	**1**	**1.037**	**650**	**1.687**	**9.776**	**9.256**	**520**	**9.776**	**520**	**9.256**	**19.552**	**9.776**	**9.776**	**$8.048.997,94**	**$124.556,58**	**$8.173.554,53**	**$1.595.863,07**
	Feeder 2 voyage chartered container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$521.642,56	$0,00	$521.642,56	$0,00
	Feeder 2 voyage owned container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$521.642,56	$0,00	$521.642,56	$282.957,53
	Total Feeder 2 [Annual]	**1.042**	**765**	**54.184**	**39.791**	**5**	**11**	**34,37**	**17.784**	**5**	**3**	**2**	**1.929**	**329**	**2.258**	**36.140**	**36.140**	**0**	**36.140**	**0**	**36.140**	**72.280**	**36.140**	**36.140**	**$27.125.413,09**	**$0,00**	**$27.125.413,09**	**$6.110.830,42**
Total Inter West Africa [Annual]				**65.312**	**47.381**				**84.084**	**8**	**5**	**3**	**2.966**	**979**	**3.945**	**45.916**	**45.396**	**520**	**45.916**	**520**	**45.396**	**91.832**	**45.916**	**45.916**	**$35.174.411,03**	**$124.556,58**	**$35.298.967,62**	**$7.706.693,48**
Grand Total [Annual]				**391.872**	**288.684**				**3.341.884**	**27**	**32**	**29**	**68.063**	**80.727**	**148.790**	**277.316**	**271.492**	**5.824**	**277.316**	**5.824**	**271.492**	**554.632**	**277.316**	**277.316**	**$332.275.129,08**	**$2.420.567,71**	**$334.695.696,79**	**$79.274.641,73**

Figure 507: Results sensitivity analysis: 20% increase in net freight rates scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.112.692,40	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$77.566,22	$491.894,43	$83.399,44	$3.926.403,78	-$1.878.387,00	$2.376,76	$0,11
	FEWA voyage owned container vessel	$0,00	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$77.566,22	$491.894,43	$83.399,44	$4.287.857,94	-$2.239.841,16	$2.595,56	$0,12
	Total FEWA [Annual]	**$29.317.635,56**	**$33.710.378,62**	**$15.938.103,48**	**$1.573.000,00**	**$32.083.314,38**	**$19.702.834,62**	**$9.356.635,68**	**$4.033.443,30**	**$25.578.510,48**	**$4.336.771,05**	**$204.381.003,92**	**-$97.884.131,64**	**$2.379,18**	**$0,12**
	SWAX voyage chartered container vessel	$794.309,50	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$31.476,35	$208.361,38	$31.451,48	$1.995.118,15	-$1.141.015,23	$3.202,44	$0,15
	SWAX voyage owned container vessel	$0,00	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$31.476,35	$208.361,38	$31.451,48	$1.967.449,74	-$1.113.346,82	$3.158,03	$0,15
	Total SWAX [Annual]	**$20.959.433,54**	**$21.662.274,39**	**$9.955.659,43**	**$1.573.000,00**	**$6.423.407,69**	**$8.549.951,81**	**$170.717,65**	**$1.636.770,24**	**$10.834.791,53**	**$1.635.477,22**	**$96.779.944,74**	**-$52.366.592,84**	**$2.987,40**	**$0,15**
Total Asia - West Africa [Annual]		**$50.277.069,10**	**$55.372.653,01**	**$25.893.762,91**	**$3.146.000,00**	**$38.506.722,07**	**$28.252.786,43**	**$9.527.353,33**	**$5.670.213,53**	**$36.413.302,01**	**$5.972.248,27**	**$301.160.948,66**	**-$150.250.724,48**	**$2.545,74**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$724.803,64	$433.387,14	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$94.230,72	$498.350,63	$85.267,35	$3.438.795,06	-$1.081.021,44	$2.035,99	$0,19
	WEWA voyage owned container vessel	$0,00	$433.387,14	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$94.230,72	$498.350,63	$85.267,35	$3.715.625,08	-$1.357.851,46	$2.199,90	$0,20
Total Europe - West Africa [Annual]		**$17.179.093,65**	**$22.536.131,41**	**$9.959.222,52**	**$1.573.000,00**	**$42.560.610,16**	**$23.238.477,20**	**$6.011.980,59**	**$4.899.997,29**	**$25.914.232,73**	**$4.433.902,12**	**$179.594.094,56**	**-$56.989.866,16**	**$2.044,84**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$413.817,11	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$19.909,44	$132.860,48	$24.535,19	$1.335.520,21	-$837.784,13	$2.747,98	$0,30
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$19.909,44	$132.860,48	$24.535,19	$1.373.309,15	-$875.573,06	$2.825,74	$0,31
Total South America - West Africa [Annual]		**$10.988.583,42**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.841.117,62**	**$4.866.695,53**	**$2.624.155,35**	**$1.035.291,06**	**$6.908.745,10**	**$1.275.829,74**	**$67.068.808,48**	**-$41.186.531,88**	**$2.653,88**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	$114.792,76	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$6.699,11	$33.416,37	$9.490,98	$440.182,83	-$282.999,09	$2.341,40	$1,84
	Feeder 1 voyage owned container vessel	$0,00	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$6.699,11	$33.416,37	$9.490,98	$395.121,89	-$237.938,15	$2.101,71	$1,65
	Total Feeder 1 [Annual]	**$2.335.945,54**	**$1.049.287,61**	**$2.504.752,54**	**$1.573.000,00**	**$5.188.705,95**	**$3.716.277,45**	**$308.724,16**	**$348.353,73**	**$1.737.651,39**	**$493.530,85**	**$20.852.092,28**	**-$12.678.537,76**	**$2.132,99**	**$1,71**
	Feeder 2 voyage chartered container vessel	$259.038,62	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$20.499,09	$115.836,32	$35.086,33	$1.371.937,47	-$850.294,91	$1.974,01	$5,77
	Feeder 2 voyage owned container vessel	$0,00	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$20.499,09	$115.836,32	$35.086,33	$1.395.856,38	-$874.213,82	$2.008,43	$5,87
	Total Feeder 2 [Annual]	**$5.501.303,65**	**$1.404.426,55**	**$4.686.738,68**	**$1.573.000,00**	**$25.485.943,60**	**$15.787.405,30**	**$19.295,26**	**$1.065.952,82**	**$6.023.488,83**	**$1.824.489,03**	**$69.482.874,13**	**-$42.357.461,05**	**$1.922,60**	**$5,83**
Total Inter West Africa [Annual]		**$7.837.249,19**	**$2.453.714,15**	**$7.191.491,22**	**$3.146.000,00**	**$30.674.649,55**	**$19.503.682,76**	**$328.019,42**	**$1.414.306,55**	**$7.761.140,22**	**$2.318.019,88**	**$90.334.966,42**	**-$55.035.998,80**	**$1.967,40**	**$4,29**
Grand Total [Annual]		**$86.281.995,37**	**$92.547.335,19**	**$48.663.367,32**	**$9.438.000,00**	**$123.583.099,39**	**$75.861.641,92**	**$18.491.508,69**	**$13.019.808,44**	**$76.997.420,07**	**$14.000.000,00**	**$638.158.818,12**	**-$303.463.121,32**	**$2.301,20**	**$0,71**

Figure 508: Results sensitivity analysis: 20% increase in net freight rates scenario 3, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	2.054	781	2.410	1.035	214	1.042
14 ton TEU capacity [14 ton TEU]	1.522	570	1.788	760	146	765
Amount of reefer plugs	287	123	333	155	50	156
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	193,5	139,3	202,0	159,3	98,2	159,6
B [m]	32,3	25,3	33,7	26,5	17,9	26,6
T [m]	9,2	7,4	9,6	7,8	5,3	7,8
D [m]	16,9	12,5	17,8	13,6	8,3	13,7
LBD [m³]	95.702,4	40.590,8	110.279,7	52.107,3	12.874,3	52.419,8
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [ton]	38.312	17.505	43.607	21.990	6.134	22.111
Displacement Volume [m³]	37.377	17.079	42.544	21.454	5.985	21.571
DWT [ton]	29.692	12.926	34.067	16.468	4.246	16.564
Gross Tonnage [m³]	22.131	9.370	25.509	12.035	2.965	12.107
Wsm [ton]	11.606	5.532	13.119	6.864	2.051	6.900
Wst [ton]	8.207	3.793	9.324	4.749	1.349	4.774
Vs (design) [kn]	20,2	17,3	20,6	18,4	14,7	18,4
Vs (Max)	20,3	17,4	20,7	18,5	14,7	18,5
LCB [m]	-1,23	-1,71	-1,18	-1,49	-2,42	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,4	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,9	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,9	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,4	7,2
Pb (MCR) [kW]	19.500	7.600	22.400	10.500	2.500	10.500
Cad [-]	488	467	491	473	426	475
Fuel consumption design condition [ton/h]	3,71	1,44	4,26	2,00	0,48	2,00
Generator power [kW]	2.075	1.086	2.568	1.276	661	1.282
Operational costs [$/day]	$3.193,02	$2.438,61	$3.407,99	$2.733,33	$1.744,39	$2.737,14
Average capital costs [$/day]	$8.630,83	$4.489,25	$9.600,47	$5.480,40	$2.143,25	$5.494,74
Average charter price [$/day]	$8.924,70	$7.177,89	$9.413,20	$7.526,43	$6.399,85	$7.536,03
Capacity fuel tanks [m³]	2.841	1.227	3.263	1.567	399	1.576
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	36.198	14.859	41.821	19.258	4.497	19.377
Displacement outbound [ton]	30.437	15.244	34.686	18.275	6.059	18.359
Pb inbound [kW]	2.858	1.647	4.059	2.208	815	1.933
Pb outbound [kW]	2.546	1.675	3.583	2.132	994	1.865
Fuel consumption inbound [ton/h]	0,543	0,313	0,771	0,420	0,155	0,367
Fuel consumption outbound [ton/h]	0,484	0,318	0,681	0,405	0,189	0,354

U.7.4 Scenario 4

Figure 509: Results sensitivity analysis: 20% increase in net freight rates scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.277.730,45	$21.054,80	$2.298.785,25	$0,00
	SWAX 2 voyage owned container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.277.730,45	$21.054,80	$2.298.785,25	$1.714.105,61
Total Asia - West Africa [Annual]		**2.496**	**1.853**	**129.792**	**96.339**	**6**	**11**	**129,00**	**1.321.580**	**19**	**10**	**9**	**31.026**	**38.604**	**69.631**	**98.332**	**95.628**	**2.704**	**98.332**	**2.704**	**95.628**	**196.664**	**98.332**	**98.332**	**$118.441.983,40**	**$1.094.849,85**	**$119.536.833,26**	**$36.322.464,41**
Europe - West Africa	WEWA voyage chartered container vessel	2.387	1.771	124.124	92.100	9	12	75,92	10.801	11	5	6	284	407	691	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.830.601,22	$16.521,74	$2.847.122,97	$0,00
	WEWA voyage owned container vessel	2.387	1.771	124.124	92.100	9	12	75,92	10.801	11	5	6	284	407	691	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.830.601,22	$16.521,74	$2.847.122,97	$978.061,03
Total Europe - West Africa [Annual]		**2.387**	**1.771**	**124.124**	**92.100**	**9**	**12**	**75,92**	**561.652**	**11**	**6**	**5**	**14.767**	**21.182**	**35.950**	**85.436**	**83.824**	**1.612**	**85.436**	**1.612**	**83.824**	**170.872**	**85.436**	**85.436**	**$147.191.263,64**	**$859.130,74**	**$148.050.394,38**	**$21.061.583,33**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$601.968,82	$0,00	$601.968,82	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$601.968,82	$0,00	$601.968,82	$452.911,15
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**55,14**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$31.302.378,40**	**$0,00**	**$31.302.378,40**	**$8.152.097,66**
Inter West Africa	Feeder 3 voyage chartered container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$101.956,68	$1.386,36	$103.343,03	$0,00
	Feeder 3 voyage owned container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$67.130,63
	Total Feeder 3 [Annual]	**204**	**138**	**10.608**	**7.201**	**4**	**11**	**17,64**	**23.556**	**3**	**2**	**1**	**845**	**382**	**1.227**	**7.384**	**7.072**	**312**	**7.384**	**312**	**7.072**	**14.768**	**7.384**	**7.384**	**$5.884.333,30**	**$81.101,91**	**$5.965.435,21**	**$1.549.120,33**
	Feeder 4 voyage chartered container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$317.790,28	$4.159,07	$321.949,35	$0,00
	Feeder 4 voyage owned container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$317.790,28	$4.159,07	$321.949,35	$109.694,49
	Total Feeder 4 [Annual]	**287**	**201**	**14.924**	**10.429**	**4**	**11**	**25,22**	**100.516**	**4**	**2**	**2**	**1.732**	**965**	**2.697**	**14.300**	**13.364**	**936**	**14.300**	**936**	**13.364**	**28.600**	**14.300**	**14.300**	**$16.525.094,39**	**$216.271,75**	**$16.741.366,14**	**$1.871.718,99**
	Feeder 5 voyage chartered container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$524.377,06	$0,00	$524.377,06	$0,00
	Feeder 5 voyage owned container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$524.377,06	$0,00	$524.377,06	$312.905,11
	Total Feeder 5 [Annual]	**1.036**	**761**	**53.872**	**39.558**	**5**	**11**	**38,08**	**31.772**	**6**	**3**	**3**	**2.200**	**551**	**2.751**	**35.932**	**35.932**	**0**	**35.932**	**0**	**35.932**	**71.864**	**35.932**	**35.932**	**$27.267.607,28**	**$0,00**	**$27.267.607,28**	**$6.107.396,33**
	Feeder 6 voyage chartered container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$790.691,59	$1.543,28	$792.234,88	$0,00
	Feeder 6 voyage owned container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$790.691,59	$1.543,28	$792.234,88	$383.088,03
	Total feeder 6 [Annual]	**1.040**	**764**	**54.080**	**39.714**	**5**	**11**	**46,57**	**253.396**	**7**	**4**	**3**	**4.634**	**3.882**	**8.517**	**45.448**	**45.084**	**364**	**45.448**	**364**	**45.084**	**90.896**	**45.448**	**45.448**	**$41.115.962,84**	**$80.250,77**	**$41.196.213,61**	**$8.143.755,09**
Total Inter West Africa [Annual]				**133.484**	**96.901**				**409.240**	**20**	**11**	**9**	**9.411**	**5.780**	**15.191**	**103.064**	**101.452**	**1.612**	**103.064**	**1.612**	**101.452**	**206.128**	**103.064**	**103.064**	**$90.792.997,81**	**$377.624,44**	**$91.170.622,25**	**$17.671.990,74**
Grand Total [Annual]				**441.220**	**324.859**				**2.765.412**	**58**	**31**	**27**	**65.625**	**74.737**	**140.361**	**312.104**	**306.176**	**5.928**	**312.104**	**5.928**	**306.176**	**624.208**	**312.104**	**312.104**	**$387.728.623,25**	**$2.331.605,02**	**$390.060.228,28**	**$83.208.136,14**

Figure 510: Results sensitivity analysis: 20% increase in net freight rates scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$1.229.512,23	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$81.342,28	$442.152,56	$84.824,29	$3.819.562,40	-$1.520.777,15	$2.019,86	$0,08
	SWAX 2 voyage owned container vessel	$0,00	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$81.342,28	$442.152,56	$84.824,29	$4.304.155,78	-$2.005.370,52	$2.276,13	$0,09
Total Asia - West Africa [Annual]		**$31.310.028,79**	**$43.310.254,24**	**$6.703.315,01**	**$1.573.000,00**	**$24.559.268,94**	**$15.520.772,85**	**$11.383.402,99**	**$4.229.798,81**	**$22.991.933,13**	**$4.410.863,05**	**$202.315.102,22**	**-$82.778.268,96**	**$2.057,47**	**$0,08**
Europe - West Africa	WEWA voyage chartered container vessel	$712.297,33	$430.011,84	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$114.065,73	$504.406,10	$73.699,79	$3.322.859,55	-$475.736,58	$2.022,43	$0,19
	WEWA voyage owned container vessel	$0,00	$430.011,84	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$114.065,73	$504.406,10	$73.699,79	$3.588.623,26	-$741.500,29	$2.184,19	$0,20
Total Europe - West Africa [Annual]		**$17.121.495,56**	**$22.360.615,88**	**$9.933.614,96**	**$1.573.000,00**	**$39.958.349,38**	**$22.027.881,22**	**$3.902.849,89**	**$5.931.417,96**	**$26.229.117,26**	**$3.832.389,20**	**$173.932.314,65**	**-$25.881.920,27**	**$2.035,82**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$415.013,01	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.078,75	$134.428,01	$21.800,43	$1.310.762,59	-$708.793,78	$2.697,04	$0,30
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$24.078,75	$134.428,01	$21.800,43	$1.348.660,73	-$746.691,92	$2.775,02	$0,31
Total South America - West Africa [Annual]		**$10.988.583,42**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.412.278,79**	**$5.018.600,95**	**$1.395.397,34**	**$1.252.095,14**	**$6.990.256,49**	**$1.133.622,13**	**$65.719.659,22**	**-$34.417.280,82**	**$2.600,49**	**$0,30**
Inter West Africa	Feeder 3 voyage chartered container vessel	$112.671,04	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.018,14	$13.677,61	$6.369,67	$301.127,91	-$197.784,87	$2.120,62	$4,68
	Feeder 3 voyage owned container vessel	$0,00	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$4.018,14	$13.677,61	$6.369,67	$255.587,50	-$129.490,71	$1.799,91	$3,97
	Total Feeder 3 [Annual]	**$2.330.937,01**	**$763.228,35**	**$3.334.721,73**	**$1.573.000,00**	**$842.734,24**	**$454.976,03**	**$1.579.694,78**	**$208.943,35**	**$711.235,82**	**$331.222,93**	**$13.679.814,57**	**-$7.714.379,36**	**$1.852,63**	**$4,21**
	Feeder 4 voyage chartered container vessel	$163.958,07	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$13.378,77	$30.976,55	$12.335,63	$528.396,83	-$206.447,48	$1.921,44	$0,99
	Feeder 4 voyage owned container vessel	$0,00	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$13.378,77	$30.976,55	$12.335,63	$474.133,25	-$152.183,90	$1.724,12	$0,89
	Total Feeder 4 [Annual]	**$4.745.015,62**	**$1.677.351,70**	**$3.375.792,78**	**$1.573.000,00**	**$3.763.089,74**	**$2.106.936,44**	**$3.506.715,55**	**$695.695,88**	**$1.610.780,73**	**$641.452,85**	**$25.567.550,27**	**-$8.826.184,13**	**$1.787,94**	**$0,94**
	Feeder 5 voyage chartered container vessel	$286.683,85	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$20.686,85	$71.244,33	$30.996,08	$907.539,24	-$383.162,18	$1.313,37	$2,15
	Feeder 5 voyage owned container vessel	$0,00	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$20.686,85	$71.244,33	$30.996,08	$933.760,50	-$409.383,43	$1.351,32	$2,21
	Total Feeder 5 [Annual]	**$8.242.940,12**	**$1.710.982,35**	**$4.683.027,44**	**$1.573.000,00**	**$5.204.211,99**	**$3.269.905,53**	**$9.451.135,53**	**$1.075.716,18**	**$3.704.705,17**	**$1.611.796,07**	**$46.634.816,72**	**-$19.367.209,43**	**$1.297,86**	**$2,18**
	Feeder 6 voyage chartered container vessel	$350.798,19	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$34.561,72	$120.129,83	$39.204,88	$1.224.869,90	-$432.635,03	$1.401,45	$0,29
	Feeder 6 voyage owned container vessel	$0,00	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$34.561,72	$120.129,83	$39.204,88	$1.257.159,74	-$464.924,86	$1.438,40	$0,30
	Total feeder 6 [Annual]	**$8.248.950,36**	**$5.297.394,29**	**$4.685.501,60**	**$1.573.000,00**	**$8.501.988,26**	**$5.625.449,13**	**$9.685.781,42**	**$1.797.209,46**	**$6.246.750,97**	**$2.038.653,78**	**$61.844.434,36**	**-$20.648.220,75**	**$1.360,77**	**$0,29**
Total Inter West Africa [Annual]		**$23.567.843,12**	**$9.448.956,68**	**$16.079.043,55**	**$6.292.000,00**	**$18.312.024,23**	**$11.457.267,12**	**$24.223.327,28**	**$3.777.564,88**	**$12.273.472,69**	**$4.623.125,62**	**$147.726.615,92**	**-$56.555.993,67**	**$1.433,35**	**$1,58**
Grand Total [Annual]		**$82.987.950,89**	**$87.304.663,42**	**$38.334.864,20**	**$11.011.000,00**	**$94.241.921,34**	**$54.024.522,15**	**$40.904.977,51**	**$15.190.876,79**	**$68.484.779,58**	**$14.000.000,00**	**$589.693.692,00**	**-$199.633.463,73**	**$1.889,41**	**$0,65**

Figure 511: Results sensitivity analysis: 20% increase in net freight rates scenario 4, specifications container vessels

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.496	2.387	1.035	204	287	1.036	1.040
14 ton TEU capacity [14 ton TEU]	1.853	1.771	760	138	201	761	764
Amount of reefer plugs	344	330	155	48	59	156	156
Amount of ship cranes	3	3	2	2	2	2	2
Lpp [m]	204,0	201,5	159,3	96,9	106,3	159,3	159,5
B [m]	34,0	33,6	26,5	17,6	19,3	26,6	26,6
T [m]	9,7	9,6	7,8	5,2	5,7	7,8	7,8
D [m]	18,0	17,8	13,6	8,2	9,1	13,6	13,7
LBD [m³]	113.763,3	109.345,6	52.107,3	12.339,2	16.702,7	52.151,9	52.330,5
B/T [-]	3,5	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.864	43.270	21.990	5.901	7.781	22.007	22.076
Displacement Volume [m³]	43.769	42.215	21.454	5.757	7.591	21.471	21.538
DWT [t]	35.110	33.787	16.468	4.075	5.465	16.482	16.537
Gross Tonnage [m³]	26.316	25.292	12.035	2.842	3.849	12.045	12.087
Wsm [t]	13.476	13.023	6.864	1.977	2.568	6.869	6.889
Wst [t]	9.589	9.253	4.749	1.299	1.706	4.752	4.767
Vs (design) [kn]	20,7	20,5	18,4	14,6	15,2	18,4	18,4
Vs (Max)	20,8	20,6	18,5	14,6	15,2	18,5	18,5
LCB [m]	-1,16	-1,18	-1,49	-2,45	-2,24	-1,49	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Ta [m]	8,9	8,8	7,7	5,8	6,1	7,7	7,7
Tf [m]	7,9	7,8	6,7	4,8	5,1	6,7	6,7
Tav (in ballast) [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Pb (MCR) [kW]	23.100	21.900	10.500	2.350	3.150	10.500	10.500
Cad [-]	492	492	473	432	438	474	475
Fuel consumption design condition [t/h]	4,39	4,16	2,00	0,45	0,60	2,00	2,00
Generator power [kW]	2.687	2.536	1.276	653	715	1.277	1.280
Operational costs [$/day]	$3.458,67	$3.382,10	$2.733,33	$1.724,52	$1.848,65	$2.733,87	$2.736,05
Average capital costs [$/day]	$9.829,12	$9.499,91	$5.480,40	$2.080,40	$2.500,12	$5.482,45	$5.490,65
Average charter price [$/day]	$9.531,21	$9.381,64	$7.526,43	$6.386,13	$6.500,02	$7.527,80	$7.533,29
Capacity fuel tanks [m³]	3.364	3.236	1.567	383	515	1.568	1.573
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	43.364	41.443	19.258	4.306	5.528	19.279	16.235
Displacement outbound [t]	35.712	34.412	18.275	5.855	7.547	18.287	18.335
Pb inbound [kW]	3.195	4.023	2.208	779	909	1.933	1.720
Pb outbound [kW]	2.807	3.554	2.132	956	1.119	1.866	1.865
Fuel consumption inbound [t/h]	0,607	0,764	0,420	0,148	0,173	0,367	0,327
Fuel consumption outbound [t/h]	0,533	0,675	0,405	0,182	0,213	0,355	0,354

U.8 20% increase in net freight rates

U.8.1 Scenario 1

Figure 512: Results sensitivity analysis: 20% increase in net freight rates scenario 1

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$3.135.792,61	$0,00	$3.135.792,61	$0,00
	FEWA voyage owned container vessel	2.092	1.551	108.784	80.627	15	11	124,78	21.190	18	9	9	439	614	1.053	1.663	1.663	0	1.663	0	1.663	3.326	1.663	1.663	$3.135.792,61	$0,00	$3.135.792,61	$1.489.141,86
	Total FEWA [Annual]	**2.092**	**1.551**	**108.784**	**80.627**	**15**	**11**	**124,78**	**1.101.880**	**18**	**9**	**9**	**22.834**	**31.920**	**54.754**	**86.476**	**86.476**	**0**	**86.476**	**0**	**86.476**	**172.952**	**86.476**	**86.476**	**$163.061.215,50**	**$0,00**	**$163.061.215,50**	**$29.053.450,83**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.286.413,80	$1.202,63	$1.287.616,43	$0,00
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665	600	598	2	600	2	598	1.200	600	600	$1.286.413,80	$1.202,63	$1.287.616,43	$755.949,42
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$66.893.517,52**	**$62.536,97**	**$66.956.054,49**	**$13.182.835,52**
Total Asia - West Africa [Annual]				**148.564**	**109.645**				**2.223.208**	**34**	**17**	**17**	**39.892**	**49.431**	**89.323**	**117.676**	**117.572**	**104**	**117.676**	**104**	**117.572**	**235.352**	**117.676**	**117.676**	**$229.954.733,02**	**$62.536,97**	**$230.017.269,99**	**$42.236.286,35**
Europe - West Africa	WEWA voyage chartered container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.603.421,01	$53.348,84	$3.656.769,85	$0,00
	WEWA voyage owned container vessel	2.537	1.883	131.924	97.933	9	11	81,13	10.801	12	6	6	250	358	608	1.782	1.702	80	1.782	80	1.702	3.564	1.782	1.782	$3.603.421,01	$53.348,84	$3.656.769,85	$1.091.206,24
Total Europe - West Africa [Annual]		**2.537**	**1.883**	**131.924**	**97.933**	**9**	**11**	**81,13**	**561.652**	**12**	**6**	**6**	**12.996**	**18.594**	**31.591**	**92.664**	**88.504**	**4.160**	**92.664**	**4.160**	**88.504**	**185.328**	**92.664**	**92.664**	**$187.377.892,72**	**$2.774.139,70**	**$190.152.032,42**	**$22.116.834,82**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$766.259,45	$0,00	$766.259,45	$0,00
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381	499	499	0	499	0	499	998	499	499	$766.259,45	$0,00	$766.259,45	$459.494,70
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**	**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$39.845.491,23**	**$0,00**	**$39.845.491,23**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$234.517,24	$6.432,13	$240.949,36	$0,00
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32	197	180	17	197	17	180	394	197	197	$234.517,24	$6.432,13	$240.949,36	$69.160,40
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$12.194.896,22**	**$334.470,74**	**$12.529.366,97**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$806.318,79	$0,00	$806.318,79	$0,00
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44	716	716	0	716	0	716	1.432	716	716	$806.318,79	$0,00	$806.318,79	$292.174,61
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$41.928.577,26**	**$0,00**	**$41.928.577,26**	**$6.247.074,01**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**	**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$54.123.473,48**	**$334.470,74**	**$54.457.944,23**	**$7.816.589,19**
Grand Total [Annual]				**402.480**	**296.618**				**3.341.884**	**62**	**32**	**30**	**66.394**	**78.247**	**144.641**	**283.764**	**278.616**	**5.148**	**283.764**	**5.148**	**278.616**	**567.528**	**283.764**	**283.764**	**$511.301.590,45**	**$3.171.147,42**	**$514.472.737,87**	**$80.469.174,19**

Figure 513: Results sensitivity analysis: 20% increase in net freight rates scenario 1 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.120.123,02	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$118.733,35	$485.399,43	$82.047,05	$3.986.921,54	-$851.128,93	$2.397,43	$0,11
	FEWA voyage owned container vessel	$0,00	$654.946,09	$307.858,02	$30.250,00	$623.039,86	$379.936,93	$184.587,79	$118.733,35	$485.399,43	$82.047,05	$4.355.940,38	-$1.220.147,77	$2.619,33	$0,12
	Total FEWA [Annual]	**$29.488.927,28**	**$34.057.196,45**	**$16.008.617,04**	**$1.573.000,00**	**$32.398.072,74**	**$19.756.720,18**	**$9.598.565,17**	**$6.174.134,18**	**$25.240.770,56**	**$4.266.446,77**	**$207.615.901,22**	**-$44.554.685,72**	**$2.400,85**	**$0,12**
	SWAX voyage chartered container vessel	$790.694,05	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$47.474,51	$197.612,24	$29.602,06	$1.981.185,27	-$693.568,84	$3.301,98	$0,15
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$47.474,51	$197.612,24	$29.602,06	$1.946.440,64	-$658.824,21	$3.244,07	$0,15
	Total SWAX [Annual]	**$20.895.324,36**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.468.674,62**	**$10.275.836,35**	**$1.539.307,31**	**$95.983.703,39**	**-$29.027.648,90**	**$3.076,40**	**$0,15**
Total Asia - West Africa [Annual]		**$50.384.251,64**	**$55.558.611,60**	**$25.942.503,86**	**$3.146.000,00**	**$38.574.495,02**	**$28.082.366,79**	**$9.709.919,56**	**$8.642.808,80**	**$35.516.606,91**	**$5.805.754,08**	**$303.599.604,61**	**-$73.582.334,62**	**$2.579,96**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$777.795,08	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$146.294,04	$524.296,42	$87.918,13	$3.588.439,23	$68.330,63	$2.013,71	$0,19
	WEWA voyage owned container vessel	$0,00	$377.873,81	$194.242,71	$30.250,00	$857.307,20	$473.136,19	$119.325,64	$146.294,04	$524.296,42	$87.918,13	$3.901.850,39	-$245.080,53	$2.189,59	$0,20
Total Europe - West Africa [Annual]		**$20.996.562,37**	**$19.649.438,30**	**$10.100.620,76**	**$1.573.000,00**	**$44.579.974,52**	**$24.603.082,09**	**$6.204.933,19**	**$7.607.290,15**	**$27.263.413,99**	**$4.571.742,72**	**$189.266.892,91**	**$885.139,51**	**$2.042,51**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$30.650,38	$134.372,17	$24.619,05	$1.363.018,86	-$596.759,41	$2.731,50	$0,30
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$30.650,38	$134.372,17	$24.619,05	$1.405.910,59	-$639.651,15	$2.817,46	$0,31
Total South America - West Africa [Annual]		**$11.044.678,96**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.593.819,65**	**$6.987.352,91**	**$1.280.190,58**	**$68.557.769,19**	**-$28.712.277,95**	**$2.642,12**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$10.256,57	$34.564,88	$9.719,34	$451.695,44	-$210.746,07	$2.292,87	$1,80
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$10.256,57	$34.564,88	$9.719,34	$405.707,86	-$164.758,50	$2.059,43	$1,62
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$533.341,63**	**$1.797.373,86**	**$505.405,90**	**$21.403.424,48**	**-$8.874.057,52**	**$2.089,36**	**$1,68**
	Feeder 2 voyage chartered container vessel	$263.930,29	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$31.663,52	$118.920,24	$35.325,13	$1.416.079,00	-$609.760,21	$1.977,76	$5,78
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$31.663,52	$118.920,24	$35.325,13	$1.444.323,32	-$638.004,53	$2.017,21	$5,90
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.646.503,16**	**$6.183.852,29**	**$1.836.906,73**	**$71.692.165,30**	**-$29.763.588,04**	**$1.925,55**	**$5,85**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$2.179.844,78**	**$7.981.226,14**	**$2.342.312,63**	**$93.095.589,78**	**-$38.637.645,56**	**$1.960,90**	**$4,29**
Grand Total [Annual]		**$90.292.292,49**	**$89.966.995,90**	**$48.892.227,12**	**$9.438.000,00**	**$126.878.243,09**	**$77.731.284,98**	**$19.079.275,37**	**$20.023.763,38**	**$77.748.599,96**	**$14.000.000,00**	**$654.519.856,49**	**-$140.047.118,62**	**$2.306,56**	**$0,70**

Figure 514: Results sensitivity analysis: 20% increase in net freight rates scenario 1, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	1	2	3	4	5	6
Nominal TEU capacity [TEU]	2.092	765	2.537	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.551	558	1.883	781	142	789
Amount of reefer plugs	292	121	349	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	194,5	138,5	204,9	160,4	97,6	160,9
B [m]	32,4	25,2	34,1	26,7	17,7	26,8
T [m]	9,3	7,4	9,8	7,9	5,2	7,9
D [m]	17,0	12,4	18,1	13,8	8,2	13,8
LBD [m³]	97.271,3	39.852,4	115.419,4	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	38.885	17.214	45.460	22.471	6.018	22.659
Displacement Volume [m³]	37.937	16.795	44.351	21.923	5.871	22.106
DWT [t]	30.163	12.698	35.605	16.851	4.160	17.000
Gross Tonnage [m³]	22.494	9.199	26.700	12.324	2.904	12.437
Wsm [t]	11.770	5.445	13.645	7.006	2.014	7.061
Wst [t]	8.328	3.731	9.714	4.851	1.324	4.891
Vs (design) [kn]	20,2	17,2	20,7	18,5	14,6	18,5
Vs (Max)	20,3	17,3	20,8	18,6	14,6	18,6
LCB [m]	-1,22	-1,72	-1,16	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,3	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,8	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,8	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,3	7,2
Pb (MCR) [kW]	19.700	7.400	23.300	10.800	2.400	10.900
Cad [-]	487	466	492	474	429	473
Fuel consumption design condition [t/h]	3,74	1,41	4,43	2,05	0,46	2,07
Generator power [kW]	2.127	1.074	2.744	1.297	657	1.306
Operational costs [$/day]	$3.211,94	$2.418,33	$3.480,65	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$8.722,27	$4.423,16	$9.970,07	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$8.976,84	$7.155,93	$9.587,47	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	2.886	1.205	3.412	1.604	391	1.618
Vs inbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	11,0	11,5	11,0	11,0
Weight TEU loading inbound [t]	21.720	7.809	25.880	10.928	1.987	11.044
Displacement inbound [t]	36.840	14.579	43.477	19.727	4.401	19.916
Displacement outbound [t]	30.891	15.053	36.202	18.610	5.957	18.741
Pb inbound [kW]	2.892	1.629	3.200	2.239	797	1.979
Pb outbound [kW]	2.572	1.664	2.832	2.153	975	1.900
Fuel consumption inbound [t/h]	0,549	0,309	0,608	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,489	0,316	0,538	0,409	0,185	0,361

U.8.2 Scenario 2

Figure 515: Results sensitivity analysis: 20% increase in net freight rates scenario 2

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]
Asia - West Africa	FEWA 2 voyage chartered container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187
	FEWA 2 voyage owned container vessel	2.219	1.645	115.388	85.566	16	12	122,86	21.223	18	9	9	500	687	1.187
	Total FEWA [Annual]	**2.219**	**1.645**	**115.388**	**85.566**	**16**	**12**	**122,86**	**1.103.596**	**18**	**9**	**9**	**26.017**	**35.711**	**61.728**
	SWAX voyage chartered container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665
	SWAX voyage owned container vessel	765	558	39.780	29.019	11	11	110,49	21.564	16	8	8	328	337	665
	Total SWAX [Annual]	**765**	**558**	**39.780**	**29.019**	**11**	**11**	**110,49**	**1.121.328**	**16**	**8**	**8**	**17.057**	**17.511**	**34.568**
Total Asia - West Africa [Annual]				**155.168**	**114.584**				**2.224.924**		**17**	**17**	**43.074**	**53.222**	**96.297**
Europe - West Africa	WEWA 2 voyage chartered container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672
	WEWA 2 voyage owned container vessel	2.612	1.939	135.818	100.845	10	12	83,76	10.827	12	6	6	260	412	672
Total Europe - West Africa [Annual]		**2.612**	**1.939**	**135.818**	**100.845**	**10**	**12**	**83,76**	**563.004**	**12**	**6**	**6**	**13.522**	**21.416**	**34.937**
South America - West Africa	ECSA voyage chartered container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381
	ECSA voyage owned container vessel	1.063	781	55.276	40.608	6	12	55,07	9.095	8	4	4	203	178	381
Total South America - West Africa [Annual]		**1.063**	**781**	**55.276**	**40.608**	**6**	**12**	**55,07**	**472.940**	**8**	**4**	**4**	**10.540**	**9.250**	**19.790**
Inter West Africa	Feeder 1 voyage chartered container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32
	Feeder 1 voyage owned container vessel	209	142	10.868	7.395	3	11	18,01	1.275	3	2	1	20	12	32
	Total Feeder 1 [Annual]	**209**	**142**	**10.868**	**7.395**	**3**	**11**	**18,01**	**66.300**	**3**	**2**	**1**	**1.026**	**640**	**1.667**
	Feeder 2 voyage chartered container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44
	Feeder 2 voyage owned container vessel	1.074	789	55.848	41.036	5	11	34,82	342	5	3	2	37	6	44
	Total Feeder 2 [Annual]	**1.074**	**789**	**55.848**	**41.036**	**5**	**11**	**34,82**	**17.784**	**5**	**3**	**2**	**1.939**	**333**	**2.272**
Total Inter West Africa [Annual]				**66.716**	**48.431**				**84.084**	**8**	**5**	**3**	**2.966**	**973**	**3.939**
Grand Total [Annual]				**412.978**	**304.469**				**3.344.952**	**28**	**32**	**30**	**70.102**	**84.860**	**154.962**

Trade	Service voyage	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA 2 voyage chartered container vessel	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$3.267.100,89	$6.614,07	$3.273.714,96	$0,00
	FEWA 2 voyage owned container vessel	1.731	1.721	10	1.731	10	1.721	3.462	1.731	1.731	$3.267.100,89	$6.614,07	$3.273.714,96	$1.521.991,24
	Total FEWA [Annual]	**90.012**	**89.492**	**520**	**90.012**	**520**	**89.492**	**180.024**	**90.012**	**90.012**	**$169.889.246,11**	**$343.931,89**	**$170.233.178,01**	**$30.272.549,93**
	SWAX voyage chartered container vessel	600	598	2	600	2	598	1.200	600	600	$1.286.413,80	$1.202,63	$1.287.616,43	$0,00
	SWAX voyage owned container vessel	600	598	2	600	2	598	1.200	600	600	$1.286.413,80	$1.202,63	$1.287.616,43	$755.949,42
	Total SWAX [Annual]	**31.200**	**31.096**	**104**	**31.200**	**104**	**31.096**	**62.400**	**31.200**	**31.200**	**$66.893.517,52**	**$62.536,97**	**$66.956.054,49**	**$13.182.835,52**
Total Asia - West Africa [Annual]		**121.212**	**120.588**	**624**	**121.212**	**624**	**120.588**	**242.424**	**121.212**	**121.212**	**$236.782.763,63**	**$406.468,86**	**$237.189.232,50**	**$43.455.385,45**
Europe - West Africa	WEWA 2 voyage chartered container vessel	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.699.631,74	$94.211,78	$3.793.843,53	$0,00
	WEWA 2 voyage owned container vessel	1.876	1.742	134	1.876	134	1.742	3.752	1.876	1.876	$3.699.631,74	$94.211,78	$3.793.843,53	$1.147.946,27
Total Europe - West Africa [Annual]		**97.552**	**90.584**	**6.968**	**97.552**	**6.968**	**90.584**	**195.104**	**97.552**	**97.552**	**$192.380.850,65**	**$4.899.012,67**	**$197.279.863,32**	**$22.585.311,72**
South America - West Africa	ECSA voyage chartered container vessel	499	499	0	499	0	499	998	499	499	$766.259,45	$0,00	$766.259,45	$0,00
	ECSA voyage owned container vessel	499	499	0	499	0	499	998	499	499	$766.259,45	$0,00	$766.259,45	$459.494,70
Total South America - West Africa [Annual]		**25.948**	**25.948**	**0**	**25.948**	**0**	**25.948**	**51.896**	**25.948**	**25.948**	**$39.845.491,23**	**$0,00**	**$39.845.491,23**	**$8.299.463,82**
Inter West Africa	Feeder 1 voyage chartered container vessel	197	180	17	197	17	180	394	197	197	$234.517,24	$6.432,13	$240.949,36	$0,00
	Feeder 1 voyage owned container vessel	197	180	17	197	17	180	394	197	197	$234.517,24	$6.432,13	$240.949,36	$69.160,40
	Total Feeder 1 [Annual]	**10.244**	**9.360**	**884**	**10.244**	**884**	**9.360**	**20.488**	**10.244**	**10.244**	**$12.194.896,22**	**$334.470,74**	**$12.529.366,97**	**$1.569.515,18**
	Feeder 2 voyage chartered container vessel	716	716	0	716	0	716	1.432	716	716	$806.318,79	$0,00	$806.318,79	$0,00
	Feeder 2 voyage owned container vessel	716	716	0	716	0	716	1.432	716	716	$806.318,79	$0,00	$806.318,79	$292.174,61
	Total Feeder 2 [Annual]	**37.232**	**37.232**	**0**	**37.232**	**0**	**37.232**	**74.464**	**37.232**	**37.232**	**$41.928.577,26**	**$0,00**	**$41.928.577,26**	**$6.247.074,01**
Total Inter West Africa [Annual]		**47.476**	**46.592**	**884**	**47.476**	**884**	**46.592**	**94.952**	**47.476**	**47.476**	**$54.123.473,48**	**$334.470,74**	**$54.457.944,23**	**$7.816.589,19**
Grand Total [Annual]		**292.188**	**283.712**	**8.476**	**292.188**	**8.476**	**283.712**	**584.376**	**292.188**	**292.188**	**$523.132.579,00**	**$5.639.952,28**	**$528.772.531,27**	**$82.156.750,18**

Figure 516: Results sensitivity analysis: 20% increase in net freight rates scenario 2 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA 2 voyage chartered container vessel	$1.124.300,01	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$123.560,63	$510.689,25	$82.939,75	$4.147.541,24	-$873.826,28	$2.396,04	$0,11
	FEWA 2 voyage owned container vessel	$0,00	$738.367,21	$333.216,02	$30.250,00	$638.101,59	$381.529,00	$184.587,79	$123.560,63	$510.689,25	$82.939,75	$4.545.232,47	-$1.271.517,51	$2.625,78	$0,12
	Total FEWA [Annual]	**$30.061.402,26**	**$38.395.094,93**	**$17.327.232,83**	**$1.573.000,00**	**$33.181.282,48**	**$19.839.508,08**	**$9.598.565,17**	**$6.425.152,87**	**$26.555.840,95**	**$4.312.867,06**	**$217.542.496,56**	**-$47.309.318,56**	**$2.416,82**	**$0,12**
	SWAX voyage chartered container vessel	$790.694,05	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$47.474,51	$197.076,66	$28.748,61	$1.979.796,24	-$692.179,81	$3.299,66	$0,15
	SWAX voyage owned container vessel	$0,00	$413.488,75	$191.036,29	$30.250,00	$118.777,35	$160.108,59	$2.141,43	$47.474,51	$197.076,66	$28.748,61	$1.945.051,61	-$657.435,18	$3.241,75	$0,15
	Total SWAX [Annual]	**$20.895.324,36**	**$21.501.415,14**	**$9.933.886,82**	**$1.573.000,00**	**$6.176.422,28**	**$8.325.646,61**	**$111.354,38**	**$2.468.674,62**	**$10.247.986,19**	**$1.494.927,92**	**$95.911.473,85**	**-$28.955.419,36**	**$3.074,09**	**$0,15**
Total Asia - West Africa [Annual]		**$50.956.726,62**	**$59.896.510,07**	**$27.261.119,65**	**$3.146.000,00**	**$39.357.704,76**	**$28.165.154,69**	**$9.709.919,56**	**$8.893.827,48**	**$36.803.827,14**	**$5.807.794,98**	**$313.453.970,41**	**-$76.264.737,91**	**$2.586,00**	**$0,13**
Europe - West Africa	WEWA 2 voyage chartered container vessel	$811.619,29	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$151.776,99	$559.430,06	$89.887,33	$3.769.418,75	$24.424,78	$2.009,29	$0,19
	WEWA 2 voyage owned container vessel	$0,00	$417.902,52	$217.606,68	$30.250,00	$876.097,98	$495.522,26	$119.325,64	$151.776,99	$559.430,06	$89.887,33	$4.105.745,73	-$311.902,20	$2.188,56	$0,20
Total Europe - West Africa [Annual]		**$21.221.593,11**	**$21.730.931,20**	**$11.315.547,60**	**$1.573.000,00**	**$45.557.094,76**	**$25.767.157,30**	**$6.204.933,19**	**$7.892.403,39**	**$29.090.363,22**	**$4.674.141,31**	**$197.612.476,80**	**-$332.613,48**	**$2.025,71**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$416.602,97	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$30.650,38	$134.478,34	$23.909,26	$1.362.415,24	-$596.155,79	$2.730,29	$0,30
	ECSA voyage owned container vessel	$0,00	$236.715,36	$108.455,26	$30.250,00	$233.571,37	$95.833,52	$51.948,78	$30.650,38	$134.478,34	$23.909,26	$1.405.306,98	-$639.047,53	$2.816,25	$0,31
Total South America - West Africa [Annual]		**$11.044.678,96**	**$12.309.198,67**	**$5.639.673,62**	**$1.573.000,00**	**$12.145.711,39**	**$4.983.343,18**	**$2.701.336,39**	**$1.593.819,65**	**$6.992.873,56**	**$1.243.281,72**	**$68.526.380,98**	**-$28.680.889,75**	**$2.640,91**	**$0,30**
Inter West Africa	Feeder 1 voyage chartered container vessel	$115.147,98	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$10.256,57	$34.564,77	$9.439,13	$451.415,11	-$210.465,75	$2.291,45	$1,80
	Feeder 1 voyage owned container vessel	$0,00	$19.935,73	$48.132,63	$30.250,00	$102.087,00	$73.066,86	$8.534,44	$10.256,57	$34.564,77	$9.439,13	$405.427,54	-$164.478,17	$2.058,01	$1,61
	Total Feeder 1 [Annual]	**$2.333.441,28**	**$1.036.657,72**	**$2.502.896,92**	**$1.573.000,00**	**$5.308.524,15**	**$3.799.476,87**	**$443.790,98**	**$533.341,63**	**$1.797.368,20**	**$490.834,67**	**$21.388.847,59**	**-$8.859.480,63**	**$2.087,94**	**$1,68**
	Feeder 2 voyage chartered container vessel	$263.930,29	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$31.663,52	$118.920,24	$34.306,68	$1.415.060,55	-$608.741,76	$1.976,34	$5,78
	Feeder 2 voyage owned container vessel	$0,00	$27.174,80	$90.510,23	$30.250,00	$505.183,42	$312.750,31	$371,06	$31.663,52	$118.920,24	$34.306,68	$1.443.304,87	-$636.986,08	$2.015,79	$5,89
	Total Feeder 2 [Annual]	**$5.533.358,24**	**$1.413.089,60**	**$4.706.531,96**	**$1.573.000,00**	**$26.269.538,01**	**$16.263.016,05**	**$19.295,26**	**$1.646.503,16**	**$6.183.852,29**	**$1.783.947,32**	**$71.639.205,89**	**-$29.710.628,63**	**$1.924,13**	**$5,85**
Total Inter West Africa [Annual]		**$7.866.799,52**	**$2.449.747,33**	**$7.209.428,88**	**$3.146.000,00**	**$31.578.062,16**	**$20.062.492,92**	**$463.086,24**	**$2.179.844,78**	**$7.981.220,48**	**$2.274.781,99**	**$93.028.053,49**	**-$38.570.109,26**	**$1.959,48**	**$4,28**
Grand Total [Annual]		**$91.089.798,21**	**$96.386.387,27**	**$51.425.769,76**	**$9.438.000,00**	**$128.638.573,07**	**$78.978.148,10**	**$19.079.275,37**	**$20.559.895,30**	**$80.868.284,41**	**$14.000.000,00**	**$672.620.881,68**	**-$143.848.350,40**	**$2.302,01**	**$0,70**

Figure 517: Results sensitivity analysis: 20% increase in net freight rates scenario 2, specifications container vessels

Liner service	FEWA 2	SWAX	WEWA 2	ECSA	Feeder 1	Feeder 2
Container vessel nr.	7	8	9	10	11	12
Nominal TEU capacity [TEU]	2.219	765	2.612	1.063	209	1.074
14 ton TEU capacity [14 ton TEU]	1.645	558	1.939	781	142	789
Amount of reefer plugs	308	121	359	159	49	160
Amount of ship cranes	3	2	4	2	2	2
Lpp [m]	197,6	138,5	206,5	160,4	97,6	160,9
B [m]	32,9	25,2	34,4	26,7	17,7	26,8
T [m]	9,4	7,4	9,8	7,9	5,2	7,9
D [m]	17,4	12,4	18,3	13,8	8,2	13,8
LBD [m³]	102.491,5	39.852,4	118.436,1	53.355,8	12.607,1	53.845,2
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [t]	40.786	17.214	46.544	22.471	6.018	22.659
Displacement Volume [m³]	39.791	16.795	45.408	21.923	5.871	22.106
DWT [t]	31.732	12.698	36.507	16.851	4.160	17.000
Gross Tonnage [m³]	23.704	9.199	27.399	12.324	2.904	12.437
Wsm [t]	12.314	5.445	13.953	7.006	2.014	7.061
Wst [t]	8.729	3.731	9.943	4.851	1.324	4.891
Vs (design) [kn]	20,4	17,2	20,8	18,5	14,6	18,5
Vs (Max)	20,5	17,3	20,9	18,6	14,6	18,6
LCB [m]	-1,20	-1,72	-1,15	-1,48	-2,44	-1,48
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,2	6,7	8,5	7,2	5,3	7,2
Ta [m]	8,7	7,2	9,0	7,7	5,8	7,7
Tf [m]	7,7	6,2	8,0	6,7	4,8	6,7
Tav (in ballast) [m]	8,2	6,7	8,5	7,2	5,3	7,2
Pb (MCR) [kW]	20.900	7.400	24.000	10.800	2.400	10.900
Cad [-]	488	466	492	474	429	473
Fuel consumption design condition [t/h]	3,97	1,41	4,56	2,05	0,46	2,07
Generator power [kW]	2.303	1.074	2.847	1.297	657	1.306
Operational costs [$/day]	$3.295,96	$2.418,33	$3.527,75	$2.763,36	$1.732,50	$2.774,23
Average capital costs [$/day]	$9.092,12	$4.423,16	$10.178,01	$5.580,33	$2.107,27	$5.616,87
Average charter price [$/day]	$9.151,11	$7.155,93	$9.690,23	$7.564,85	$6.392,99	$7.579,94
Capacity fuel tanks [m³]	3.038	1.205	3.499	1.604	391	1.618
Vs inbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Vs outbound [kn]	11,5	11,0	11,5	11,5	11,0	11,0
Weight TEU loading inbound [t]	23.037	7.809	26.421	10.928	1.987	11.044
Displacement inbound [t]	38.886	14.579	44.411	19.727	4.401	19.916
Displacement outbound [t]	32.406	15.053	37.096	18.610	5.957	18.741
Pb inbound [kW]	3.419	1.629	3.707	2.239	797	1.979
Pb outbound [kW]	3.028	1.664	3.288	2.153	975	1.900
Fuel consumption inbound [t/h]	0,650	0,309	0,704	0,425	0,151	0,376
Fuel consumption outbound [t/h]	0,575	0,316	0,625	0,409	0,185	0,361

U.8.3 Scenario 3

Figure 518: Results sensitivity analysis: 20% increase in net freight rates scenario 3

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	FEWA voyage chartered container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$3.053.836,46	$18.188,71	$3.072.025,16	$0,00
	FEWA voyage owned container vessel	2.054	1.522	106.808	79.149	15	11	124,68	21.190	18	9	9	434	608	1.042	1.652	1.620	32	1.652	32	1.620	3.304	1.652	1.652	$3.053.836,46	$18.188,71	$3.072.025,16	$1.474.146,56
	Total FEWA [Annual]	**2.054**	**1.522**	**106.808**	**79.149**	**15**	**11**	**124,68**	**1.101.880**	**18**	**9**	**9**	**22.581**	**31.616**	**54.197**	**85.904**	**84.240**	**1.664**	**85.904**	**1.664**	**84.240**	**171.808**	**85.904**	**85.904**	**$158.799.495,71**	**$945.812,70**	**$159.745.308,41**	**$28.750.376,75**
	SWAX voyage chartered container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.257.133,19	$24.021,19	$1.281.154,38	$0,00
	SWAX voyage owned container vessel	781	570	40.612	29.641	11	11	110,66	21.564	16	8	8	331	339	670	623	584	39	623	39	584	1.246	623	623	$1.257.133,19	$24.021,19	$1.281.154,38	$766.641,09
	Total SWAX [Annual]	**781**	**570**	**40.612**	**29.641**	**11**	**11**	**110,66**	**1.121.328**	**16**	**8**	**8**	**17.209**	**17.618**	**34.827**	**32.396**	**30.368**	**2.028**	**32.396**	**2.028**	**30.368**	**64.792**	**32.396**	**32.396**	**$65.370.925,86**	**$1.249.102,00**	**$66.620.027,86**	**$13.378.461,25**
Total Asia - West Africa [Annual]				**147.420**	**108.790**				**2.223.208**		**17**	**17**	**39.790**	**49.234**	**89.024**	**118.300**	**114.608**	**3.692**	**118.300**	**3.692**	**114.608**	**236.600**	**118.300**	**118.300**	**$224.170.421,58**	**$2.194.914,70**	**$226.365.336,27**	**$42.128.838,00**
Europe - West Africa	WEWA voyage chartered container vessel	2.410	1.788	125.320	92.994	9	12	77,00	10.801	11	5	6	286	410	697	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$3.512.639,24	$24.021,19	$3.536.660,43	$0,00
	WEWA voyage owned container vessel	2.410	1.788	125.320	92.994	9	12	77,00	10.801	11	5	6	286	410	697	1.689	1.658	31	1.689	31	1.658	3.378	1.689	1.689	$3.512.639,24	$24.021,19	$3.536.660,43	$1.001.633,66
Total Europe - West Africa [Annual]		**2.410**	**1.788**	**125.320**	**92.994**	**9**	**12**	**77,00**	**561.652**	**11**	**6**	**5**	**14.887**	**21.345**	**36.232**	**87.828**	**86.216**	**1.612**	**87.828**	**1.612**	**86.216**	**175.656**	**87.828**	**87.828**	**$182.657.240,60**	**$1.249.102,00**	**$183.906.342,59**	**$21.287.446,89**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$746.604,13	$0,00	$746.604,13	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	54,98	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$746.604,13	$0,00	$746.604,13	$451.606,04
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**54,98**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$38.823.414,89**	**$0,00**	**$38.823.414,89**	**$8.151.663,35**
Inter West Africa	Feeder 1 voyage chartered container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$232.182,63	$3.592,98	$235.775,61	$0,00
	Feeder 1 voyage owned container vessel	214	146	11.128	7.590	3	11	17,94	1.275	3	2	1	20	13	32	188	178	10	188	10	178	376	188	188	$232.182,63	$3.592,98	$235.775,61	$69.731,82
	Total Feeder 1 [Annual]	**214**	**146**	**11.128**	**7.590**	**3**	**11**	**17,94**	**66.300**	**3**	**2**	**1**	**1.037**	**650**	**1.687**	**9.776**	**9.256**	**520**	**9.776**	**520**	**9.256**	**19.552**	**9.776**	**9.776**	**$12.073.496,91**	**$186.834,88**	**$12.260.331,79**	**$1.595.863,07**
	Feeder 2 voyage chartered container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$782.463,84	$0,00	$782.463,84	$0,00
	Feeder 2 voyage owned container vessel	1.042	765	54.184	39.791	5	11	34,37	342	5	3	2	37	6	43	695	695	0	695	0	695	1.390	695	695	$782.463,84	$0,00	$782.463,84	$282.957,53
	Total Feeder 2 [Annual]	**1.042**	**765**	**54.184**	**39.791**	**5**	**11**	**34,37**	**17.784**	**5**	**3**	**2**	**1.929**	**329**	**2.258**	**36.140**	**36.140**	**0**	**36.140**	**0**	**36.140**	**72.280**	**36.140**	**36.140**	**$40.688.119,63**	**$0,00**	**$40.688.119,63**	**$6.110.830,42**
Total Inter West Africa [Annual]				**65.312**	**47.381**				**84.084**	**8**	**5**	**3**	**2.966**	**979**	**3.945**	**45.916**	**45.396**	**520**	**45.916**	**520**	**45.396**	**91.832**	**45.916**	**45.916**	**$52.761.616,55**	**$186.834,88**	**$52.948.451,43**	**$7.706.693,48**
Grand Total [Annual]				**391.872**	**288.684**				**3.341.884**	**27**	**32**	**29**	**68.063**	**80.727**	**148.790**	**277.316**	**271.492**	**5.824**	**277.316**	**5.824**	**271.492**	**554.632**	**277.316**	**277.316**	**$498.412.693,62**	**$3.630.851,57**	**$502.043.545,19**	**$79.274.641,73**

Figure 519: Results sensitivity analysis: 20% increase in net freight rates scenario 3 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	FEWA voyage chartered container vessel	$1.112.692,40	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$116.349,33	$491.894,43	$83.399,44	$3.965.186,88	-$893.161,72	$2.400,23	$0,11
	FEWA voyage owned container vessel	$0,00	$648.276,51	$306.501,99	$30.250,00	$616.986,82	$378.900,67	$179.935,30	$116.349,33	$491.894,43	$83.399,44	$4.326.641,05	-$1.254.615,89	$2.619,03	$0,12
	Total FEWA [Annual]	**$29.317.635,56**	**$33.710.378,62**	**$15.938.103,48**	**$1.573.000,00**	**$32.083.314,38**	**$19.702.834,62**	**$9.356.635,68**	**$6.050.164,94**	**$25.578.510,48**	**$4.336.771,05**	**$206.397.725,56**	**-$46.652.417,15**	**$2.402,66**	**$0,12**
	SWAX voyage chartered container vessel	$794.309,50	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$47.214,53	$208.361,38	$31.451,48	$2.010.856,33	-$729.701,94	$3.227,70	$0,15
	SWAX voyage owned container vessel	$0,00	$416.582,20	$191.454,99	$30.250,00	$123.527,07	$164.422,15	$3.283,03	$47.214,53	$208.361,38	$31.451,48	$1.983.187,92	-$702.033,54	$3.183,29	$0,15
	Total SWAX [Annual]	**$20.959.433,54**	**$21.662.274,39**	**$9.955.659,43**	**$1.573.000,00**	**$6.423.407,69**	**$8.549.951,81**	**$170.717,65**	**$2.455.155,35**	**$10.834.791,53**	**$1.635.477,22**	**$97.598.329,86**	**-$30.978.302,00**	**$3.012,67**	**$0,15**
Total Asia - West Africa [Annual]		**$50.277.069,10**	**$55.372.653,01**	**$25.893.762,91**	**$3.146.000,00**	**$38.506.722,07**	**$28.252.786,43**	**$9.527.353,33**	**$8.505.320,30**	**$36.413.302,01**	**$5.972.248,27**	**$303.996.055,42**	**-$77.630.719,15**	**$2.569,70**	**$0,13**
Europe - West Africa	WEWA voyage chartered container vessel	$724.803,64	$433.387,14	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$141.346,08	$498.350,63	$85.267,35	$3.485.910,42	$50.750,01	$2.063,89	$0,19
	WEWA voyage owned container vessel	$0,00	$433.387,14	$191.523,51	$30.250,00	$818.473,27	$446.893,79	$115.615,01	$141.346,08	$498.350,63	$85.267,35	$3.762.740,44	-$226.080,01	$2.227,79	$0,21
Total Europe - West Africa [Annual]		**$17.179.093,65**	**$22.536.131,41**	**$9.959.222,52**	**$1.573.000,00**	**$42.560.610,16**	**$23.238.477,20**	**$6.011.980,59**	**$7.349.995,94**	**$25.914.232,73**	**$4.433.902,12**	**$182.044.093,20**	**$1.862.249,39**	**$2.072,73**	**$0,20**
South America - West Africa	ECSA voyage chartered container vessel	$413.817,11	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$29.864,17	$132.860,48	$24.535,19	$1.345.474,94	-$598.870,80	$2.768,47	$0,30
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$227.713,80	$93.590,30	$50.464,53	$29.864,17	$132.860,48	$24.535,19	$1.383.263,87	-$636.659,74	$2.846,22	$0,31
Total South America - West Africa [Annual]		**$10.988.583,42**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.841.117,62**	**$4.866.695,53**	**$2.624.155,35**	**$1.552.936,60**	**$6.908.745,10**	**$1.275.829,74**	**$67.586.454,01**	**-$28.763.039,12**	**$2.674,36**	**$0,31**
Inter West Africa	Feeder 1 voyage chartered container vessel	$114.792,76	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$10.048,67	$33.416,37	$9.490,98	$443.532,39	-$207.756,78	$2.359,21	$1,85
	Feeder 1 voyage owned container vessel	$0,00	$20.178,61	$48.168,32	$30.250,00	$99.782,81	$71.466,87	$5.937,00	$10.048,67	$33.416,37	$9.490,98	$398.471,44	-$162.695,83	$2.119,53	$1,66
	Total Feeder 1 [Annual]	**$2.335.945,54**	**$1.049.287,61**	**$2.504.752,54**	**$1.573.000,00**	**$5.188.705,95**	**$3.716.277,45**	**$308.724,16**	**$522.530,60**	**$1.737.651,39**	**$493.530,85**	**$21.026.269,15**	**-$8.765.937,36**	**$2.150,80**	**$1,73**
	Feeder 2 voyage chartered container vessel	$259.038,62	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$30.748,64	$115.836,32	$35.086,33	$1.382.187,01	-$599.723,17	$1.988,76	$5,82
	Feeder 2 voyage owned container vessel	$0,00	$27.008,20	$90.129,59	$30.250,00	$490.114,30	$303.603,95	$371,06	$30.748,64	$115.836,32	$35.086,33	$1.406.105,92	-$623.642,08	$2.023,17	$5,92
	Total Feeder 2 [Annual]	**$5.501.303,65**	**$1.404.426,55**	**$4.686.738,68**	**$1.573.000,00**	**$25.485.943,60**	**$15.787.405,30**	**$19.295,26**	**$1.598.929,23**	**$6.023.488,83**	**$1.824.489,03**	**$70.015.850,54**	**-$29.327.730,91**	**$1.937,35**	**$5,88**
Total Inter West Africa [Annual]		**$7.837.249,19**	**$2.453.714,15**	**$7.191.491,22**	**$3.146.000,00**	**$30.674.649,55**	**$19.503.682,76**	**$328.019,42**	**$2.121.459,83**	**$7.761.140,22**	**$2.318.019,88**	**$91.042.119,70**	**-$38.093.668,27**	**$1.982,80**	**$4,32**
Grand Total [Annual]		**$86.281.995,37**	**$92.547.335,19**	**$48.663.367,32**	**$9.438.000,00**	**$123.583.099,39**	**$75.861.641,92**	**$18.491.508,69**	**$19.529.712,66**	**$76.997.420,07**	**$14.000.000,00**	**$644.668.722,34**	**-$142.625.177,15**	**$2.324,67**	**$0,72**

Figure 520: Results sensitivity analysis: 20% increase net freight rates scenario 3, specifications container vessels

Liner service	FEWA	SWAX	WEWA	ECSA	Feeder 1	Feeder 2
Container vessel nr.	13	14	15	16	17	18
Nominal TEU capacity [TEU]	2.054	781	2.410	1.035	214	1.042
14 ton TEU capacity [14 ton TEU]	1.522	570	1.788	760	146	765
Amount of reefer plugs	287	123	333	155	50	156
Amount of ship cranes	3	2	3	2	2	2
Lpp [m]	193,5	139,3	202,0	159,3	98,2	159,6
B [m]	32,3	25,3	33,7	26,5	17,9	26,6
T [m]	9,2	7,4	9,6	7,8	5,3	7,8
D [m]	16,9	12,5	17,8	13,6	8,3	13,7
LBD [m³]	95.702,4	40.590,8	110.279,7	52.107,3	12.874,3	52.419,8
B/T [-]	3,5	3,4	3,5	3,4	3,4	3,4
Displacement Weight [ton]	38.312	17.505	43.607	21.990	6.134	22.111
Displacement Volume [m³]	37.377	17.079	42.544	21.454	5.985	21.571
DWT [ton]	29.692	12.926	34.067	16.468	4.246	16.564
Gross Tonnage [m³]	22.131	9.370	25.509	12.035	2.965	12.107
Wsm [ton]	11.606	5.532	13.119	6.864	2.051	6.900
Wst [ton]	8.207	3.793	9.324	4.749	1.349	4.774
Vs (design) [kn]	20,2	17,3	20,6	18,4	14,7	18,4
Vs (Max)	20,3	17,4	20,7	18,5	14,7	18,5
LCB [m]	-1,23	-1,71	-1,18	-1,49	-2,42	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,1	6,7	8,4	7,2	5,4	7,2
Ta [m]	8,6	7,2	8,9	7,7	5,9	7,7
Tf [m]	7,6	6,2	7,9	6,7	4,9	6,7
Tav (in ballast) [m]	8,1	6,7	8,4	7,2	5,4	7,2
Pb (MCR) [kW]	19.500	7.600	22.400	10.500	2.500	10.500
Cad [-]	488	467	491	473	426	475
Fuel consumption design condition [ton/h]	3,71	1,44	4,26	2,00	0,48	2,00
Generator power [kW]	2.075	1.086	2.568	1.276	661	1.282
Operational costs [$/day]	$3.193,02	$2.438,61	$3.407,99	$2.733,33	$1.744,39	$2.737,14
Average capital costs [$/day]	$8.630,83	$4.489,25	$9.600,47	$5.480,40	$2.143,25	$5.494,74
Average charter price [$/day]	$8.924,70	$7.177,89	$9.413,20	$7.526,43	$6.399,85	$7.536,03
Capacity fuel tanks [m³]	2.841	1.227	3.263	1.567	399	1.576
Vs inbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Vs outbound [kn]	11,0	11,0	12,0	11,5	11,0	11,0
Weight TEU loading inbound [ton]	21.301	7.977	24.901	10.643	2.037	10.716
Displacement inbound [ton]	36.198	14.859	41.821	19.258	4.497	19.377
Displacement outbound [ton]	30.437	15.244	34.686	18.275	6.059	18.359
Pb inbound [kW]	2.858	1.647	4.059	2.208	815	1.933
Pb outbound [kW]	2.546	1.675	3.583	2.132	994	1.865
Fuel consumption inbound [ton/h]	0,543	0,313	0,771	0,420	0,155	0,367
Fuel consumption outbound [ton/h]	0,484	0,318	0,681	0,405	0,189	0,354

U.8.4 Scenario 4

Figure 521: Results sensitivity analysis: 20% increase in net freight rates scenario 4

Trade	Service voyage	Nominal TEU capacity per container vessel [TEU]	14 ton TEU capacity per container vessel [14 ton TEU]	Annual TEU capacity [TEU]	Annual 14 ton TEU capacity [14 ton TEU]	Number of ports	Vessel speed [kn]	Duration of voyage [days]	Distance voyage [Mile]	Container vessels needed per trade	Owned container vessels needed per trade	Chartered container vessels needed per trade	Fuel consumption inbound [mt]	Fuel consumption outbound [mt]	Fuel consumption [mt]	Total full TEU	Full TEU inbound	Full TEU outbound	Total empty TEU	Empty TEU inbound	Empty TEU outbound	Total TEU	TEU inbound	TEU outbound	Net freight rate inbound [$]	Net freight rate outbound [$]	Revenue [$]	Costs owned vessel [$]
Asia - West Africa	SWAX 2 voyage chartered container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.659.183,19	$23.590,20	$2.682.773,39	$0,00
	SWAX 2 voyage owned container vessel	2.496	1.853	129.792	96.339	6	11	129,00	25.415	19	9	10	597	742	1.339	1.891	1.839	52	1.891	52	1.839	3.782	1.891	1.891	$2.659.183,19	$23.590,20	$2.682.773,39	$1.714.105,61
Total Asia - West Africa [Annual]		**2.496**	**1.853**	**129.792**	**96.339**	**6**	**11**	**129,00**	**1.321.580**	**19**	**10**	**9**	**31.026**	**38.604**	**69.631**	**98.332**	**95.628**	**2.704**	**98.332**	**2.704**	**95.628**	**196.664**	**98.332**	**98.332**	**$138.277.526,10**	**$1.226.690,41**	**$139.504.216,51**	**$36.322.464,41**
Europe - West Africa	WEWA voyage chartered container vessel	2.387	1.771	124.124	92.100	9	12	75,92	10.801	11	5	6	284	407	691	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.961.330,96	$17.530,71	$2.978.861,67	$0,00
	WEWA voyage owned container vessel	2.387	1.771	124.124	92.100	9	12	75,92	10.801	11	5	6	284	407	691	1.643	1.612	31	1.643	31	1.612	3.286	1.643	1.643	$2.961.330,96	$17.530,71	$2.978.861,67	$978.061,03
Total Europe - West Africa [Annual]		**2.387**	**1.771**	**124.124**	**92.100**	**9**	**12**	**75,92**	**561.652**	**11**	**6**	**5**	**14.767**	**21.182**	**35.950**	**85.436**	**83.824**	**1.612**	**85.436**	**1.612**	**83.824**	**170.872**	**85.436**	**85.436**	**$153.989.209,94**	**$911.596,73**	**$154.900.806,68**	**$21.061.583,33**
South America - West Africa	ECSA voyage chartered container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$642.371,41	$0,00	$642.371,41	$0,00
	ECSA voyage owned container vessel	1.035	760	53.820	39.519	6	12	55,14	9.095	8	4	4	200	176	377	486	486	0	486	0	486	972	486	486	$642.371,41	$0,00	$642.371,41	$452.911,15
Total South America - West Africa [Annual]		**1.035**	**760**	**53.820**	**39.519**	**6**	**12**	**55,14**	**472.940**	**8**	**4**	**4**	**10.420**	**9.170**	**19.590**	**25.272**	**25.272**	**0**	**25.272**	**0**	**25.272**	**50.544**	**25.272**	**25.272**	**$33.403.313,09**	**$0,00**	**$33.403.313,09**	**$8.152.097,66**
Inter West Africa	Feeder 3 voyage chartered container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$146.770,99	$2.079,54	$148.850,53	$0,00
	Feeder 3 voyage owned container vessel	204	138	10.608	7.201	4	11	17,64	453	3	2	1	16	7	24	142	136	6	142	6	136	284	142	142	$124.363,84	$1.732,95	$126.096,78	$67.130,63
	Total Feeder 3 [Annual]	**204**	**138**	**10.608**	**7.201**	**4**	**11**	**17,64**	**23.556**	**3**	**2**	**1**	**845**	**382**	**1.227**	**7.384**	**7.072**	**312**	**7.384**	**312**	**7.072**	**14.768**	**7.384**	**7.384**	**$7.049.505,58**	**$99.124,55**	**$7.148.630,13**	**$1.549.120,33**
	Feeder 4 voyage chartered container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$446.745,89	$6.238,61	$452.984,50	$0,00
	Feeder 4 voyage owned container vessel	287	201	14.924	10.429	4	11	25,22	1.933	4	2	2	33	19	52	275	257	18	275	18	257	550	275	275	$446.745,89	$6.238,61	$452.984,50	$109.694,49
	Total Feeder 4 [Annual]	**287**	**201**	**14.924**	**10.429**	**4**	**11**	**25,22**	**100.516**	**4**	**2**	**2**	**1.732**	**965**	**2.697**	**14.300**	**13.364**	**936**	**14.300**	**936**	**13.364**	**28.600**	**14.300**	**14.300**	**$23.230.786,36**	**$324.407,63**	**$23.555.193,99**	**$1.871.718,99**
	Feeder 5 voyage chartered container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$780.401,58	$0,00	$780.401,58	$0,00
	Feeder 5 voyage owned container vessel	1.036	761	53.872	39.558	5	11	38,08	611	6	3	3	42	11	53	691	691	0	691	0	691	1.382	691	691	$780.401,58	$0,00	$780.401,58	$312.905,11
	Total Feeder 5 [Annual]	**1.036**	**761**	**53.872**	**39.558**	**5**	**11**	**38,08**	**31.772**	**6**	**3**	**3**	**2.200**	**551**	**2.751**	**35.932**	**35.932**	**0**	**35.932**	**0**	**35.932**	**71.864**	**35.932**	**35.932**	**$40.580.881,91**	**$0,00**	**$40.580.881,91**	**$6.107.396,33**
	Feeder 6 voyage chartered container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$1.037.220,35	$2.314,93	$1.039.535,27	$0,00
	Feeder 6 voyage owned container vessel	1.040	764	54.080	39.714	5	11	46,57	4.873	7	4	3	89	75	164	874	867	7	874	7	867	1.748	874	874	$1.037.220,35	$2.314,93	$1.039.535,27	$383.088,03
	Total feeder 6 [Annual]	**1.040**	**764**	**54.080**	**39.714**	**5**	**11**	**46,57**	**253.396**	**7**	**4**	**3**	**4.634**	**3.882**	**8.517**	**45.448**	**45.084**	**364**	**45.448**	**364**	**45.084**	**90.896**	**45.448**	**45.448**	**$53.935.457,99**	**$120.376,16**	**$54.055.834,15**	**$8.143.755,09**
Total Inter West Africa [Annual]				**133.484**	**96.901**				**409.240**	**20**	**11**	**9**	**9.411**	**5.780**	**15.191**	**103.064**	**101.452**	**1.612**	**103.064**	**1.612**	**101.452**	**206.128**	**103.064**	**103.064**	**$124.796.631,84**	**$543.908,35**	**$125.340.540,18**	**$17.671.990,74**
Grand Total [Annual]				**441.220**	**324.859**				**2.765.412**	**58**	**31**	**27**	**65.625**	**74.737**	**140.361**	**312.104**	**306.176**	**5.928**	**312.104**	**5.928**	**306.176**	**624.208**	**312.104**	**312.104**	**$450.466.680,98**	**$2.682.195,49**	**$453.148.876,47**	**$83.208.136,14**

Figure 522: Results sensitivity analysis: 20% increase in net freight rates scenario 4 (2)

Trade	Service voyage	Vessel hire costs [$]	Bunker costs [$]	Port costs [$]	General vessel expenses [$]	Stevedoring costs loading [$]	Stevedoring costs discharging [$]	Stevedoring costs transshipment [$]	Commissions [$]	Container costs [$]	General expenses [$]	Total costs [$]	Net result [$]	MRFF1 [$/TEU]	MRFF2 [$/TEU/Mile]
Asia - West Africa	SWAX 2 voyage chartered container vessel	$1.229.512,23	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$95.210,18	$442.152,56	$84.824,29	$3.833.430,30	-$1.150.656,90	$2.027,20	$0,08
	SWAX 2 voyage owned container vessel	$0,00	$832.889,50	$128.909,90	$30.250,00	$472.293,63	$298.476,40	$218.911,60	$95.210,18	$442.152,56	$84.824,29	$4.318.023,68	-$1.635.250,28	$2.283,46	$0,09
Total Asia - West Africa [Annual]		**$31.310.028,79**	**$43.310.254,24**	**$6.703.315,01**	**$1.573.000,00**	**$24.559.268,94**	**$15.520.772,85**	**$11.383.402,99**	**$4.950.929,42**	**$22.991.933,13**	**$4.410.863,05**	**$203.036.232,82**	**-$63.532.016,31**	**$2.064,80**	**$0,08**
Europe - West Africa	WEWA voyage chartered container vessel	$712.297,33	$430.011,84	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$119.406,31	$504.406,10	$73.699,79	$3.328.200,13	-$349.338,47	$2.025,68	$0,19
	WEWA voyage owned container vessel	$0,00	$430.011,84	$191.031,06	$30.250,00	$768.429,80	$423.613,10	$75.054,81	$119.406,31	$504.406,10	$73.699,79	$3.593.963,84	-$615.102,17	$2.187,44	$0,20
Total Europe - West Africa [Annual]		**$17.121.495,56**	**$22.360.615,88**	**$9.933.614,96**	**$1.573.000,00**	**$39.958.349,38**	**$22.027.881,22**	**$3.902.849,89**	**$6.209.128,17**	**$26.229.117,26**	**$3.832.389,20**	**$174.210.024,86**	**-$19.309.218,18**	**$2.039,07**	**$0,19**
South America - West Africa	ECSA voyage chartered container vessel	$415.013,01	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$25.694,86	$134.428,01	$21.800,43	$1.312.378,70	-$670.007,29	$2.700,37	$0,30
	ECSA voyage owned container vessel	$0,00	$234.323,78	$108.055,59	$30.250,00	$219.466,90	$96.511,56	$26.834,56	$25.694,86	$134.428,01	$21.800,43	$1.350.276,84	-$707.905,43	$2.778,35	$0,31
Total South America - West Africa [Annual]		**$10.988.583,42**	**$12.184.836,62**	**$5.618.890,68**	**$1.573.000,00**	**$11.412.278,79**	**$5.018.600,95**	**$1.395.397,34**	**$1.336.132,52**	**$6.990.256,49**	**$1.133.622,13**	**$65.803.696,61**	**-$32.400.383,51**	**$2.603,82**	**$0,30**
Inter West Africa	Feeder 3 voyage chartered container vessel	$112.671,04	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$5.712,85	$13.677,61	$6.369,67	$302.822,61	-$153.972,08	$2.132,55	$4,71
	Feeder 3 voyage owned container vessel	$0,00	$14.677,47	$64.129,26	$30.250,00	$16.206,43	$8.749,54	$30.378,75	$5.712,85	$13.677,61	$6.369,67	$257.282,20	-$131.185,42	$1.811,85	$4,00
	Total Feeder 3 [Annual]	**$2.330.937,01**	**$763.228,35**	**$3.334.721,73**	**$1.573.000,00**	**$842.734,24**	**$454.976,03**	**$1.579.694,78**	**$297.068,05**	**$711.235,82**	**$331.222,93**	**$13.767.939,26**	**-$6.619.309,13**	**$1.864,56**	**$4,24**
	Feeder 4 voyage chartered container vessel	$163.958,07	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$18.541,23	$30.976,55	$12.335,63	$533.559,30	-$80.574,80	$1.940,22	$1,00
	Feeder 4 voyage owned container vessel	$0,00	$32.256,76	$64.919,09	$30.250,00	$72.367,11	$40.518,01	$67.436,84	$18.541,23	$30.976,55	$12.335,63	$479.295,72	-$26.311,22	$1.742,89	$0,90
	Total Feeder 4 [Annual]	**$4.745.015,62**	**$1.677.351,70**	**$3.375.792,78**	**$1.573.000,00**	**$3.763.089,74**	**$2.106.936,44**	**$3.506.715,55**	**$964.144,20**	**$1.610.780,73**	**$641.452,85**	**$25.835.998,60**	**-$2.280.804,60**	**$1.806,71**	**$0,95**
	Feeder 5 voyage chartered container vessel	$286.683,85	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$30.715,91	$71.244,33	$30.996,08	$917.568,30	-$137.166,73	$1.327,88	$2,17
	Feeder 5 voyage owned container vessel	$0,00	$32.903,51	$90.058,22	$30.250,00	$100.081,00	$62.882,80	$181.752,61	$30.715,91	$71.244,33	$30.996,08	$943.789,56	-$163.387,98	$1.365,83	$2,24
	Total Feeder 5 [Annual]	**$8.242.940,12**	**$1.710.982,35**	**$4.683.027,44**	**$1.573.000,00**	**$5.204.211,99**	**$3.269.905,53**	**$9.451.135,53**	**$1.597.227,30**	**$3.704.705,17**	**$1.611.796,07**	**$47.156.327,83**	**-$6.575.445,92**	**$1.312,38**	**$2,20**
	Feeder 6 voyage chartered container vessel	$350.798,19	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$44.252,91	$120.129,83	$39.204,88	$1.234.561,10	-$195.025,82	$1.412,54	$0,29
	Feeder 6 voyage owned container vessel	$0,00	$101.872,97	$90.105,80	$30.250,00	$163.499,77	$108.181,71	$186.265,03	$44.252,91	$120.129,83	$39.204,88	$1.266.850,93	-$227.315,66	$1.449,49	$0,30
	Total feeder 6 [Annual]	**$8.248.950,36**	**$5.297.394,29**	**$4.685.501,60**	**$1.573.000,00**	**$8.501.988,26**	**$5.625.449,13**	**$9.685.781,42**	**$2.301.151,40**	**$6.246.750,97**	**$2.038.653,78**	**$62.348.376,29**	**-$8.292.542,14**	**$1.371,86**	**$0,29**
Total Inter West Africa [Annual]		**$23.567.843,12**	**$9.448.956,68**	**$16.079.043,55**	**$6.292.000,00**	**$18.312.024,23**	**$11.457.267,12**	**$24.223.327,28**	**$5.159.590,94**	**$12.273.472,69**	**$4.623.125,62**	**$149.108.641,98**	**-$23.768.101,80**	**$1.446,76**	**$1,59**
Grand Total [Annual]		**$82.987.950,89**	**$87.304.663,42**	**$38.334.864,20**	**$11.011.000,00**	**$94.241.921,34**	**$54.024.522,15**	**$40.904.977,51**	**$17.655.781,05**	**$68.484.779,58**	**$14.000.000,00**	**$592.158.596,27**	**-$139.009.719,79**	**$1.897,31**	**$0,65**

Figure 523: Results sensitivity analysis: 20% increase in net freight rates scenario 4, specifications container vessels

Liner service	SWAX 2	WEWA	ECSA	Feeder 3	Feeder 4	Feeder 5	Feeder 6
Container vessel nr.	19	20	21	22	23	24	25
Nominal TEU capacity [TEU]	2.496	2.387	1.035	204	287	1.036	1.040
14 ton TEU capacity [14 ton TEU]	1.853	1.771	760	138	201	761	764
Amount of reefer plugs	344	330	155	48	59	156	156
Amount of ship cranes	3	3	2	2	2	2	2
Lpp [m]	204,0	201,5	159,3	96,9	106,3	159,3	159,5
B [m]	34,0	33,6	26,5	17,6	19,3	26,6	26,6
T [m]	9,7	9,6	7,8	5,2	5,7	7,8	7,8
D [m]	18,0	17,8	13,6	8,2	9,1	13,6	13,7
LBD [m³]	113.763,3	109.345,6	52.107,3	12.339,2	16.702,7	52.151,9	52.330,5
B/T [-]	3,5	3,5	3,4	3,4	3,4	3,4	3,4
Displacement Weight [t]	44.864	43.270	21.990	5.901	7.781	22.007	22.076
Displacement Volume [m³]	43.769	42.215	21.454	5.757	7.591	21.471	21.538
DWT [t]	35.110	33.787	16.468	4.075	5.465	16.482	16.537
Gross Tonnage [m³]	26.316	25.292	12.035	2.842	3.849	12.045	12.087
Wsm [t]	13.476	13.023	6.864	1.977	2.568	6.869	6.889
Wst [t]	9.589	9.253	4.749	1.299	1.706	4.752	4.767
Vs (design) [kn]	20,7	20,5	18,4	14,6	15,2	18,4	18,4
Vs (Max)	20,8	20,6	18,5	14,6	15,2	18,5	18,5
LCB [m]	-1,16	-1,18	-1,49	-2,45	-2,24	-1,49	-1,49
Cb [-]	0,65	0,65	0,65	0,65	0,65	0,65	0,65
Cp [-]	0,67	0,67	0,67	0,67	0,67	0,67	0,67
Cm [-]	0,97	0,97	0,97	0,97	0,97	0,97	0,97
Dp [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Ta [m]	8,9	8,8	7,7	5,8	6,1	7,7	7,7
Tf [m]	7,9	7,8	6,7	4,8	5,1	6,7	6,7
Tav (in ballast) [m]	8,4	8,3	7,2	5,3	5,6	7,2	7,2
Pb (MCR) [kW]	23.100	21.900	10.500	2.350	3.150	10.500	10.500
Cad [-]	492	492	473	432	438	474	475
Fuel consumption design condition [t/h]	4,39	4,16	2,00	0,45	0,60	2,00	2,00
Generator power [kW]	2.687	2.536	1.276	653	715	1.277	1.280
Operational costs [$/day]	$3.458,67	$3.382,10	$2.733,33	$1.724,52	$1.848,65	$2.733,87	$2.736,05
Average capital costs [$/day]	$9.829,12	$9.499,91	$5.480,40	$2.080,40	$2.500,12	$5.482,45	$5.490,65
Average charter price [$/day]	$9.531,21	$9.381,64	$7.526,43	$6.386,13	$6.500,02	$7.527,80	$7.533,29
Capacity fuel tanks [m³]	3.364	3.236	1.567	383	515	1.568	1.573
Vs inbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Vs outbound [kn]	11,0	12,0	11,5	11,0	11,0	11,0	11,0
Weight TEU loading inbound [t]	25.946	24.653	10.643	1.938	2.457	10.657	7.869
Displacement inbound [t]	43.364	41.443	19.258	4.306	5.528	19.279	16.235
Displacement outbound [t]	35.712	34.412	18.275	5.855	7.547	18.287	18.335
Pb inbound [kW]	3.195	4.023	2.208	779	909	1.933	1.720
Pb outbound [kW]	2.807	3.554	2.132	956	1.119	1.866	1.865
Fuel consumption inbound [t/h]	0,607	0,764	0,420	0,148	0,173	0,367	0,327
Fuel consumption outbound [t/h]	0,533	0,675	0,405	0,182	0,213	0,355	0,354