BE AWARE

Bonn Agreement
Accord de Bonn

# Technical Sub Report 3: Future Traffic Model 2020

Photo: Craig Bagguley

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# BE-AWARE Project Summary

The Greater North Sea and its wider approaches is one of the busiest and most highly used maritime areas in the world. With the ever-increasing competition for space there may come an increased risk of accidents that could result in marine pollution.

Currently the area has no overall risk assessment for marine pollution; risk is mapped with a variety of national risk assessments which are undertaken with differing methodologies; thus reducing comparability.

The BE-AWARE project is therefore undertaking the first area-wide risk assessment of marine pollution using a common methodology that allows the risk to be mapped and compared under different scenarios.

The project outcomes will contribute to improving disaster prevention by allowing North Sea States to better focus their resources on areas of high risk.

The project is a two year initiative (2012-2014), co-financed by the European Union, with participation and support from the Bonn Agreement Secretariat, Belgium, Denmark and the Netherlands, with co-financing from Norway.

# Contents

# Executive Summary

In this Report written by MARIN in execution of BE-AWARE Task E-4 – 'Future traffic', the traffic growth over the years is analysed and growth rates for cargo and passenger traffic between 2011 and 2020 are determined. The BE-AWARE project gives results for the risk assessment for 2011 based on historical data and a future prognosis for 2020. To be able to make calculations for 2020, an estimation of the traffic in that year is needed. This report aims to provide yearly growth rates for the different ship types that can be used to prepare a traffic database for 2020.

To prepare the traffic database for 2020, a different method has been used for cargo ships from that used passenger ships. For cargo ships, general growth factors have been used for the total area, while the growth rates for passenger traffic are specific per origin and destination country.

The final aim of this future traffic analysis is to determine the number of voyages in 2020 per ship type and ship size category. The future passenger traffic prognosis is based on the data received by the BE-AWARE data collection. The information of the SAMSON traffic database from 2000 and 2008 was used to prepare the prognosis for 2020 for the cargo traffic. SAMSON stands for Safety Assessment Model for Shipping and Offshore in the North Sea and the model can be used to perform risk assessment studies on maritime safety. The model is developed by MARIN for the Dutch Ministry of Infrastructure and the Environment and is owned by the Ministry.

**Cargo traffic**

The annual growth rates have been determined for the number of voyages; the results are given in Table 0-1. Also the annual growth rates for the growth in ship size have been determined. These results are shown in Table 0-2.

| Ship type | Total based on 2000-2008 | Totals adjusted |
|---|---|---|
| Bulk | 0.9% | 0.9% |
| Oil/Bulk/Ore | -4.0% | -4.0% |
| Oil tankers | 0.4% | 0.4% |
| LNG/LPG/Gas | 0.1% | 1.2% |
| Chemical tankers | 1.3% | 1.3% |
| Tankers, Food | 0.8% | 0.8% |
| Car carrier | -0.4% | -0.4% |
| Container | 1.9% | 1.2% |
| Reefer | -0.4% | -0.4% |
| RoRo | 0.0% | 0.0% |
| Dry Cargo | -0.8% | 0.4% |
| Total | 0.3% | |

**Table 0-1 Annual growth rates for the number of voyages per ship type**

| Ship type | Total |
|---|---|
| Bulk | 1.7% |
| Oil/Bulk/Ore | -3.4% |
| Oil tankers | 1.2% |
| LNG/LPG/Gas | 2.3% |
| Chemical tankers | 4.9% |
| Tankers, Food | 5.3% |
| Car carrier | 2.3% |
| Container | 5.2% |
| Reefer | 0.7% |
| RoRo | 3.0% |
| Dry Cargo | -0.3% |
| Total | 3.5% |

**Table 0-2 Annual growth rates for the Gross tonnage per ship type**

**Passenger traffic**

For passenger traffic the growth rates have been determined for domestic routes and for the routes between the different countries.

| | United Kingdom | Denmark | Norway | Sweden | France | Ireland | Germany | Netherlands | Baltic | Spain |
|---|---|---|---|---|---|---|---|---|---|---|
| United Kingdom | -3.8% | 0.0% | N/A | N/A | -4.5% | 0.0% | N/A | -0.5% | -12.7% | 6.8% |
| Denmark | | N/A | 1.7% | -4.9% | N/A | N/A | N/A | N/A | | |
| Norway | | | 0.8% | 1.7% | N/A | N/A | 1.7% | N/A | | |
| Sweden | | | | N/A | N/A | N/A | -4.9% | N/A | | |
| France | | | | | N/A | 1.7% | N/A | N/A | | |
| Ireland | | | | | | 1.7% | N/A | N/A | | |
| Germany | | | | | | | N/A | N/A | | |
| Netherlands | | | | | | | | N/A | | |

Where no values are available, the average 1.7% of BRISK can be used (MRIL, 2011)
N/A means that there are no ferry routes in the BE-AWARE route network
The Swedish data is based on the number of passengers, not on the number of crossings
From Norwegian future traffic prognosis data

**Table 0-3 Annual growth rates for the number of voyages of passenger ships between countries**

**Cruise vessels**

For cruise ships it is proposed to use the growth rate of 6% that is mentioned in the BRISK report as long term five year world-wide average.

# 1. INTRODUCTION

The main objective of the BE-AWARE project is to conduct an area-wide risk assessment of the spillage of oil and HNS. One of the main tasks in the project is gathering information related to the risk assessment. The project gives results for 2011 based on historical data and a future prognosis for 2020. To be able to make calculations for 2020, an estimation of the traffic in that year is needed. This report aims to provide yearly growth rates for the different ship types that can be used to prepare a traffic database for 2020.

**Objective of the report**

This report describes the prognosis for future ship traffic in the Bonn Agreement area for 2020. Both cargo and passenger ship traffic are discussed. Included in the report is a description of the data and the methodology.

**Report structure**

Chapter 2 contains a description of the input data for cargo and passenger traffic. Chapter 3 is a data analysis of cargo and passenger traffic. Chapter 4 describes the resulting growth rates of cargo and passenger traffic.

# 2. Description of input data

## 2.1 Cargo traffic input data

The BE-AWARE data collection for future cargo traffic resulted in input from the following countries: France, Germany, Ireland, Norway, Sweden and the UK.

### 2.1.1 Historical data

France, Sweden, Ireland and the UK provided historical data in the form of excel spreadsheets and pdf tables about the transported tonnage per cargo category. A quick analysis of the data shows that the growth rates for different countries can be very different. The analysis model that is available works with one growth factor per ship type. This makes it very difficult to use historical data from the participating countries to prepare a prognosis for cargo traffic.

### 2.1.2 Future outlooks

Germany and Norway provided future outlooks. The outlook from Germany (Planco, 2007) contains transported tonnage in German ports. The outlook from Norway contains the mileage per ship type for the North Sea. The Norwegian outlook is based on the results from the Ex-tremis project (Chiffi, 2011). Based on the Norwegian data, the following growth rates were obtained:

| Ship type | Growth of mileage |
|---|---|
| Bulk carrier | 0.9% |
| Chemical tanker | 0.7% |
| Container ship | 0.8% |
| General Cargo | 0.8% |
| LG tanker | 0.6% |
| Oil tanker | 0.9% |
| RoRo cargo | 0.6% |

**Table 2-1 Growth rates based on the Ex-tremis project**

### 2.1.3 Data used

The final aim of this future traffic analysis is to determine the number of voyages in 2020 per ship type and ship size category. Table 2-1 does not contain information about ship size. Another data source was therefore used to determine the growth rates as input for a future traffic prognosis. The information in the SAMSON traffic database for the years 2000 and 2008 was used to prepare the prognosis for 2020.

SAMSON stands for Safety Assessment Model for Shipping and Offshore in the North Sea and the model can be used to perform risk assessment studies regarding maritime safety. The model is developed by MARIN for the Dutch Ministry of Infrastructure and the Environment and is owned by the Ministry.

The core of the model is a maritime traffic database. This traffic database is updated every four years with the latest movement database from Lloyd's List Intelligence (LLI).

## 2.2 Passenger traffic input data

### 2.2.1 Ferry lines

The BE-AWARE data collection for future passenger traffic resulted in input from the following countries: Denmark, France, Germany, Ireland, Netherlands, Norway, Sweden and the UK. References to reports cannot be made because the data was provided mainly in tables and text format. Denmark, the Netherlands and the UK provided information about the number of trips. The information provided by the UK and the Netherlands contained all the ferry lines in the area for which the route structure for the BE-AWARE project was made. Denmark sent information about some of the ferry lines.

France and Sweden provided information about the number of passengers per port. By looking up the ferry lines for these countries this information could be used as well. The number of passengers does not necessarily change in the same way as the number of trips. Norway provided a growth rate which was used for domestic ferry movements. The information for Ireland and Germany could not be used to calculate any growth rates.

### 2.2.2 Cruise ships

Very little information about cruise ships was obtained. Only Sweden and France included data in their response to the data request note.

# 3. Data analysis

## 3.1 Treatment of data for cargo and passenger ships

To prepare the traffic database for 2020, a different method was used for cargo ships from that used for passenger ships. For cargo ships, general growth factors have been used for the total area, while the growth rates for passenger traffic are specific per origin and destination country. For this reason, this report also treats cargo and passenger traffic separately.

## 3.2 Ship type and size class definitions for cargo ships

The ship type and size categories that were used in the model have been defined by COWI. It was not possible to differentiate between all the tanker groups that COWI had used previously because the number of tankers of the various types differed too much between 2000 and 2008. Therefore the ship types “chemical/product tanker” and “product tanker” were not included.

| Ship type |
|---|
| Bulk |
| Oil/Bulk/Ore |
| Oil tankers |
| LNG/LPG/Gas |
| Chemical tankers |
| Tankers, Food |
| Car carrier |
| Container |
| Reefer |
| RoRo |
| Dry Cargo |

| Ship size class | GTmin | GTmax |
|---|---|---|
| 1 | 100 | 999 |
| 2 | 1000 | 1599 |
| 3 | 1600 | 4999 |
| 4 | 5000 | 9999 |
| 5 | 10000 | 29999 |
| 6 | 30000 | 59999 |
| 7 | 60000 | 99999 |
| 8 | 100000 | 300000 |

**Table 3-1 Overview of the different ship types and ship sizes**

## 3.3 Trends for cargo ships

The expected trends for some of the ship types are described below. In general one can say that, due to the financial crisis that started in 2008, the average growth rates in the number of voyages after 2008 have not grown as fast as before 2008. Moreover, several prognoses expect that the cargo transport in 2015 will reach the level it was at in 2008.

### 3.3.1 **Oil/Bulk/Ore**

The reduction in Oil/Bulk/Ore carriers is because they are becoming unpopular (Marineinsight, 2010). The average age of this ship type in the world merchant fleet increased by almost three years between 2004 and 2008. For the same period, the number of ships and the DWT reduced by over 15%. It has mostly been the larger ships of this ship type that have taken out of service and there are very few new ships of this type being built.

### 3.3.2 Oil tankers

While oil production in the North Sea is declining rapidly (see Figure 3-1), oil production in the Barents Sea (Norway and Russia) is expected to increase rather rapidly. Ships from the Barents Sea sail through the whole North Sea on their way to the market, mainly in the Netherlands. This is the reason why the voyages and ship sizes for oil tankers are not decreasing as dramatically as the drop in oil production indicates. Oil from Russia and the Barents Sea in other words balances the decrease in North Sea production.

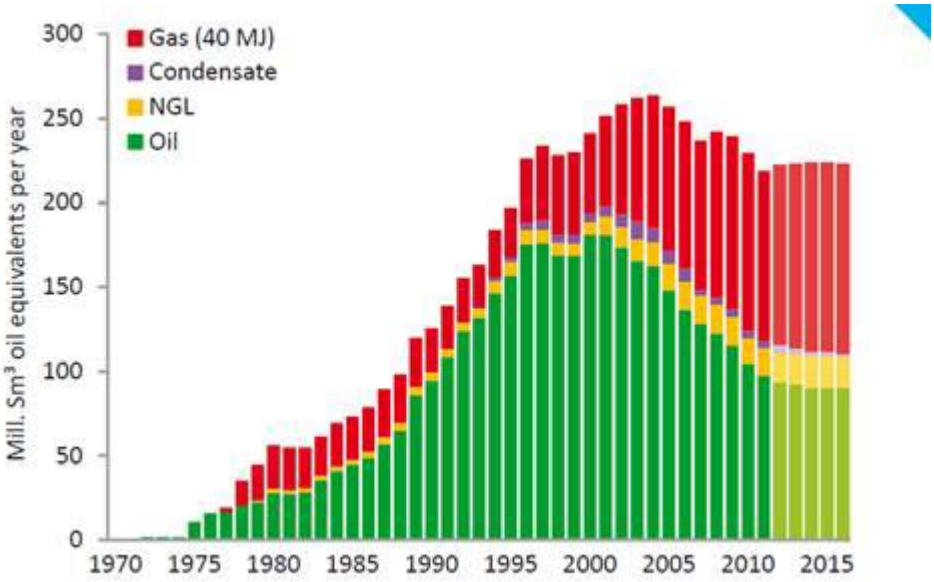


**Figure 3-1 Historical production of oil and gas in Norway and production forecast for the coming years (Hansen, 2012)**

### 3.3.3 LNG/LPG Gas

The transported LNG/LPG and Gas has been relatively constant in the past decade. A growth is expected in the future as the importance of oil slowly decreases. The production of oil wells is decreasing and gas fields are becoming relatively more important (see Figure 3-1). Also due to emission regulations LNG/LPG and gas options are increasingly being used as ship fuel (Sname 2013).

### 3.3.4 Container/reefers/RoRo/Car carriers

There are a significant number of large container ships on order. This will result in a rapid increase in ship size for this ship type. The container vessels are taking further market shares from reefers and roll-on/roll-off vessels (DNV 2012). Furthermore, there has been investment in the infrastructure required to accommodate larger container vessels which will be completed in the near future. In the car carrier segment, orders for new ships are also expected (DNV 2012), probably resulting in increasing ship size.

### 3.3.5 Dry cargo

A slight decrease was seen in the number of voyages and in the size of dry cargo ships in the period 2000-2008. A slow increase is expected until 2020 because of EU regulations attempting to move transport from roads to ships. This will mainly lead to an increase in short sea shipping with relatively small vessels.

## 3.4 Cargo traffic data analysis

As described in Section 2.1.3 the information of the SAMSON traffic database from 2000 and 2008 was used to prepare the prognosis for 2020. Both for 2000 and for 2008, all movements starting in ports in the Bonn Agreement area were gathered. For both years, a table was made containing the number of vessel movements per BE-AWARE ship type and ship size, including the actual Gross Tonnage of the ships.

Next, the growth per year in the number of voyages ($N_{growth}$) per ship size (i) and type (j) is calculated. Because some ship type and size categories contain a very low number of voyages, the values were calculated by taking the neighbouring size classes also into account. This results in less extreme values. This had to be done for some of the ship type classes as well. The equations below are for a ship type for which enough information is available, so that the growth rate can be based on this ship type alone. For those ship types for which not enough information is available, logical combinations are made. For example, dry cargo ships and reefers are combined.

$$N_{growth,i,j} = \left( \frac{\sum_i N_{2008,i-1,j} + \sum_i N_{2008,i,j} + \sum_i N_{2008,i+1,j}}{\sum_i N_{2000i-1,j} + \sum_i N_{2000,i,j} + \sum_i N_{2000,i+1,j}} \right)^{\frac{1}{8}} - 1$$

As explained in Section 2.1.3, it is not only the change in the number of voyages that is important, but also the change in ship sizes. Therefore, the growth per year in average Gross Tonnage ($GT_{av}$) per ship size (i) and type (j) is also calculated. To do this, first, the growth per year in the number of voyages times the Gross Tonnage was calculated.

$$\left(N \cdot GT\right)_{growth,i,j} = \left( \frac{\sum_i \left( N_{2008,i-1,j} \cdot GT_{2008,i-1,j} \right) + \sum_i \left( N_{2008,i,j} \cdot GT_{2008,i,j} \right) + \sum_i \left( N_{2008,i+1} \cdot GT_{2008,i+1,j} \right)}{\sum_i \left( N_{2000i-1,j} \cdot GT_{2000,i-1,j} \right) + \sum_i \left( N_{2000,i,j} \cdot GT_{2000,i,j} \right) + \sum_i \left( N_{2000,i+1,j} \cdot GT_{2000,i+1,j} \right)} \right)^{\frac{1}{8}} - 1$$

Then, growth in average Gross Tonnage is calculated by subtracting the growth in the number of voyages from the growth in the number of voyages times the Gross Tonnage.

$$GT_{av,growth,i,j} = \left(N \cdot GT\right)_{growth,i,j} - N_{growth,i,j}$$

For each voyage in the 2008 database, a new Gross Tonnage and corresponding size class were calculated based on the $GT_{av,growth,i,j}$ that was previously calculated. The yearly growth between 2011 and 2020 was assumed to be similar to the growth between 2000 and 2008. The equation for this would be:

$$GT_{2020,i,j} = GT_{2008,i,j} \cdot \left(1 + GT_{av,growth,i,j}\right)^{12}$$

Also, the new number of voyages has been calculated. Using the same assumption as for the Gross Tonnage, the number of voyages would be calculated as follows:

$$N_{2020} = N_{2008} \cdot (1 + N_{growth,i,j})^{12}$$

Finally, the resulting totals per ship type and size can be divided by the values in 2008 to calculate resulting average growth rates.

As described in Section 3.3, the yearly growth between 2011 and 2020 will not be the same as between 2000 and 2008. Therefore, the exponents (12) in the two last equations were tuned to obtain growth rates that are in the expected range.

## 3.5 Passenger traffic analysis

The information for the different countries was put in tables and figures and it was decided whether the total period of information was representative or not. For the representative period ($N_{first}$ to $N_{last}$), the growth rate was calculated as follows:

$$\left(\frac{N_{last}}{N_{first}}\right)^{\frac{1}{years}} - 1$$

The input data and the resulting growth rates are given below.

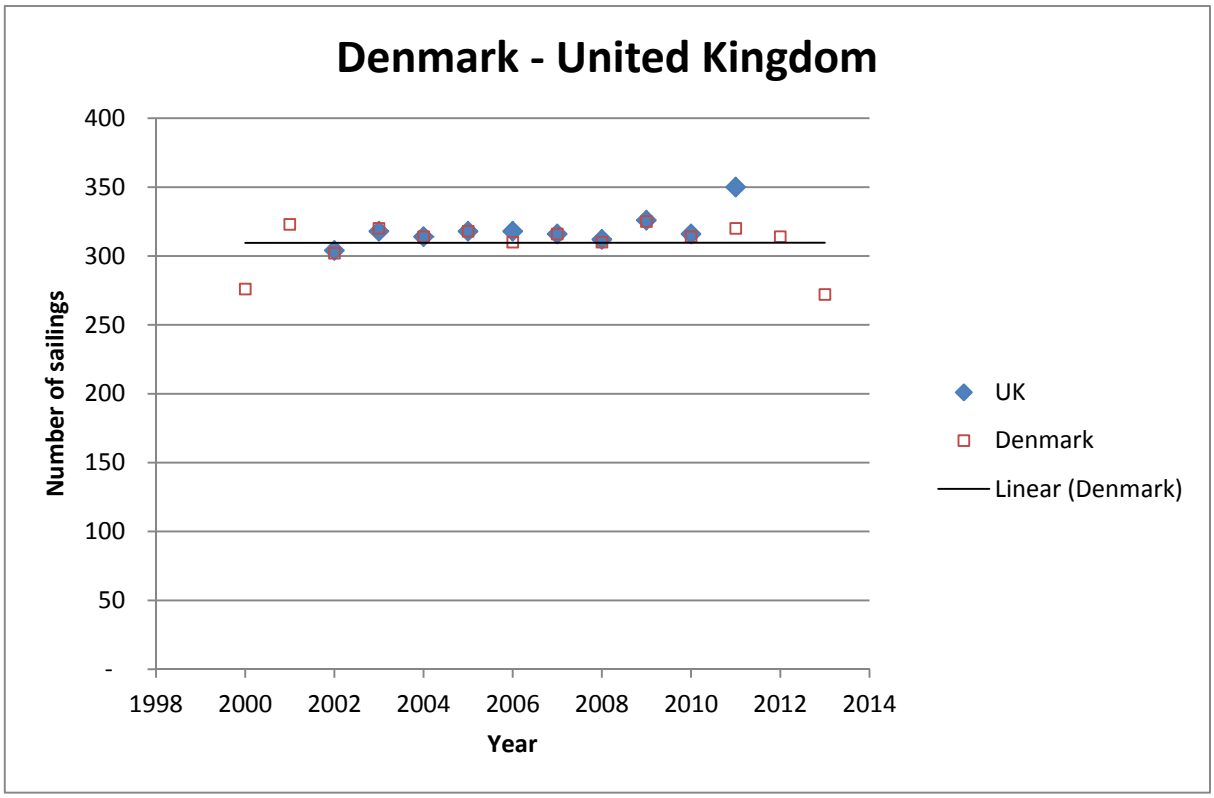


**Figure 3-2 Growth rate for passenger traffic between Denmark and the UK: 0.0%**

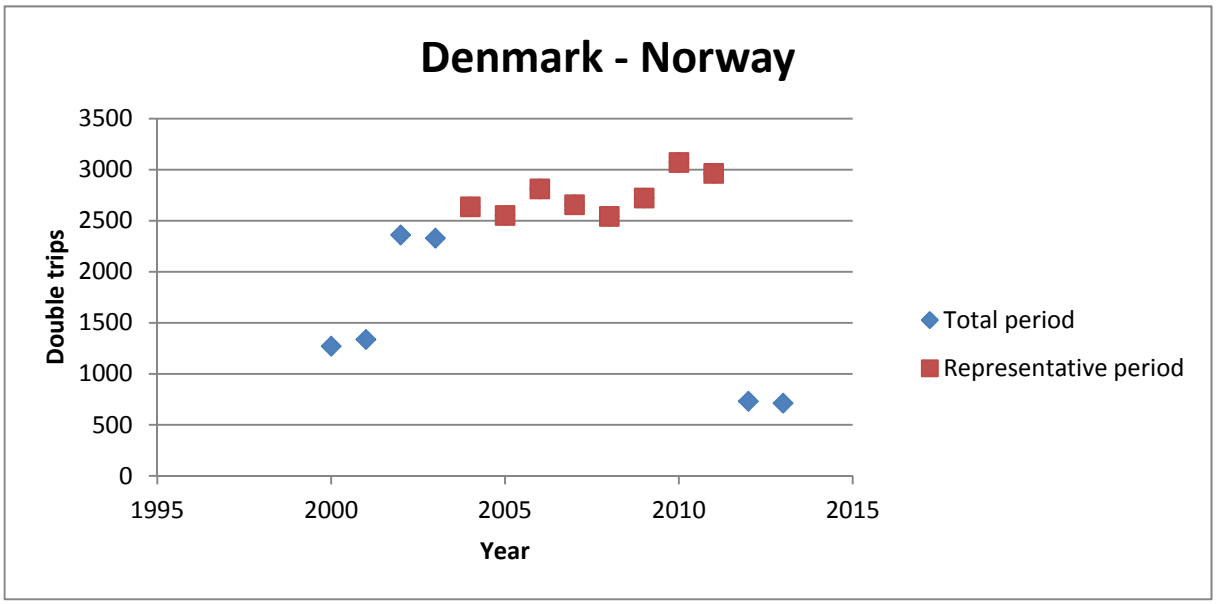


**Figure 3-3 Growth rate for passenger traffic between Denmark and Norway: 1.7%**

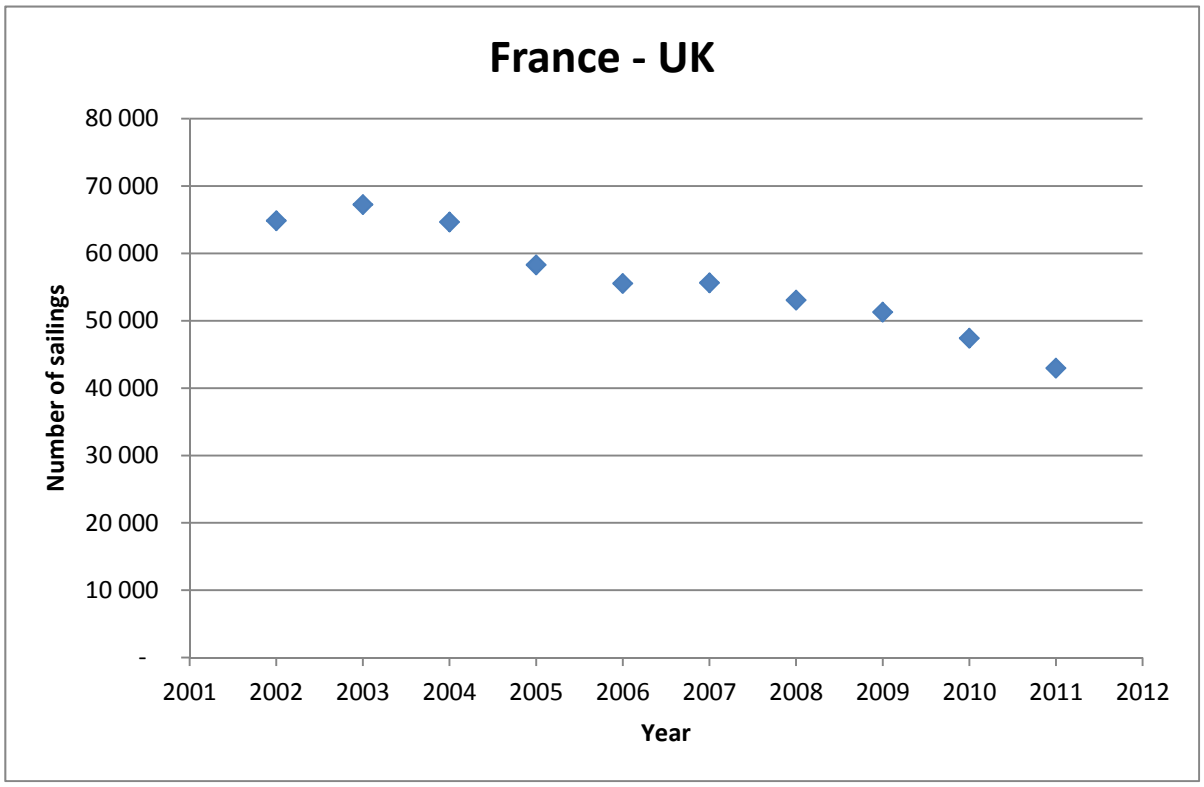


**Figure 3-4 Growth rate for passenger traffic between France and the UK: -4.5%**

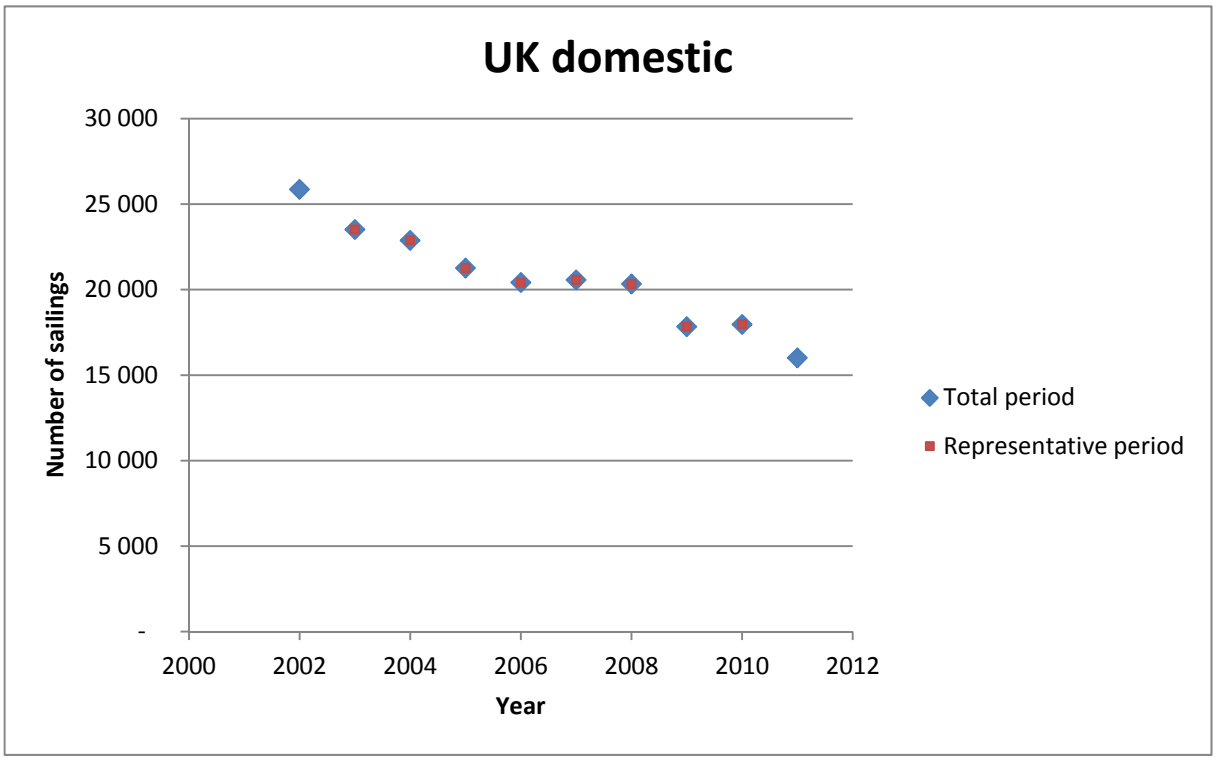


**Figure 3-5** **Growth rate for domestic passenger traffic in the UK: -3.8%**

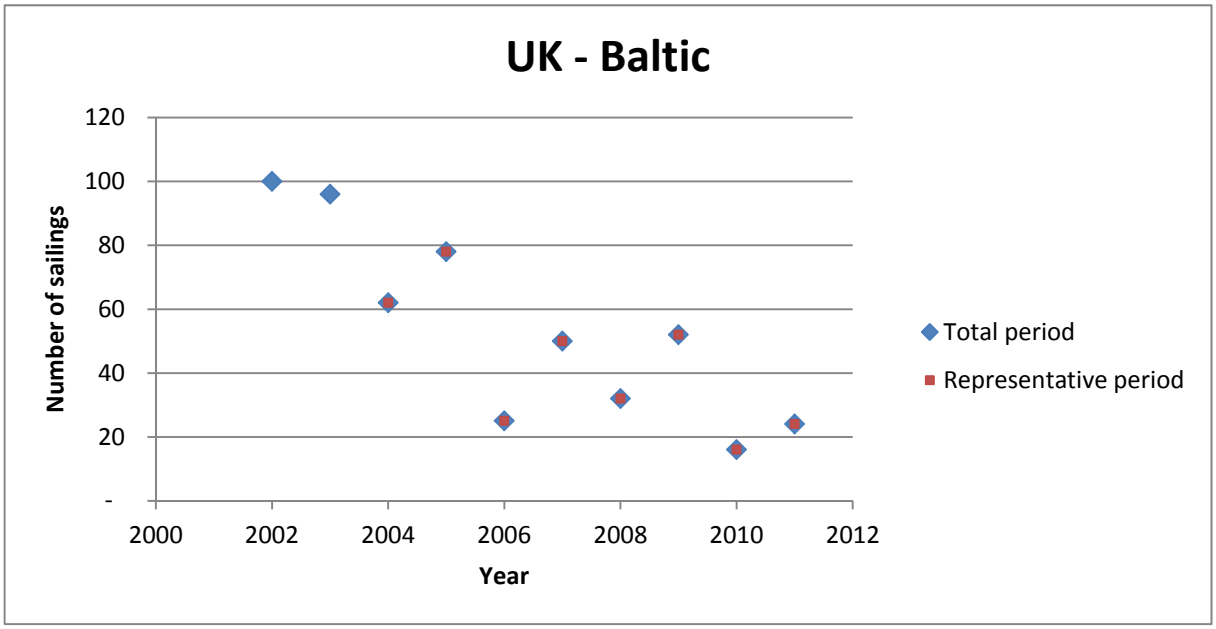


**Figure 3-6** **Growth rate for passenger traffic between the UK and the Baltic: -12.7%**

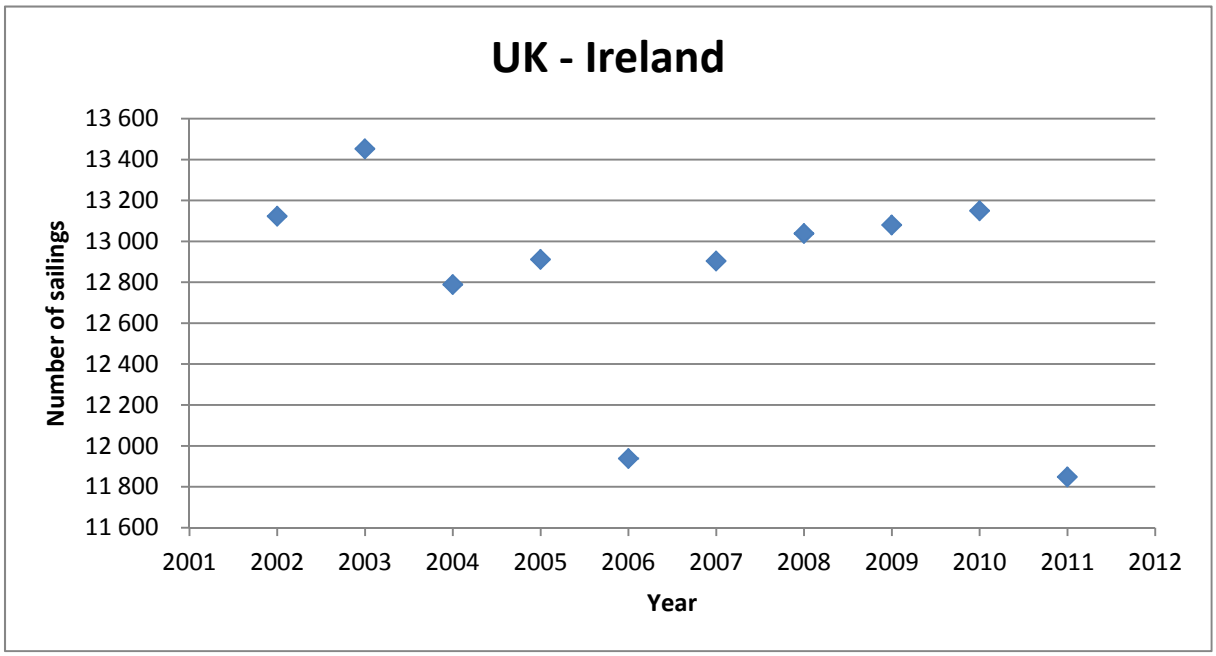


**Figure 3-7** **Growth rate for passenger traffic between the UK and Ireland: 0%**

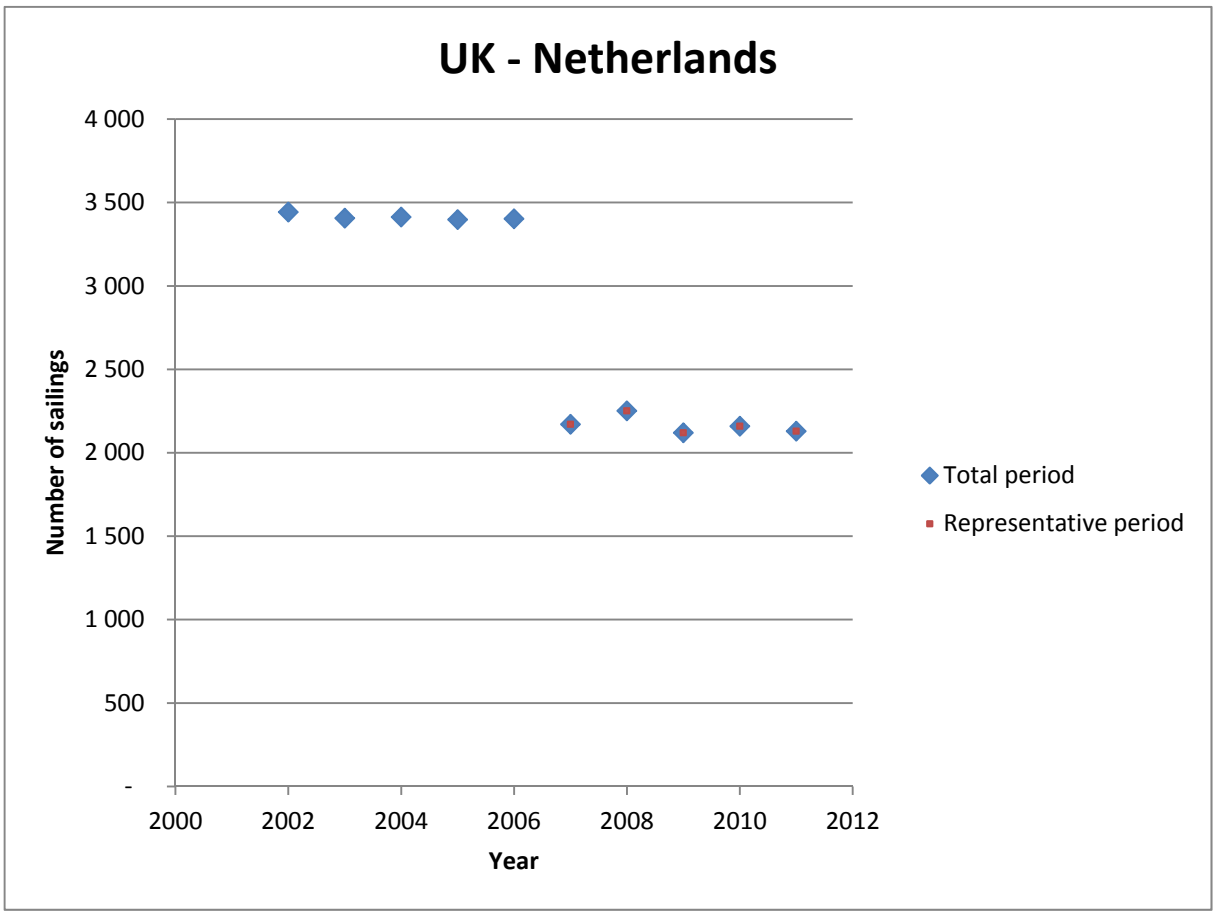


**Figure 3-8** **Growth rate for passenger traffic between the UK and the Netherlands: -0.5%**

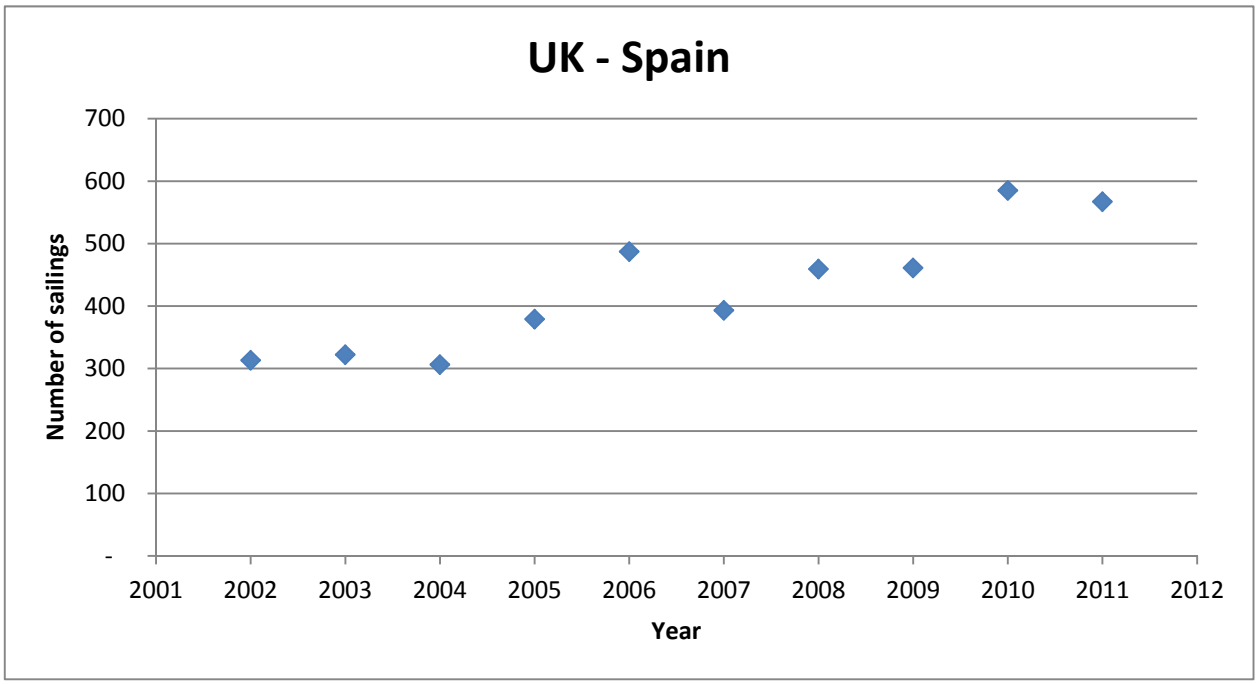


**Figure 3-9 Growth rate for passenger traffic between the UK and Spain: 6.8%**

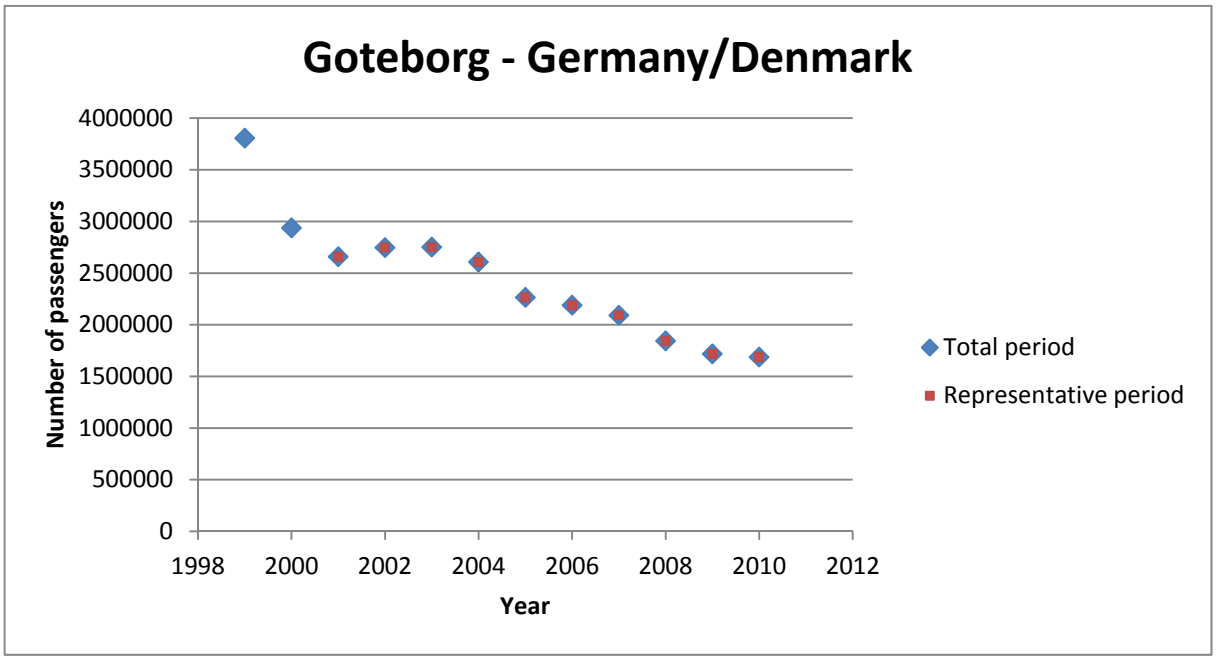


**Figure 3-10 Growth rate for passenger traffic between Goteborg and Germany/Denmark: -4.9%**

# 4. Resulting growth rates

## 4.1 Cargo traffic growth rates

The annual growth rates have been determined for the number of voyages; the results are given in Table 4-1. Some adjustments were made to accommodate expected changes in growth for the period 2011-2020 compared with the period 2000-2008. The numbers on the right-hand side were therefore used for the analysis. As a basis for the adjusted values, reference is made to (Chiffi, 2011). The following adjustments were made after the method described in Section 3.4 was used:

- The annual growth rate for the number of voyages of container ships was slightly reduced to accommodate the large increase in gross tonnage. The volume transported and the number of voyages are expected to grow but at a smaller growth rate than calculated based on the data for 2000-2008.
- The annual growth rate for the number of voyages of LNG/LPG/Gas carriers increased. For an explanation see Section 3.3.3.
- The annual growth rate for the number of voyages of dry cargo ships was increased. For an explanation see Section 3.3.5.

The annual growth rates for the growth in ship size have also been determined. These results are shown in Table 4-2.

| Ship type | Total based on 2000-2008 | Totals adjusted |
|---|---|---|
| Bulk | 0.9% | 0.9% |
| Oil/Bulk/Ore | -4.0% | -4.0% |
| Oil tankers | 0.4% | 0.4% |
| LNG/LPG/Gas | 0.1% | 1.2% |
| Chemical tankers | 1.3% | 1.3% |
| Tankers, Food | 0.8% | 0.8% |
| Car carrier | -0.4% | -0.4% |
| Container | 1.9% | 1.2% |
| Reefer | -0.4% | -0.4% |
| RoRo | 0.0% | 0.0% |
| Dry Cargo | -0.8% | 0.4% |
| Total | 0.3% | |

**Table 4-1 Annual growth rates for the number of voyages per ship type**

| Ship type | Total |
|---|---|
| Bulk | 1.7% |
| Oil/Bulk/Ore | -3.4% |
| Oil tankers | 1.2% |
| LNG/LPG/Gas | 2.3% |
| Chemical tankers | 4.9% |
| Tankers, Food | 5.3% |
| Car carrier | 2.3% |
| Container | 5.2% |
| Reefer | 0.7% |
| RoRo | 3.0% |
| Dry Cargo | -0.3% |
| Total | 3.5% |

**Table 4-2 Annual growth rates for the Gross tonnage per ship type**

## 4.2 Passenger traffic growth rates

### 4.2.1 Ferry lines

For the passenger traffic the growth rates have been determined for domestic routes and for the routes between the different countries. The results can be found in Table 4-3.

| | United Kingdom | Denmark | Norway | Sweden | France | Ireland | Germany | Netherlands | Baltic | Spain |
|---|---|---|---|---|---|---|---|---|---|---|
| United Kingdom | -3.8% | 0.0% | N/A | N/A | -4.5% | 0.0% | N/A | -0.5% | -12.7% | 6.8% |
| Denmark | | N/A | 1.7% | -4.9% | N/A | N/A | N/A | N/A | | |
| Norway | | | 0.8% | 1.7% | N/A | N/A | 1.7% | N/A | | |
| Sweden | | | | N/A | N/A | N/A | -4.9% | N/A | | |
| France | | | | | N/A | 1.7% | N/A | N/A | | |
| Ireland | | | | | | 1.7% | N/A | N/A | | |
| Germany | | | | | | | N/A | N/A | | |
| Netherlands | | | | | | | | N/A | | |

Where no values are available, the average 1.7% of BRISK can be used (MRIL, 2011)
N/A means that there are no ferry routes in the BE-AWARE route network
The Swedish data is based on number of passengers, not on the number of crossings
From Norwegian future traffic prognosis data

**Table 4-3 Annual growth rates for the number of voyages of passenger ships between countries**

### 4.2.2 Cruise ships

From the Swedish data a growth rate of 14.7% could be obtained. Analysing the French data resulted in a growth rate of 13% for stopovers and of 0% for initial or final embarkation. This gives so little information that it is proposed to use the growth rate of 6% that is mentioned in the BRISK report (MRIL, 2011) as long-term five-year world-wide average.

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| | |
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