

Analysis of the actual shipping situation and the Port of Barcelona. Strategy for the near future and application of Horizon 2020 policies.

Treball Final de Grau



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Abstract

The shipping industry is making the ports to change continuously in order to adapt their strategies to new challenges to attract more traffic to their ports and to take into account seriously the impact of the industry to the environment.

The Port of Barcelona (PoB) is not an exception for this and needs to detect its main weaknesses and strengths in order to improve its position. Nowadays, PoB is very far from some of its competitors despite being located near Africa and being one of the European closest port to Asia. Accordingly, it is needed to strengthen its positive factors and to improve the ones that are worst. For this reason, PoB needs a change of strategy focusing on its main market (China) and trying to catch traffic mostly from ports located in Africa (because its proximity) or United Arab Emirates (constantly growing during last years). In addition, for becoming a model to follow about green transport, it is urgent to have an international gauge to connect the port to Europe, build the Mediterranean Corridor and apply some policies explained in the program of the European Commission Horizon 2020 about inland connections (awards to the cleanest carriers, for example). Applying those measures, PoB could become a more competitive port and respectful with the environment.

The methodology used in the study consists on a deep explanation about the PoB, a comparison between the port and the Port of Rotterdam (because its leadership in Europe), Valencia Port (because it is the closest and the second most important port of Spain) and Port of Marseille (because its proximity going to the North and its competitiveness). After the comparison, Horizon 2020 is applied to Port of Barcelona for finalizing making proposals that connect both parts of the work (traffics and environment).

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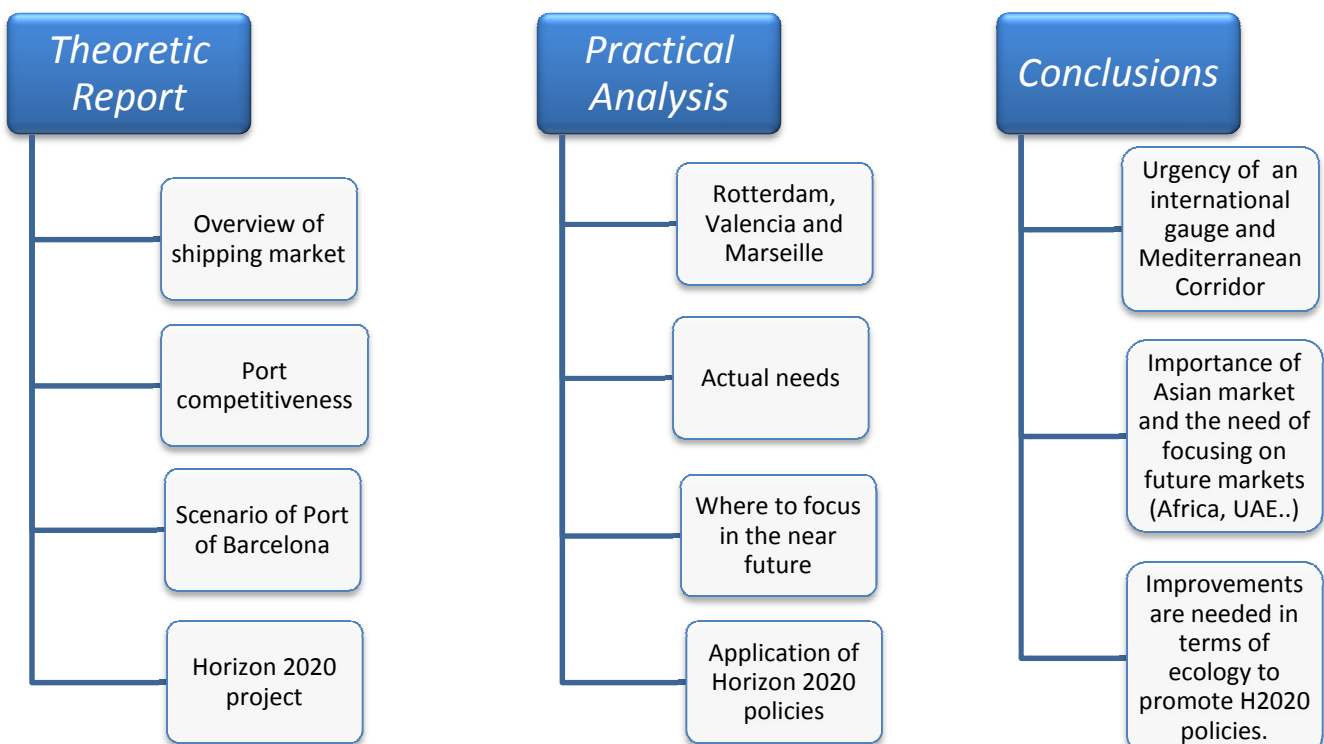
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Structure of the study

MAIN OBJECTIVES

- 1) Analyze the weaknesses and strengths of the Port of Barcelona.
- 2) Need of changing Barcelona's inland communications.
- 3) Detect the new market opportunities and the strategy to attract those markets.
- 4) Need to apply Horizon 2020 policies. How can Barcelona be a model to follow?





Chapter 0. Introduction.

The importance of maritime transport has been growing since it was firstly used thousands of years ago. Nowadays, the shipping sector is probably the one that has more influence in the economy not only of a specific country but also the whole world. For example, if there is a strike in all the ports of a country, the prices of the product would probably increase and the situation may be urgent. Moreover, most of the products that we are wearing or using in our life are coming from many parts of the world and almost no product is completely from our region. Accordingly, ports are strategic facilities of the states and it really matters the strategy they follow.

Therefore, maritime transport is essential for exchanging goods from one place to another without losing much time, and it is an efficient transport if we consider the pollution per unit transported (container or tone, for example). During the transportation process there are many actors that have different roles in order to make possible the supply chain, but ports have an especial relevance if we consider that they are the ones that transfer goods from the landside to the ships or vice versa. For that reason, the purpose of this project is to understand the different factors have more influence to a specific port when talking about traffic of goods (containerized and bulk).

Taking into account all the factors, the work will be focused on the Port of Barcelona (PoB) because of the proximity to our Faculty and my aim of working in the near future in a terminal of the port or in any company related to it as a shipping agent or similar. Furthermore, despite some of our academic subjects are focused on ports, we only know some things about the traffics of the PoB and how it is organized. For me it is something very interesting to focus on the PoB in order to make my first project of my career related to a port that can be considered the most important place of our degree taking into account its essential role.

During this chapter it will be explained all the different terminals that the port has in order to know the actual scenario of the port, the different factors that influence the traffics (geographical location, infrastructures, etc.) and its hinterland to know why the port is in the actual situation in terms of cargo per year. Later, it will be described the traffics of the port in the last years to understand the evolution of the port and the strategy that the port is establishing for the following years. For our project, it is very important to know where the port

is focusing for the near future and the different infrastructures that are planned to be build in the future and can affect favourably to the port.

After all the situation of the port is explained (from traffics to the hinterland of the port) it will be compared to the Port of Rotterdam (because its importance in Europe), the Port of Marseille (the closest port to the north) and the Port of Valencia (the most important port of Spain if transit traffic is not considered) using the official data that each port publishes in its website (and in the case of Valencia, using the program Foreland 2008). As we can see, the aim of the comparison is to obtain the main strengths and weaknesses of the competitors of the PoB in order to understand why Barcelona is very far of the leaders in Europe like Rotterdam or Hamburg. Very diverse ports have been chosen in order to have different points of view comparing to the PoB. In addition, it is beneficial for the project to study ports very different among them because its diversity of traffic (for example, Valencia is focused on containerized traffic and Marseille in bulk traffic).

The second part of the work, smaller than the first part, is related to the pollution of the ports and its surroundings. I have always been against the pollution to the environment and the impact that humanity is making to the world, especially because of the pollution related to transport and factories. For this reason, it will be explained firstly the impact that the shipping industry makes to the environment and why it is very important to regulate the sector of maritime transport. Afterwards, it will be explained what are exactly Horizon 2020 policies in order to know different possible measures that are proposed by the European Commission to minimize the pollution in the different ports of the world and, in our case, we are going to apply them to the case of the Port of Barcelona to suggest some possible improvements that could affect to protect the atmosphere and the surroundings of the port.

Once all different parts are explained, the main objective of the work is to suggest a possible strategy to the Port of Barcelona in order to increase the current traffics and to grow faster than its main competitors like the Port of Valencia and the Port of Marseille (that will be studied in depth). Accordingly, the strategy must be in the short run because the shipping sector is continuously changing and the uncertainty is very big when talking about future traffics or the evolution of the maritime ports worldwide Special attention to the hinterland connection must be also taken.

In addition, the strategy proposed must be respectful with the different Horizon 2020 policies that will be explained, not only to increase in traffic but also to become an example of efficiency and respect to the environment. Should this strategy become a reality, it will make possible for the PoB to become a leader in the shipping sector.

Chapter 1. General overview of the shipping market

1.1 The role of ports in worldwide transport

A port is a very important actor in the supply chain if we consider that is the one that makes possible the transfer of goods from the landside to the seaside. It is for this reason that the ports have a significant impact on the global economy.

According to the European Commission, the ports facilitate the 90% in weight of the total external trade of the European Union and 40% of the trade in the European internal market. Therefore, a port is a place where many jobs are generated and it is a significant contributor to the growth of the economy (GDP) thanks to its activity and the millions of jobs. Moreover, if a study on the global economy is made, the traffic in ports is an important factor to take into account if we want to know the state of an economy. For example, during the years of economical crisis the traffic in most of the ports was reduced significantly, being a sign of debility in the economy due to reduction of the imports and exports.

We also need to comment the importance of the ports in the added value generation. In Europe, there are lots of ports that are not only generating employment but also reinforcing the competitiveness due to the activities that generate wealth to the local economy as the case of the Port of Barcelona. Accordingly, the roles of the ports have changed a lot during the last years.

In the past, ports were only considered the platform where the exchange of goods was made but now after the sophistication of the logistics and the globalization, the ports have become a platform of distribution of goods and covers also activities of commercial character. The activities that are taking place in a port can determine its competitiveness comparing to other ports.

1.2 Different types of competitiveness

We can consider different types of competitiveness that affect the port. For that reason we can divide it in three different types depending on the actor of the supply chain that it affects:

- a) Interport competitiveness is the one that affects two or more different ports when they are competing because their similarities. Some of the similarities can be the type of traffics (two ports that are moving the same bulk cargo, for example), the geographical situation (those ports that are one closed to the other and are fighting for the same costumers) or the infrastructure factor (the facilities affect directly to the traffic that a port is moving).
- b) Intraport competitiveness is the competition that appears between two different operators that want to be in charge of a port terminal and they try to make their best in order to obtain, for example, a specific concession.
- c) Competitiveness between sea transport and other means of transport. The sea transport has the feature of having low power consumption, it releases the congestion of the roads, the port capacity is enough to deal with the future traffics and it is more respectful with the preservation of the environment.

All the different competitiveness's commented have distinct actors that are competing among them. In our case, we are going to focus only on the interport competitiveness that is, in conclusion, the one that affects one port and its competitors.

1.3 Interport competitiveness

The port, as we have seen, is one of the most important steps in the transport chain. That's why the competition has been growing as the increase of transport has done, making the ports to fight with each other in order to move as much traffic as they can.

We are going to comment all factors that can influence the amount of cargo that is loaded or unloaded and especially why companies decide to go to a specific port instead of another one that is better located for their interests. We need to take into account that some factors can be changed/modified and others are invariable. We will focus only on the interport competitiveness (between different ports), because the intraport competitiveness refers to the competition between private company for managing the services of the port and it doesn't concern our project.

1.3.1 Non-Variable factor

The main factor that we must comment is the geographical location of a port.

We refer to it as a non-variable factor because it is something we cannot change. The location is one of the most important factors because it conditions in a notable way the traffic that the port receives. Probably the best example to mention is the ports located in China.

In the years 2011-2013 nine of the twenty top container ports of the world were Chinese (Table 1). That happens because of the big amount of goods that are being exported by China that has not stopped growing in the last years (except Hong Kong that that has decrease the traffic during two consecutive years). The average of grow of all Chinese ports is 5,64%. It is clear that the location of that ports is totally influential in the exports, and it is not difficult to conclude that it depends on the big amount of goods that China produce every year.

| Port Name | 2011 | 2012 | Preliminary figures for 2013 | Percentage change 2012-2011 | Percentage change 2013 -2012 |
|-------------------|-------------|-------------|------------------------------|-----------------------------|------------------------------|
| Shanghai | 31 700 000 | 32 529 000 | 36 617 000 | 2.62 | 12.57 |
| Singapore | 29 937 700 | 31 649 400 | 32 600 000 | 5.72 | 3.00 |
| Shenzhen | 22 569 800 | 22 940 130 | 23 279 000 | 1.64 | 1.48 |
| Hong Kong (China) | 24 384 000 | 23 117 000 | 22 352 000 | -5.20 | -3.31 |
| Busan | 16 184 706 | 17 046 177 | 17 686 000 | 5.32 | 3.75 |
| Ningbo | 14 686 200 | 15 670 000 | 17 351 000 | 6.70 | 10.73 |
| Qingdao | 13 020 000 | 14 503 000 | 15 520 000 | 11.39 | 7.01 |
| Guangzhou | 14 400 000 | 14 743 600 | 15 309 000 | 2.39 | 3.83 |
| Dubai | 13 000 000 | 13 270 000 | 13 641 000 | 2.08 | 2.80 |
| Tianjin | 11 500 000 | 12 300 000 | 13 000 000 | 6.96 | 5.69 |
| Rotterdam | 11 876 921 | 11 865 916 | 11 621 000 | -0.09 | -2.06 |
| Port Klang | 9 603 926 | 10 001 495 | 10 350 000 | 4.14 | 3.48 |
| Dalian | 6 400 000 | 8 064 000 | 10 015 000 | 26.00 | 24.19 |
| Kaohsiung | 9 636 289 | 9 781 221 | 9 938 000 | 1.50 | 1.60 |
| Hamburg | 9 014 165 | 8 863 896 | 9 258 000 | -1.67 | 4.45 |
| Long Beach | 6 061 099 | 6 045 662 | 8 730 000 | -0.25 | 44.40 |
| Antwerp | 8 664 243 | 8 635 169 | 8 578 000 | -0.34 | -0.66 |
| Xiamen | 6 460 700 | 7 201 700 | 8 008 000 | 11.47 | 11.20 |
| Los Angeles | 7 940 511 | 8 077 714 | 7 869 000 | 1.73 | -2.58 |
| Tanjung Pelepas | 7 500 000 | 7 700 000 | 7 628 000 | 2.67 | -0.94 |
| Total top 20 | 274 540 260 | 284 005 080 | 299 350 000 | 3.45 | 5.40 |

Table 1. Top 20 container terminals for 2011-2013 – Source: UNCTAD Review of Maritime Transport 2014.

Another perfect example to comment and much closer to Barcelona is the case of Algeciras. Algeciras is located in the strait of Gibraltar, letting all the traffic going through it (Illustration 1) to do transshipment or discharge the containers without the need of modifying the route if their destination is the American continent (Brazil, USA...), West Africa (Ivory Coast, Ghana...) or North Europe (Rotterdam, Ambers, Hamburg...). That's why the port of Algeciras is one of the top ten ports if we talk about transshipments.

That happens because the strategic place it is located, making lots of companies the decision of creating routes that stops in Algeciras in order to do the transshipments commented above and reducing sailing time avoiding ports like Marseille, Barcelona or Genoa.

It is important to remark the competitiveness that is growing constantly between Algeciras and Tangier (both are owned by Maersk, which has the complete monopoly of the business in the strait of Gibraltar).



Illustration 1. Vessels through Strait of Gibraltar 10/03/2015 18.00h – Source: www.marinetraffic.com

1.3.2 Variable factors

We are going to comment the most important variable factors that can make a port increase or decrease the cargo that they move. All ports must take those factors into consideration because it is the way to detect the strengths and weaknesses so as to improve their strategy.

Infrastructural factor

Probably it is a factor that can affect directly to the amount of traffic moved. When we talk about the term “infrastructural” we should specify in order not to get confused.

The principal aspect we must comment is the dock and the cranes. A port is an area where ships can shelter with the aim of loading or discharging the goods that they are transporting. It is not difficult to remark that as bigger the dock is, more vessels can be berthed at the same time being a direct factor of the number of vessels discharging. Therefore, if a port is not big enough or has a limitation of space (if we talk about the sea side) it will not be able to grow for

absorbing more routes that it already has. Moreover, it's important to have good marine accesses to be capable of receiving vessels of any type and any size.

As commented, the cranes are another important aspect. Nowadays vessels are continuously growing in length, beam and draft forcing all ports over the world to modify not only their accesses to the port (and capacity) but also the size of the cranes used. It is a way for shipping owners to reduce costs applying as much as they can scale economies (reducing the cost per container) and only stopping in the biggest ports, using a Hub & Spoke system (feeders are in charge of distributing the containers to smaller ports). At this moment, the largest container vessels are the Triple E class (Illustration 2) produced by Maersk and working since 2013 and it is believed that in the near future we will arrive to 487 meters in length (UNCTAD. Review of Marine Transport, 2014).

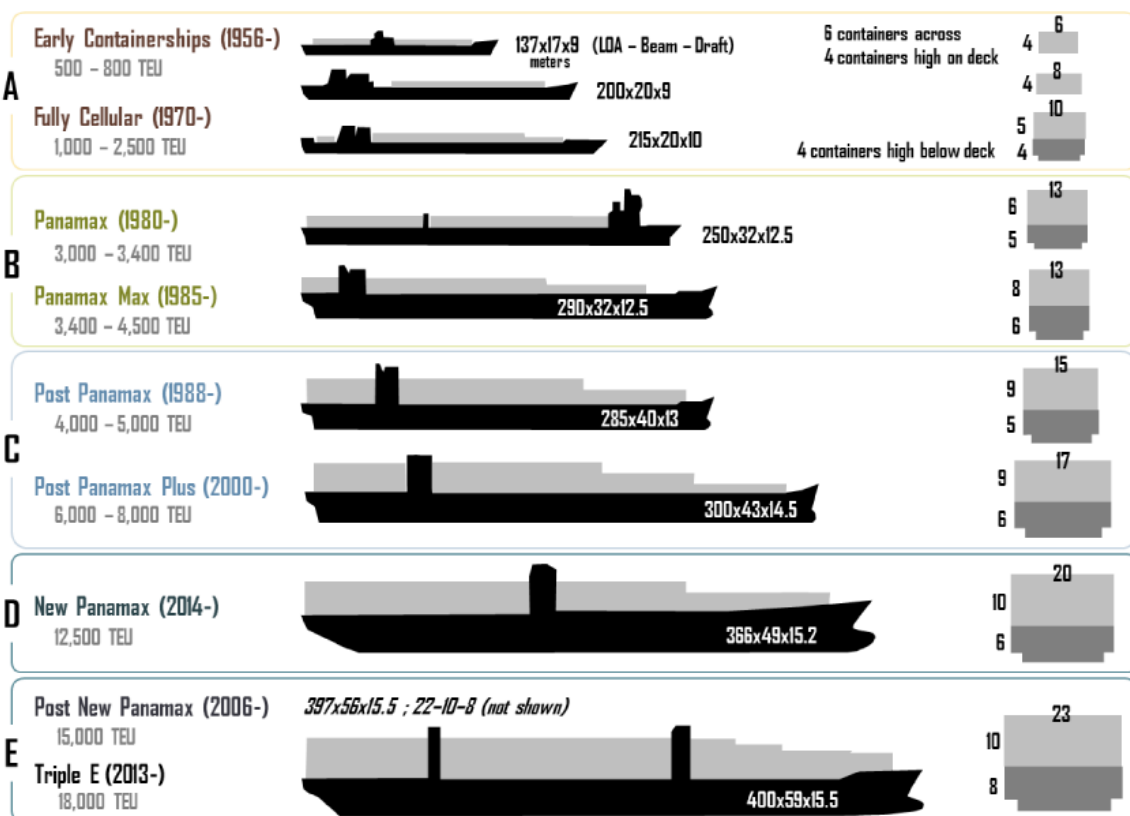


Illustration 2. Evolution of container ships (in meters) – Source: Ashar and Rodrigue, 2012

Another aspect to comment is the inland access to the port for trucks and rails. A perfect access must be big enough for not having congestion in the gates of the port and to avoid collapse of the cargo. This feature is very important because of the time that the cargo spend entering or leaving the port that can suppose a decisive factor for the consignee when they need to decide to receive the cargo in one port or another (if those are very closed). We should also take into consideration that we don't only refer to roads, because having an efficient entrance system (IT

systems) is very important to reduce the time that the driver needs to wait before entering into the terminal.

We must conclude that variable factor by saying that the competence between all ports of the world is making all terminals to adapt their infrastructure in order to be capable of attracting as much companies as they can and in the time coming is likely to happen that many terminals have overcapacity produced by the aim of attracting the traffic (Julián Maganto López. *El papel de Puertos del Estado en el sistema portuario español. La planificación portuaria impulsora del desarrollo.* Santiago, Chile, April 2008).

Operations and productivity

The berthing time of a vessel is a factor that the companies must take into account for reducing their operational costs. It is important for them to be berthed the less possible time because every hour can suppose thousands of Euros (or Dollars) and if the berthing time is quicker than expected they can reduce the speed of the vessel until the arrival to next port, decreasing the consumption of the vessel (once again, reducing costs).

For this reason it is indispensable for a terminal to have good berth productivity, moving efficiently the containers through the yard and loading them as fast as they can. The levels of productivity have grown in the last years due to the invention of the semi-automated terminals (Terminal BEST from Barcelona that will be commented when talking about the Port of Barcelona) and fully-automated terminals (a good example is the Container Terminal Altenwerder, located in Hamburg and operated by HLHLA¹). Those terminals have the main advantage that they do not need to spend lots of money in workers and the main disadvantage is that it requires an initial big investment.

The most productive terminal in the world is APM Terminals Yokohama, located in Yokohama (Japan), which in 2013 has a productivity of 163 container moves per ship and per hour. In Europe, the top-performing terminal in 2013 was a semi-automated terminal, Euromax Terminal Rotterdam, located in Rotterdam (Netherlands) that has a productivity of 100 container moves per ship and per hour².

¹ Hamburg Hafen und Logistik AG

² <http://unctadstat.unctad.org/>

Port services

Another aspect to consider when studying the factors of the different ports is the speed of all administrative issues that must be done by the shipper, consignee or even the ship agent. It probably is not a decisive factor when choosing the port where to stop but it is something that can determine the efficiency of the people working there.

To have a good quality service is important to invest some money in the training of the staff and the mentality should always be focused on the client (in that chase the client always will be the ship owner/ship agent).

Link port-city

It is not an important factor but we need to comment that ports have changed a lot in the last years. In the past, ports were an independent service of the city that where only linked because of the proximity of them. Whereas, nowadays the ports have become logistic' nodes that are completely related to the city. We have seen that many ports now have all type of services: from a logistics' zone to consolidation of goods.

Hinterland and Foreland

When talking about increasing the traffic of a port it is essential to explain the terms of hinterland and foreland. Surely those terms are not direct factors but they are completely associated with all real factors commented above and we must understand the meaning with the aim of analyzing the case of the Port of Barcelona in the following chapters.

Foreland is a concept related to the different seaside areas where a port is able to arrive thanks to the maritime connections to other ports, the whole areas that the imports are attracted and the exports are delivered.

More important is the analysis of the Hinterland, which refers to the inland area behind the port that is connected with it. Then, we can describe it as the area from which products are delivered in order to be loaded (to be distributed in the Foreland of the port) and where the imports are finally delivered. It is very important for a port to ensure that its hinterland is as bigger as possible in order to cover the maximum region and to compete against all closest ports.

It is for that reason that the connections between the port and all inland area must be efficient enough to reduce congestions by road and to reduce pollution. As commented in "Infrastructural factors" the connections can be made in many ways but possibly the best one is to have a competent railway network to avoid big amounts of trucks entering the port at the same time and to promote the reduction of emissions or the consumption of very pollutant fuels. In Illustration 3 we can see all the hinterland areas of US that have the feature of having

rivers where barges are used to transport containers from one place to another (mostly in the Mississippi area).

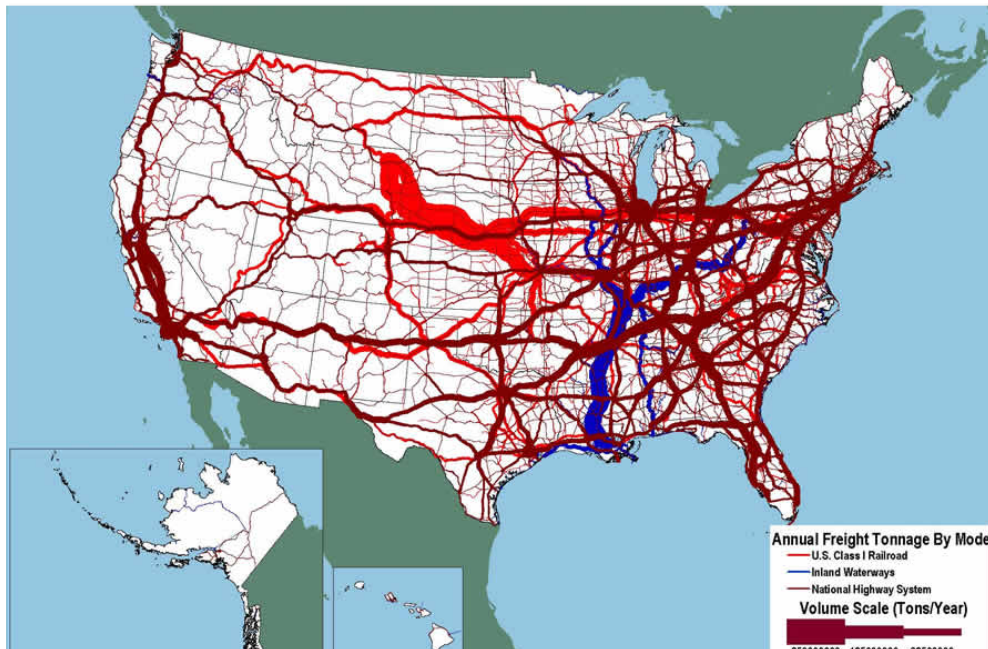


Illustration 3. Tonnage on Highways , Railroads & Inland waterways 2002 – Source: US Department of Transportation

The state authorities of the developed countries have paid special attention to all inland networks because of the factors commented above and the fact that transporting containers by railway can suppose a reduction of the price if we consider the scale economy. If we use the railway for the inland transportation we can increase our savings³:

-Maritime 4 € / 1000 mt x Km.

-Rail 12 € / 1000 mt x Km.

-Road 24 € / 1000 mt x Km.

³ Source: Marco Polo I program ruling proposal.

Chapter 2. Port of Barcelona

During the chapter focused on the Port of Barcelona, it will be described the main features of the port. Port of Barcelona is the main port of Catalonia and the one of the city of our Faculty. That is why it will be explained the actual scenario and the different characteristics that have made the port become important in the Mediterranean but still far from the leaders in Europe.

For that reason, it will be commented the different traffics that Port of Barcelona moved during the last years in order to observe why it is in the actual situation and the future strategies that is going to implement with the aim of increasing its traffic and its foreland, and to know where it will be in the near future.

2.1 Actual scenario (Source: Port de Barcelona. *Press dossier January, 2015*)

The PoB⁴ is Catalonia's gateway and one of the most important ports in Europe. The area of influence extents through the south and centre of Europe and North Africa with more than 100 regular shipping lines enabling Barcelona connect with 300 ports around the five continents. PoB is specialized in general cargo and high value added cargo (vehicles, consumer goods, electronic products...).

It is obvious that the port is very linked not only to the city of Barcelona but also to Catalonia. Nowadays, Catalonia has 7.5 million inhabitants (16% of the Spanish population) and generates 19% of the Spanish GDP.

We can summarize the power of Barcelona with the following details:

- It provides 32.000 jobs.
- 77% of Catalonia's economic activity sectors are customers of the Port.
- 27% of the national maritime trade is carried by PoB and the 77% of all trade from Catalonia.
- In 2013 the PoB moved goods worth in EUR 52 billion.

⁴ Port of Barcelona

Despite we are going to focus our work only on transport of goods (lately commented accurately), we can describe PoB as a five-in-one port:

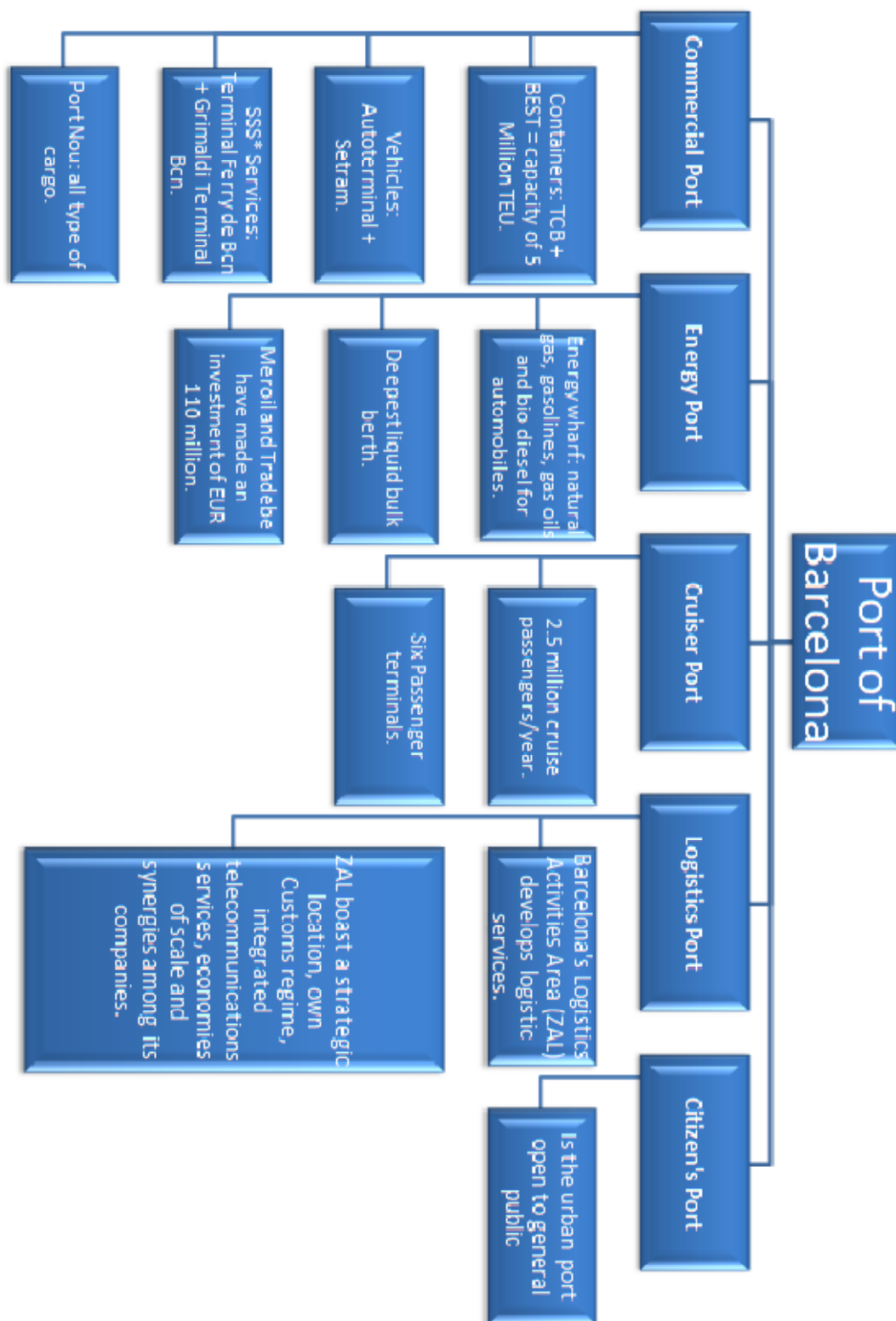


Figure 1. PoB five-in-one port. (*SSS: Short Sea shipping)

To have a general overview of how terminals in Barcelona are displayed in order to understand how PoB works. The following map shows us all types of cargoes that are in PoB:



Illustration 4. Map of PoB

- 1- Barcelona South Terminal (BEST).
- 2- Vehicle Terminals (Autoterminal & Setram).
- 3- Liquified Bulk Terminals (Terminal Enagas, Meroil, Relisa, TEPSA...).
- 4- Terminal Catalunya.
- 5- Solid Bulk Cargo (Terminales Portcemen, Cemex España, Engransa, Cargil España...).
- 6- Coffee, Fruit & Cocoa (BIT, Molenbergntatie, Pacorini...).
- 7- Terminal de Contenidors de Barelona (TCB).
- 8- Cruises.

2.1.1 Characteristics of main container terminals (only the most important ones)

2.1.1.1 Container Terminals

- Barcelona Europe South Terminal (BEST) is the leading terminal in Barcelona concerning containerized traffic. It is the first semi-automated container terminal developed by HPH since 2012, the second global terminal operator worldwide in charge of terminals in Rotterdam, Felixstowe, Honk Kong, Shanghai, Busan, Port Klang, Karachi, Dammam and many others (52 ports in total).

Nowadays, BEST has 11 super post-Panamax quay cranes, 36 automatic stacking cranes and 26 straddle carriers operating along 1.000m berth with a maximum draft of 16.5m. The new technology implemented by HPH let the terminal to increase the productivity rate when operating various vessels at the same time thanks to the semi-automated system that BEST has.

The system lets to provide the customers with a productivity of more than 220 per hour and an average Gross Crane Rate of 40 moves/hour. In addition, it has connections by road and eight-track railway facilities in order to connect Barcelona with inland Europe.

For the near future, the terminal is intended to grow and a new expansion is being built. The next phase is scheduled to be fully operational during 2015 and will increase the berthing length to 1.500m approximately.

| | Today | 2015 | End Phase 1 |
|------------------|---------|---------|-------------|
| Quay (m) | 1000 | 1500 | 1500 |
| Depth (m) | 16-16.5 | 16-16.5 | 16-15.5 |
| Area (ha) | 60 | 79 | 100 |
| Blocks | 18 | 27 | 40 |
| Quay Crane | 11 | 11 | 18 |
| ASC | 36 | 54 | 80 |
| Shuttle Carriers | 26 | 30 | 45 |
| RMG | 2 | 2 | 4 |
| Reefer Plugs | 1200 | 1700 | 2500 |
| Rail (m) | 750 | 750 | 750 |

Table 2. Characteristics of Port of Barcelona. – Source: www.best.com.es

- Terminal de Contenedors de Barcelona (TCB) is the second terminal of Barcelona in terms of container traffic. It is operating since 1972 and today it has 1.380m of berthing line and 16m of draft. TCB is able to operate with 8 super post-Panamax cranes and 6 Panamax. Moreover, TCB has 64 straddle carriers, 2 Reach Stackers and other vehicles like 9 Empty Container Forklifts.
The big investment done in BEST by HPH has delayed TCB in the growth of infrastructures and now is positioned behind the adjacent terminal.

2.1.1.2 Main Liquid Bulk Terminals

- Relisa is a terminal specialized in vegetal oils but also in other types of liquid bulk and biofuels. In their facilities, they have tankers recovered with the suitable materials for that type of products. They have 3 different wharfs with 11 meters of draught and 180 meters in length (capacity to discharge between 300 and 700 m³/h).

2.1.1.3 Main Dry Bulk Terminals

- Portcemen terminal is the most important one in the field of clinker and cement. As we will see, those products have an essential role in dry bulk traffic for the PoB. The terminal is focused on the import/export of the products in Catalonia and only about the 5% is distributed to other regions. Nowadays, it moves per year from 500.000 tons to 1 million tons.

2.1.2.4 Vehicle Terminals

- Autoterminal is the most important terminal regarding to cars, trucks and train carriers, being built in 1991 for that purpose and having a concession until the year 2020. That type of traffic needs to have big spaces in order to have multi-storey car park. That's why the terminal has a surface of about 820.000m² and the 44% is covered by car park areas having a capacity of 45.000 vehicles (being only covered the half of the total capacity). With respect to the berthing area, it has 1.210m berthing with a capacity for five vessels, two transoceanic and three ferries, 4 train terminals and 4 Ro-Ro ramps.
- Setram is the other main terminal of vehicles located in the Port of Barcelona and it is working since 1988 thanks to a concession. About technical specifications, it has a surface of 250.000m² with 1.210 metres of berthing line that allow the berthing of 6 vessels maximum at the same time. It also has 4 Ro-Ro ramps for the vehicles and 4 rail terminals. It is able to handle traffic of more than 200.000 vehicles per year.

2.2 Main features of the port⁵

2.2.1 Geographical Location

Barcelona is not located in a strategic place regarding to the typical traffic of vessels. It is a port between the Mediterranean and Europe, not far away from the strait of Gibraltar and the closest Spanish port that can be connected with central Europe through France.

The most important point of the location of Barcelona, apart from the already commented, is the easy access to Asia/Middle East thanks to the Suez Canal that let a vessel from Barcelona arrives to Shanghai (China) with a transit time of approximately 30 days. In addition, Barcelona is connected to America through the Strait of Gibraltar, having a transit time to Sao Paulo (Brazil) of 30 days and to New York (USA) of 11 days approximately.

Other factors to take into account are the following (Illustration 5):

- a) It is one of the closest ports to Balearic Islands and has become the principal gate of entrance not only for passengers but also for goods. On summer the sailing frequency of the vessels is higher because more Ro-Ro Ships are displayed due to the increase of tourism to the islands.
- b) The high amount of cargo that Barcelona can move is very important for all North Spain exports and imports that need to be loaded. Barcelona is connected by rail in order to be the reference port of the north Spanish factories.
- c) The proximity to Italy is a clear advantage to the truck transport that needs to spend more time in transit due to the location of both countries. A Short Sea Shipping route can be established in order to reduce pollution, congestion and transit time.
- d) As in “section b”, the proximity to the North of Africa is an advantage that we must take into consideration. Barcelona, thanks to the geographical location, could be the connection between all central Europe (by Rail) and the African continent (by Ship).

⁵ Source: Vídeo corporatiu del Port de Barcelona 2014 (<https://www.youtube.com/watch?v=B4Lk9nDJXuk>)



Illustration 5. Port of Barcelona, Geographical Location.

It is important not to forget the most important ports that are surrounding Barcelona and are clearly competitors in terms of maritime traffic. The main ports that we need to comment (Chapter 3) are Valencia (proximity and same country), Marseille (proximity) and when talking about the leader in Europe, Rotterdam.

2.2.2 Infrastructural factor

As already commented Barcelona has a good infrastructure to be able to compete with other ports of Europe or the Mediterranean. BEST is leading the process of change in the terminals worldwide and new systems are needed to be implemented in order to reduce costs with automated vehicles and new information systems.

2.2.3 Operations and productivity

Barcelona has become one of the most important European ports in terms of berth productivity, a very important factor for a shipping company in order to reduce costs when defining their inter-oceanic routes.

The Journal of Commerce (JOC) produces a report every year in which is studied the berth productivity worldwide (counted in TEU⁶ movements per hour)⁷. In 2014 Barcelona became the third most productive port in Europe only behind Bremerhaven (Germany) and Rotterdam (Netherlands). Moreover, it is the first time that a Southern Europe port is positioned among the top three European ports and has become the most productive Gateway Port in the Mediterranean. That situation has become possible thanks to the investments done in the last years: BEST⁸, which is managed by the group HPH⁹, has invested more than 500 million Euros to lead the most advanced semi-automated installation in the Mediterranean. In addition, TCB¹⁰ has incorporated an automated terminal gate system that speeds up the entry and exit of trucks by 30%.

In 2014 the Port of Barcelona had an average of 78 movements per hour, a big difference comparing to 2012 that was able to perform only 41 movements per hour. Despite having an excellent berth productivity comparing to last years, it is important to take into consideration that is still very far from the top ports (located most of them in Asia). Tianjin (China) is the leading port in berth productivity: 130 container moves per hour in 2013.

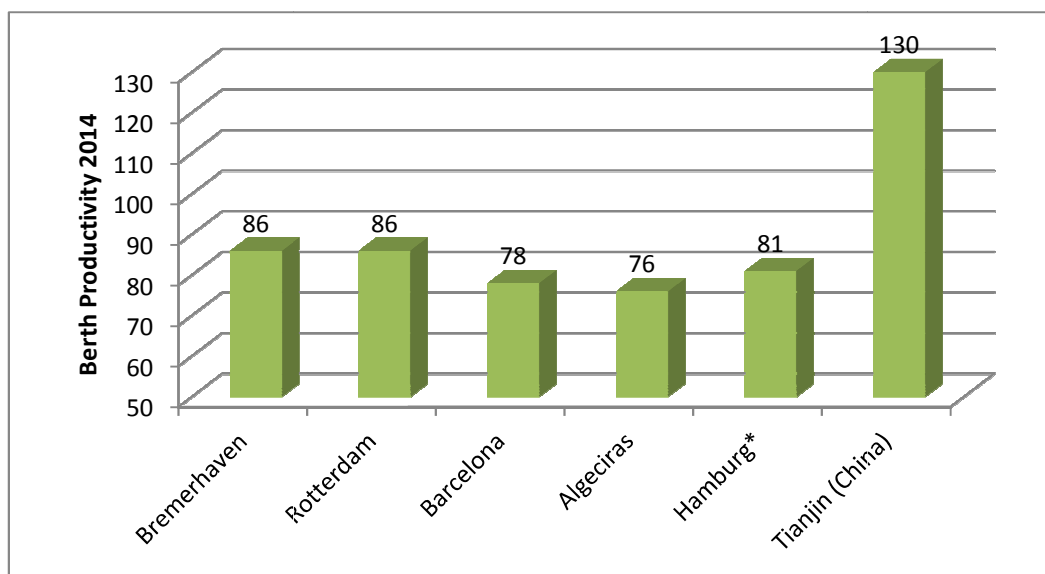


Table 3. Top European ports (berth productivity) and Tianjin.

*For Hamburg it is considered the EUROGATE Container Terminal Hamburg (CTH), not all the port.

⁶ Twenty-Foot Equivalent Unit

⁷ Source: JOC. Port productivity [on line].

⁸ Barcelona Europe South Terminal

⁹ Hutchison Port Holding

¹⁰ Terminal de Contenidors de Barcelona

2.2.4 Port services

It is not easy to evaluate this factor considering that the information that I can manage is limited and I have to evaluate it in a subjective view thanks to my internship that I developed in United Arab Shipping Company (UASC). From my point of view, the speed of the different procedures that need to be done when arriving or leaving the PoB is something fast.

In addition, we need to take into account that thanks to the standardization of the goods' clearance process in the EU¹¹ the speed has increased and the ease of the procedures have contributed a lot to make possible a faster dispatching.

2.2.5 Link port-city

We need to comment that the Port of Barcelona is very linked to the city due to its proximity and the preceding importance during lots of years. In the past, the port was the main gate for Barcelona and it enabled the region to be a very important point of trade and exchange of goods.

During the years it has changed a lot and apart from being the gate for the goods that are entering or leaving the region, any decision that the ports makes can affect directly to the inhabitants living in Barcelona or its surroundings. As we will talk later, the problem that Port of Barcelona has is that the proximity makes that all the pollution that is being produced in the ports because of the operation or the ships are affecting in a bad way to the different people, including the workers of the surroundings.

2.2.6 Foreland

Nowadays, all top ports in the world are intended to have connections with all other most important ports of all continents. The Port of Barcelona is not an exception and it has many ship owners operating in Barcelona that are able to connect the transport from China to USA. In 2012, it has more than 45 regular lines (Illustration 6) every week between the main ports and Barcelona was connected with 825 ports worldwide.

¹¹ European Union

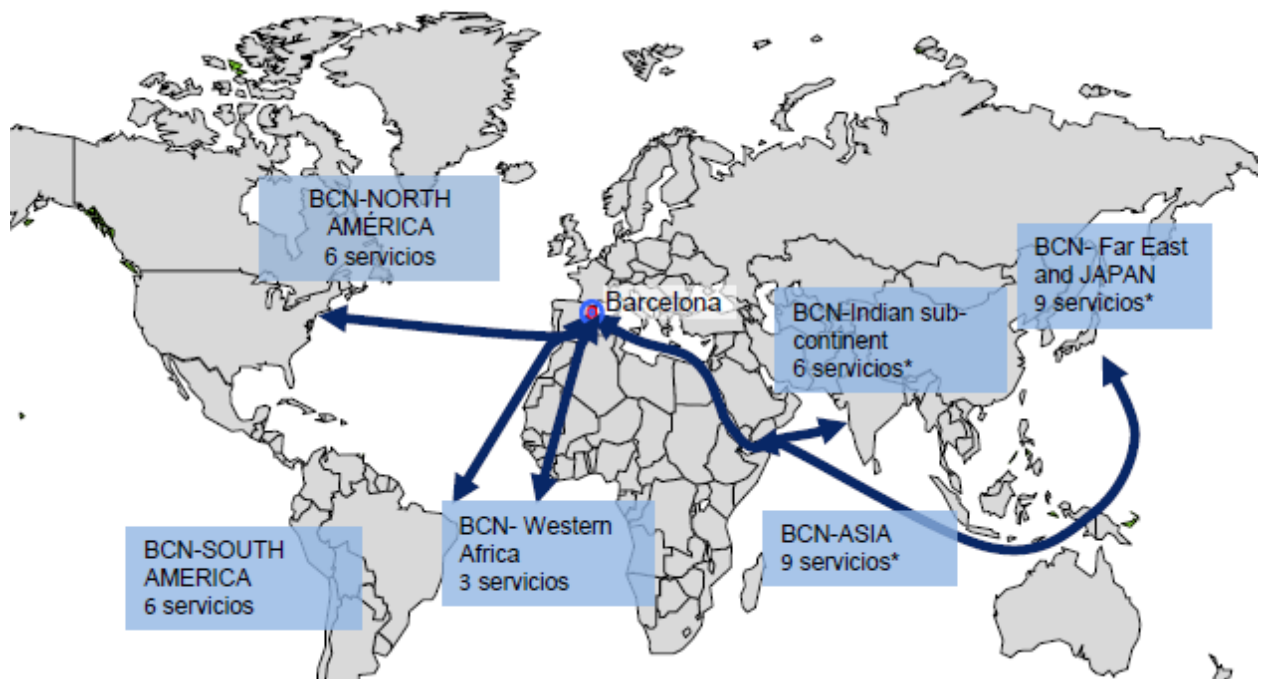


Illustration 6. The Port of Barcelona Regular Lines 2011.

Source: El Port de Barcelona: una organización al servicio del exportador.

It is important not to forget the Feeder services and the SSS routes that Barcelona provides. Maybe the benefits of those routes are not as high as the regular lines, but it is important for the port to have it in order to arrive to the closest ports and to provide a complete service to their customers.

2.2.7 Motorways of the Sea & SSS

Short Sea Shipping is said to be one of the most sustainable and economically competitive mode of transport due to the small consumption of fuel if we consider the amount of cargo that a vessel can carry comparing to a truck. Moreover, it is a mean of transport that is coming more important because of the big amounts of financial funds that the EU is giving to companies in order to reduce congestion in roads and the environmental impact.

The Port of Barcelona can offer a competitive freight comparing to the road transport and is able to cope with the times of loading/unloading expected as a result of the investments done in port facilities. Additionally, the strategic location of Barcelona has driven the Port Authority of Barcelona to bet for efficient loading and unloading areas dedicated to that important mode of transport.

Barcelona has now daily services linking the second most important port of the Mediterranean with destinations such as Genoa, Civitavecchia (Rome), Livorno, Savona, Porto Torres, Tangier and Tunis. Those connections are helping to take over 100.000 trucks off the road each year.

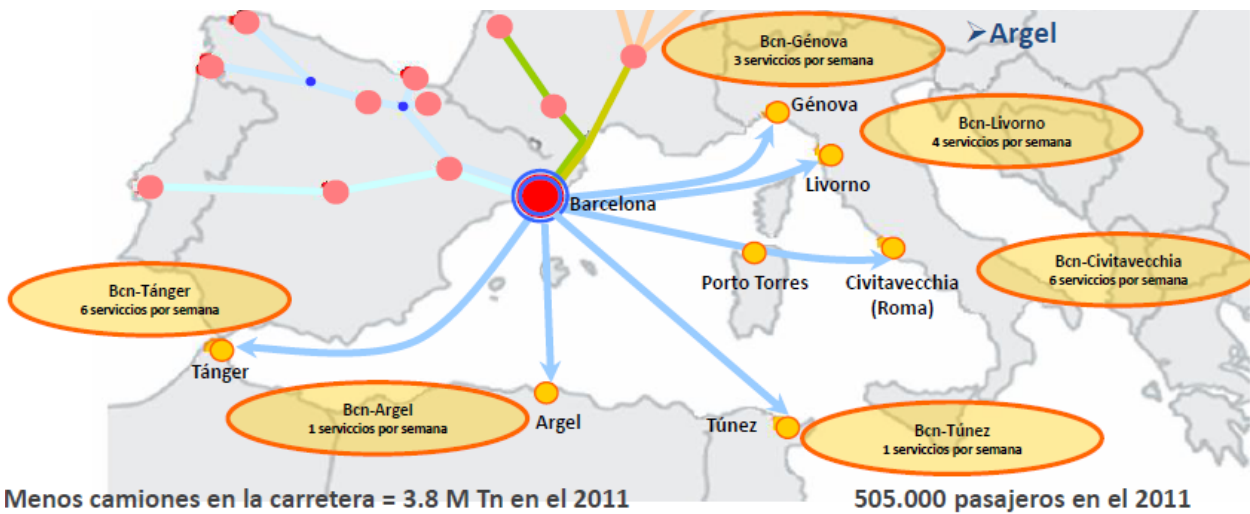


Illustration 7. SSS Services. – Source: El Port de Barcelona: una organización al servicio del exportador.

Another important matter to comment in order to understand properly the organization of the PoB is the feeder lines. In Illustration 8 we can see that Barcelona has lots of connections with lots of small ports. It is essential for Barcelona to have different feeder routes in order to distribute all cargo that arrives. When containers arrive to the Port of Barcelona, it is acting as a Hub, and the distribution to the spoke ports must be done with smaller vessels (small ports implies small draught and infrastructures).



Illustration 8. Feeder Lines – Source; El Port de Barcelona: una organización al servicio del exportador.

2.3 Hinterland¹²

Barcelona has one of the leading port authorities in the progress of the hinterland's development strategy and a network of inland rail nodes. Having a good hinterland lets Barcelona to have an additional amount of cargo that is picked up or delivered not only in the Iberian Peninsula but also in France. The situation of the last years is the following:

1. APB¹³ invested in port marketing in the hinterland. The strategy they made is to locate some port representatives around Spain and France (Toulouse and Lyon) to promote Barcelona providing information and acting as a Customer Service department. These investments provide APB with knowledge about bottlenecks in freight flows between the ports and the different hinterland locations.
2. APB invests in logistic facilities like container depots, rail terminals and logistics zones (ZAL¹⁴ in the case of Barcelona). The main problem was that companies were reluctant to invest money because of the risk and APB finally made the decision of investing in order to let the port grown. The investments have changed the concept of APB and the inland terminal development is driven from the sea.
3. In order to culminate the strategy, APB invested in new rail shuttles. The main problem of Spain is that the Iberian gauge of railways has a width of 1688mm (the European width is 1435mm). The change of the width is an urgent matter for being able to Import/Export goods between Europe and to contribute to a modal shift from road to rail. In addition, the focus on intermodal transport increases the competitiveness of the port and attracts the shipping lines due to the larger hinterland that can be reached.
4. In 2008, APB and Naviland Cargo (a subsidiary of France's national state-owned railway company SNCF) signed an agreement in which a new connection from Lyon to Barcelona by railway could be possible. That opportunity was an important change for Barcelona that could have a non-traditional new hinterland not connected before. The keys of the success were the satisfying costs, transit time, frequency and reliability.

¹² Source: Roy Van den Berg; Peter W. De Langen; Carles Rúa Costa. The role of port authorities in new intermodal service development; the case of Barcelona Port Authority. *Research in Transportation Business & Management* 5, 2012, p. 78-84

¹³ Autoritat Portuària de Barcelona // Barcelona's Port Authority

¹⁴ Zona d'Activitats Logístiques

The big problem, as commented in the paragraph 3, was that none of the companies were interested in the investment due to the barrier of having different rail width between Spain and France. Therefore, APB concluded that it was urgent for the growth of the port to solve the problem. In the end, APB (in cooperation with Contren and Naviland Cargo) invests money in the project in order to avoid bottlenecks and to connect the Port of Barcelona easily with the rest of Europe. During the first three years they received funding from the European Union for shifting transport from road to rail.

We must not forget that Lyon, thanks to the geographical location, is able to connect with some other important areas not only from France but also from central and north Europe and can be a strategic hinterland location for Barcelona. In Table 4 we can see the connections between Lyon and some other ports, including the competitive position of Barcelona.

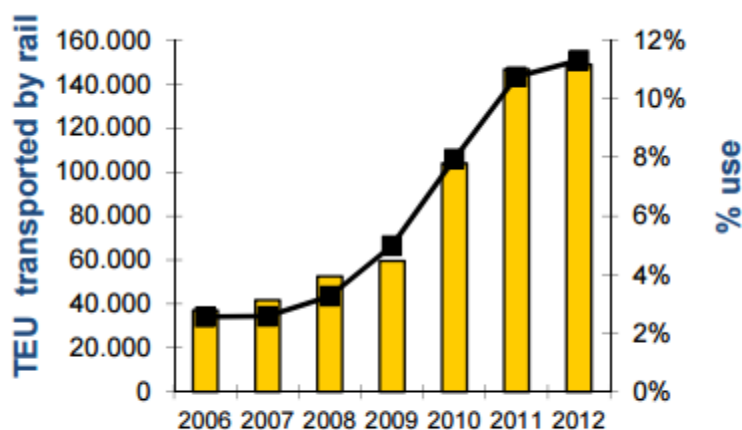
Competitive position of Barcelona (January 2012, sources website Naviland Cargo, Rail Link Europe, port of Marseille, port of Antwerp, and port of Le Havre).

| Port | Marseille | Antwerp | Le Havre | Barcelona |
|-------------------------------|------------------------------------|------------------------------------|------------------------------------|----------------|
| Distance to Lyon (km) | 300 | 750 | 650 | 600 |
| # weekly connections by rail | 13 | 8 | 8 | 3 |
| # weekly connections by barge | 5 | – | – | – |
| Logistics service providers | Naviland Cargo Rail Link Europe | Naviland Cargo Rail Link Europe | Naviland Cargo Rail Link Europe | Naviland Cargo |
| Terminal | Lyon Terminal | Vénissieux | Lyon Terminal | Vénissieux |

Table 4. Competitive position of Barcelona – Source: The role of port authorities in new intermodal service development; the case of Barcelona Port Authority.

After APB made some investments in the last years with respect to railways and intermodality, Barcelona has grown the railway traffic significantly, achieving an 8% of the containers transported by rail in 2010 (Table 5) and almost 12% in 2014¹⁵. The goal for the next years is to transport about 23% of the traffic by railway.

¹⁵ Source: Europapress. El tráfico ferroviario de contenedores de Puerto de Barcelona supera el de 2013.



From 2.6%(2006) to 11.3%(2012) Objective: 23%

Table 5. Evolution of the rail market share in the Port of Barcelona (2006-2012). – Source: Oferta ferroviaria en el Port de Barcelona.

In this age, the Port of Barcelona has four different main corridors that are connecting all the hinterland of the port by rail (Illustration 7):

- a) Transversal Iberia Corridor: It connects Barcelona – Zaragoza – Madrid - Lisbon and is the main corridor of the port. It moves around 72% of all port traffic by rail¹⁶. The reason of such traffic is the big amount of cargo that needs to be exported or imported from the capital of Spain, the main area of industry apart from Catalonia. Furthermore, Zaragoza acts as a hub of Mercamadrid and Mercazaragoza due to its location.
- b) Ebro Corridor: It connects Barcelona – Zaragoza - Pamplona – Burgos. Despite Port of Bilbao is much closer to those cities, it is not able to allow big vessels of the actual shipping companies and they don't stop in Bilbao. That is why the best network is Barcelona and it makes PoB the main port from/to the north of Spain. Much of the commodities exported are food and the corridor moves around 26% of the traffic by rail.
- c) South of France corridor: It connects Barcelona – Toulouse – Bordeaux. In spite of being the main corridor to France only 2% of the traffic by rail is international trade.

¹⁶ Source: Rail strategy of the Port of Barcelona, Port de Barcelona. 2013.

- d) European corridor: It connects Barcelona – Lyon – Metz and was created in 2008 as commented above.



Illustration 7. Hinterland network of Barcelona – Source: The role of port authorities in new intermodal service development; the case of Barcelona Port Authority.

In any case, we should remind that the hinterland of the port is not only the connections by rail and roads must be taken into consideration. Barcelona is not a bad connected city if we talk about roads and the Port of Barcelona is easily connected to all roads from Spain and has a highway connecting France.

2.3.1 Strategic facilities in the hinterland

The Port of Barcelona (PoB) has insisted on being located in strategic places around all its hinterland. Having the following main inland terminals, the PoB serves customers located throughout the entire hinterland and can let operators and shippers to improve their logistic chain.

- A) The Zaragoza Goods Terminal (mtZ): one of the most important and the oldest one. It was created in 2001 with the goal of being a platform of all importers/exporters that are located in Aragon, Navarra and La Rioja. These days, mtZ has become a hub and is acting as a waypoint to the centre of the Iberian Peninsula, moving over 100.000 TEUs thanks to the availability of its own rail facilities.

- B) Dry ports of Coslada in Madrid, Azuqueca de Henares and Yunquera de Henares in Guadalajara – Terminal Marítima Centro (mtC): the base to attract traffic located in the Autonomous Community of Madrid, one of the major centres of industry in all Spain. PoB has recently become one of the main shareholders (49% of the stake) of Terminal Intermodal Marítima Centro, S.L.
- C) The Navarre Intermodal Terminal: located in Noain (Pamplona) and working since February 2013 with regular rail services managed by BEST. It is also a strategic place of cargoes from/to the north of Spain.
- D) The Tolouse Goods Terminal (mtT): Located in order to satisfy customer from the north of the Pyrenees and to be a service platform in the south of France since 2010. The main goal is to export and import all international maritime trade of the region via the PoB.
- E) Perpignan St Charles Conteneur Terminal (PSCCT): main logistics and distribution centre for fresh cargo from southern Europe located in Perpignan. It is a principal hub of perishable cargo.

2.4 Diversity of traffics

As commented before, the Port of Barcelona is the third most important Port of Spain in terms of container traffic, what is different to bulk traffic.

2.4.1 Containerized traffic

Barcelona has the best terminals to be capable of moving lots of containers each year, arriving to the number of 1.893.299 TEUs moved in 2014 (Figure 2), 9.9% more than in 2013. The best advantage of Barcelona is the high added value goods that are being moved that lets Barcelona to have big benefits. All that benefits are achieved because of the reduced amount of containers that arrives to Barcelona for transshipment (only 16.5% of the containers in 2014). In contrast, 42.3% of the containers were loaded and 41.2% were discharged in Barcelona as port of destination. Therefore, Barcelona is not only an importer but also a very important exporter as the statistics reveals.

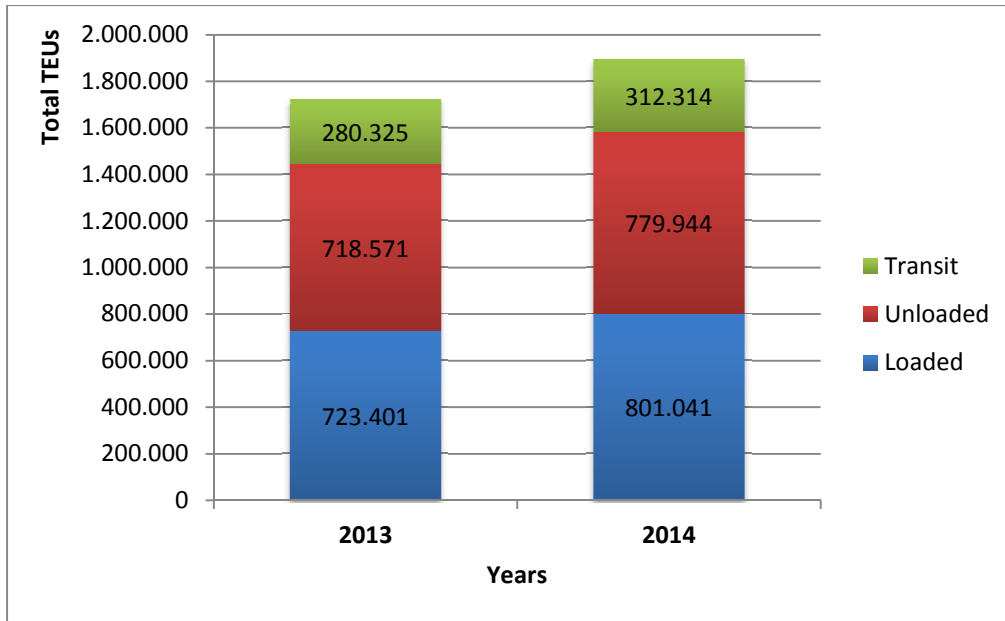


Figure 2. General cargo distribution by operation (TEU)¹⁷

If we talk about the goods that are exported, Chemical Products are the most exported commodity with more than 1.9 millions of tons in 2014 (11.9% of increase from 2013), followed by “Paper and pulp” (1M mt in 2014), “Feedstuff and fodder” (1M mt in 2014) and “Other food products” (563mt in 2014). On the one hand, the main commodity that has increased most in percentage in 2014 (exports) are “Fruits, Vegetables and pulses” that with an increase of 44.8% has arrived to export 83mt in 2014. On the other hand, the main commodity that has decreased most in percentage (exports) are “Iron and steel products” that in 2014 were exported 220mt (28.7% less than 2013).

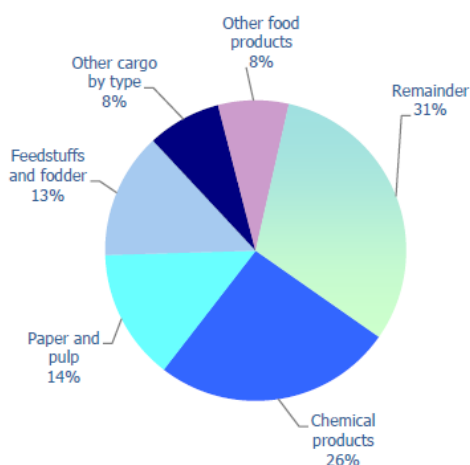


Figure 4. Distribution of main goods. Loaded in 2014.

Source: Port of Barcelona traffic statics 2014.

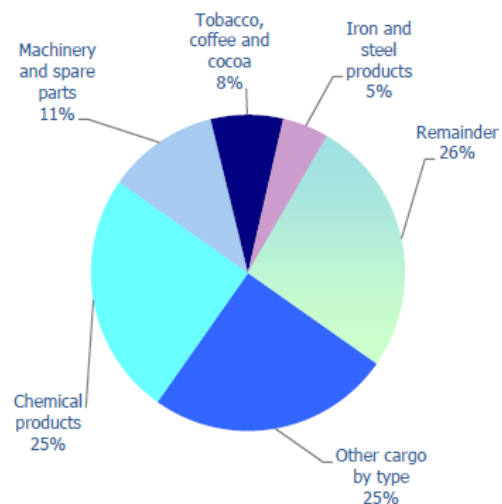


Figure 3. Distribution of main goods. Unloaded in 2014.

Source: Port of Barcelona traffic statics 2014.

¹⁷ Data extracted from PoB statics.

Another important fact to comment is the different zones around the world where the exports are distributed and where the imports are collected. It is very important in order to know which is the main market not only of the port but also of the country.

In the case of Barcelona is important to differentiate between exports and imports. The principal area of origin of the goods is the Far East and Japan with 342.451 full TEU non transit, 29.6% of all exports/imports from PoB. It is obvious that China is in charge of most of the products that are imported to Europe and is one of the main manufacturers of the world and that is why 39.4% of the unloaded products in the PoB are coming from China (179.603 Full TEUs). The importance of such a country can be proved only taking a look to the main terminals of the world that are growing continuously. Moreover, all Far East area is growing and Asiatic companies are investing big amounts of money in the last years. One perfect example is the sale of the terminal of Algeciras (TTI Algeciras) in 2014 from Hanjin Shipping to IBK (subsidiary of Industrial bank of Korea).

The areas that follow the imports of the Port of Barcelona are Southeast Asia and Pakistan, India, Sri Lanka and Bangladesh that are all main producers of clothes that afterwards are sold in Spain by the main brands like Zara, Mango, etc. On the other hand, it is relevant to realize that North of Africa is only importing into Spain by the PoB about 18.000 TEUs due to the few international manufacturers that are displayed in the zone. A huge difference between imports and exports can be observed between North Africa and the PoB.

In the exports we can see that the outlook of the areas is more or less the same but we must compare the traffics in order to differentiate the exports from the imports. As we can see in Figure 5 and Figure 6 the difference between exports and imports is very clear.

Regarding to exports from PoB Far East and Japan is the area leading the ranking as well as in the imports ranking. In any case, the difference is about the double between exports and imports. In 2014 about 110.000 TEUs were exported to the Far East and half of them to China (65.252 TEUs to China).

The difference between the regions that follows the Far East is not very big and it is followed by Persian Gulf and Arabian Sea probably because of the exportations of raw materials or industrial products and machinery.

The next area is North Africa that we commented briefly above. We can see that it is the third region by exportations from Barcelona and this is presumably because of the strategic location of Africa (very close to Barcelona) and the easy access that the distance imply (though the Mediterranean Sea).

Finally, Spain is the fourth area of destination owing to the use of Short Sea Shipping Routes, Feeders or cabotage in order to reduce costs and environmental impact that is produced by road.

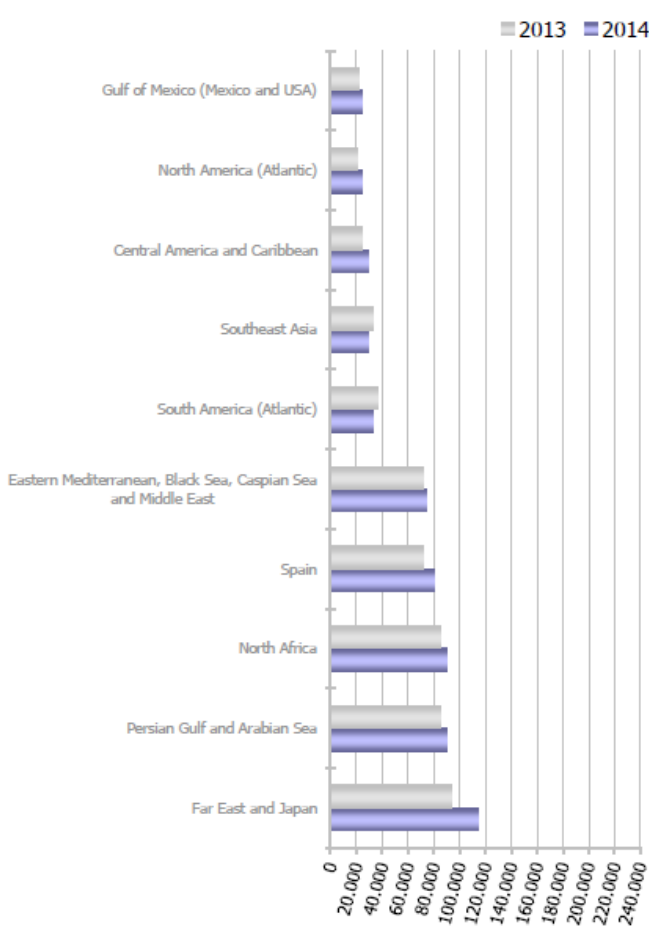


Figure 6. Main areas of destination. Full TEU non transit.

Source: Port of Barcelona traffic statics 2014.

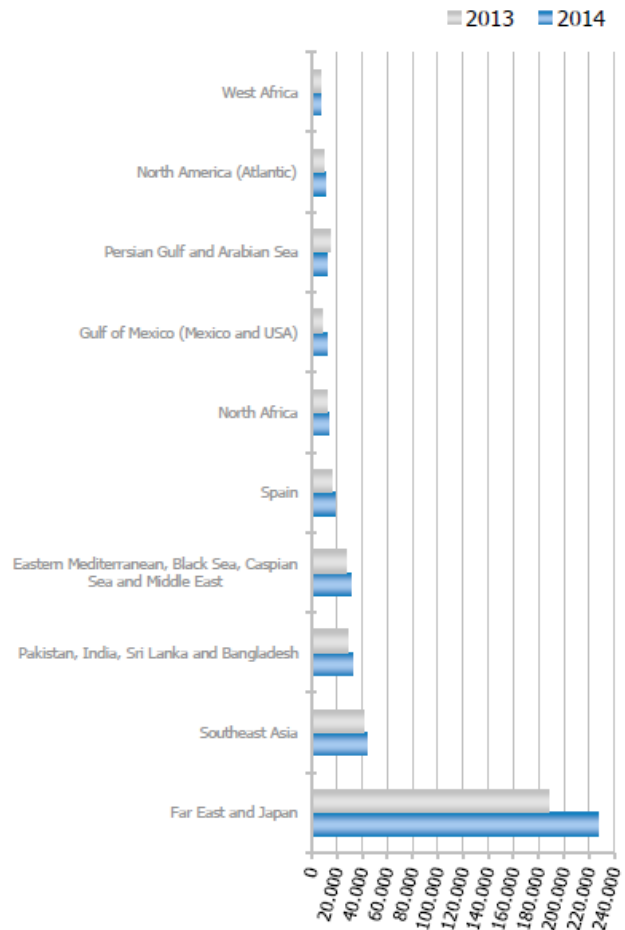


Figure 5. Main areas of origin. Full TEU non transit

Source: Port of Barcelona traffic statics 2014.

In summary, we have seen that the main market of Barcelona is the Asiatic market occasioned by the international manufacturers that are displayed in the zone. We must not forget that the small costs regarding to salary that companies need to pay to their workers and the few laws that there are, is the main reason for that companies to work in Asia. Otherwise, we have detected that there is a very small traffic from/to EEUU, a very important manufacturer in the world, or South America, a zone that is growing in the last years and is building bigger ports.

At last, it is significant to comment that the traffic from/to West Africa is very reduced comparing to all other routes, but we must take an especial look when talking about the traffic to/from that zone during this chapter: Africa is the only market that has almost not changed during the economic crisis.

2.4.2 Bulk traffic

Barcelona is very far from being a reference port in Europe, and now stands in a non privileged position if we compare it to other ports like Tarragona, the main bulk port in Spain. In 2014 PoB moved a total bulk cargo of about 17.7M mt.

The main liquid bulk cargoes are Diesel oils (3M mt of which 70% are imports), Natural gas (2.5M mt of which 95% are imports), Biofuel (2M mt, 52% imports) and Petrol (1.8M mt, 66% imports). We can see that Barcelona is importing liquid bulk and only exports some biofuel, diesel oils and petrol, because Europe is not a producer of products that derive from the petroleum but it is a big consumer (for industries, automobiles...).

On the other hand, the main dry bulk cargoes that Barcelona moves are Cement and Clinker (1.6M mt, 100% exports), Soya bean (1.5M mt, 98% imports) and Potashes (609 mt). As we can see the outlook is very different to the liquid. In that case, the exports and the imports are almost equal thanks to the exportations of the cement for the construction's industry. It is as well important to comment the fact of the big imports of Soya bean, probably for producing oil and other lactic products that derives from soya.

2.4.3 Automobile traffic

PoB moved a total of 748.394 automobiles of which 650.861 where international traffic in 2014. That means that from 2013 the traffic of that type of cargo increased in 4.2%. Of the international market, 431.440 automobiles were loaded to other countries, 123.242 were coming from other countries to be unloadded in Barcelona and about 96.000 were in transit.

We can figure out that Barcelona is an exporter of automobiles because of the big difference between imports and exports (66% of all traffic were exports). It happens because the location of some factories like brands as Seat producing cars in our region despite the reduction of production owing to the financial crisis despite the reduction of production owing to the financial crisis.

In Figure 7 we can get the point of how the traffic of automobiles evolves during a year. The month of August and the Christmas Holidays are the off-pick months because the production of the country is reduced as the traffic does.

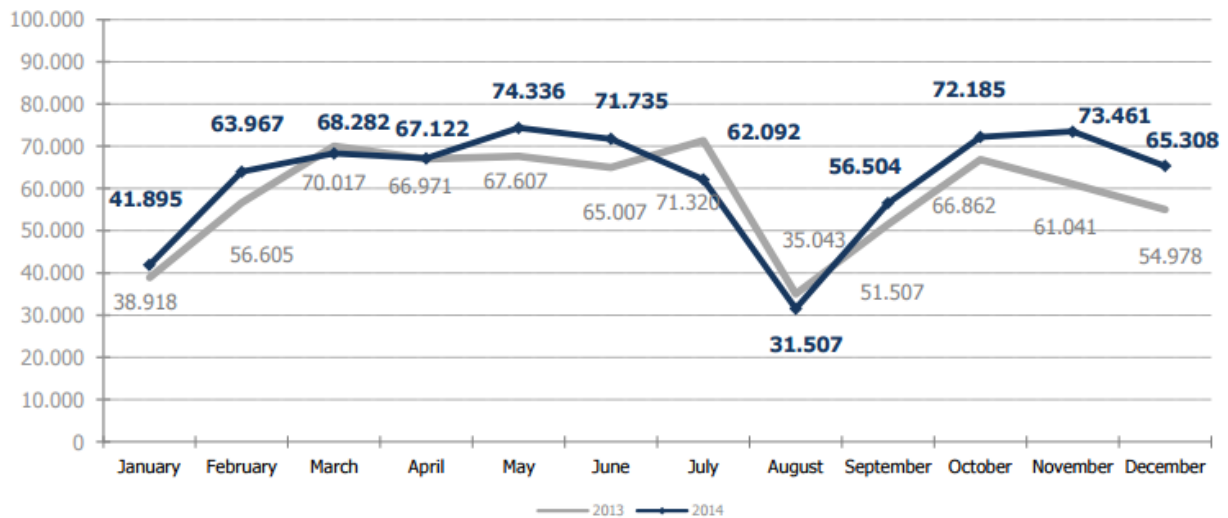


Figure 7. Evolution of monthly automobile traffic – Source: Port of Barcelona traffic statics 2014.

2.4.4 Short Sea Shipping

We have already explained the principal routes and how PoB is involved in the transport of cargo and passengers between ports situated in the European Union or between these ports and non-European ports with a coastline in seas bordering Europe. In 2014 Barcelona had a total traffic of 26.5M of metric tons, being the liquid bulk (8.8M mt), the Ro-Ro traffic (8.3M mt) and containerized cargo (6M mt) the main goods exported or imported in short sea shipping.

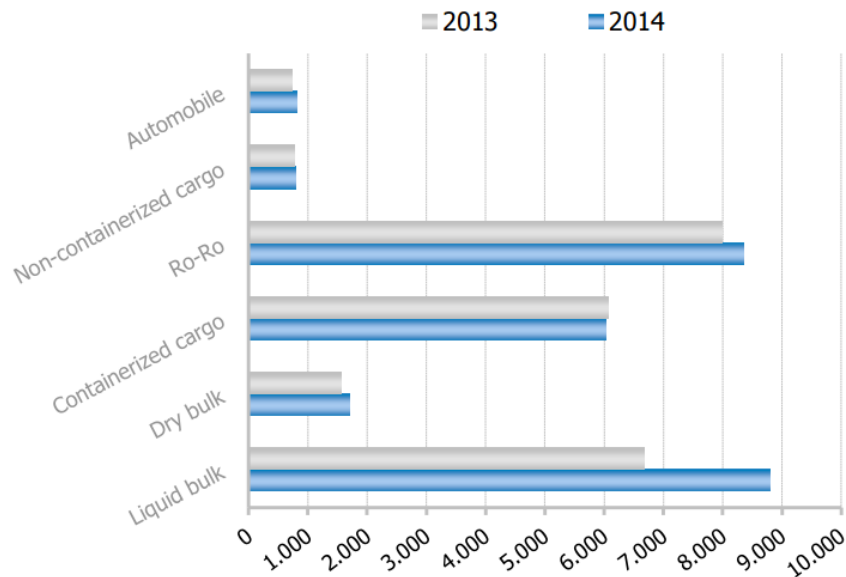


Figure 8. SSS goods classification. (Kt) - Source: Port of Barcelona traffic statics 2014.

2.4.5 Passenger traffic

Our work is focused on the traffic of goods and that is why we will not take a deep look into the traffic of passengers but it is very important to mention that Barcelona is nowadays the biggest port in Europe and in the Mediterranean in terms of cruises' passengers, with a figure of 2.35M passengers in 2014. In the world ranking, Barcelona is the fourth most important port only behind the three ports of the state of Florida: Miami, Fort Lauderdale and Port Canaveral.

2.5 Total traffic evolution up to now (Data extracted from PoB)

To understand exactly how PoB has been growing in the last years and how the financial crisis has affected the traffics, it is important to analyze how the traffic have changed and which is the point that the port is positioned nowadays. Moreover, with that short study is pretended to have a general idea of how the traffic continue progressing and where will PoB be in the short run.

To begin and before looking the evolution of the traffic that we need to focus on (containerized cargo and bulk cargo), it is recommendable to have a look of the total tonnes the PoB has moved from 2004-2014. In Figure 7 we can observe that with the appearance of the financial crisis the total tonnes decreased a lot, and now we are still trying to recover from it. However, it is important to remark that Barcelona had the minimum of traffic in 2004 when the shipping industry was growing rapidly. In 2008, the maximum tonnes of traffic were achieved (51.8M mt) but for now PoB is moving about 46.3M mt per year, still far from the position that is wanted.

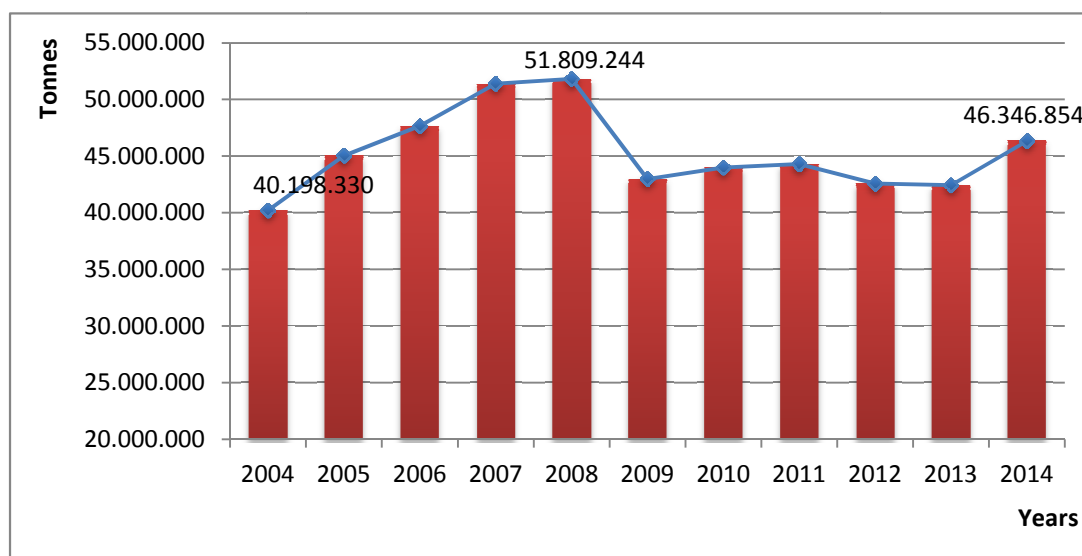


Figure 9. Evolution of the total traffic of PoB 2004-2014 (Tonnes).

The case of bulk traffic is slightly different from the total cargo that we have already seen. In Figure 10 we can see the evolution of dry bulk, liquid bulk and total bulk cargo that Barcelona had from 2004 to 2014. We can see that bulk cargo has not changed a lot during the crisis and it leads us to think that it is a traffic continuously needed for the extraction of energy mostly, like liquid bulk, and small variations have happened during the years.

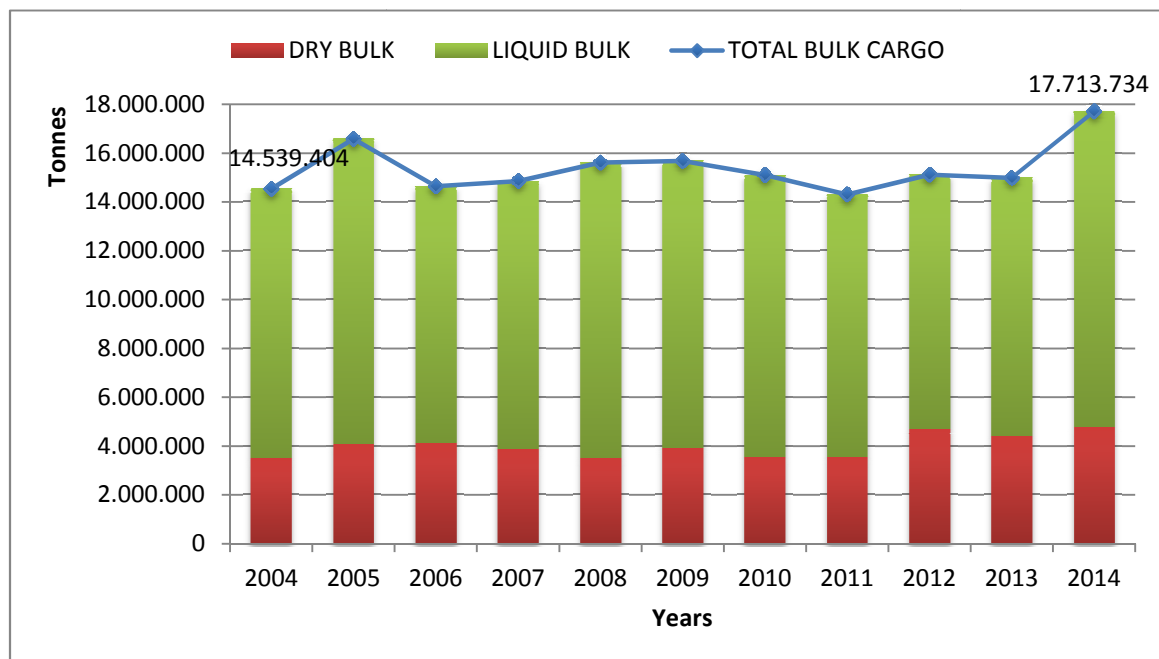


Figure 10. Evolution of Bulk traffic of PoB 2004-2014 (Tonnes).

If we analyze the dry bulk and the liquid bulk separately, dry bulk has not changed a lot during the years and in 2014 the maximum was reached with 4.764.706 tonnes of dry bulk. On the other hand, liquid bulk is more important for PoB. Like the previous one, the maximum traffic was achieved last year (2014), moving about 12.949.028 of tonnes. Thus, in 2014 Barcelona moved a number of 17.7M mt of total bulk cargo.

In the case of the containerized cargo, the scenario is a little bit different from bulk traffic. In that example the crisis has played an important role in the evolution of the traffic and is the main traffic affected. In Figure 11 it is represented the evolution of the containerized traffic from 2007 to 2014, the years before and during the financial crisis. We can observe that before the financial crisis appears strongly (we consider 2008) PoB moved 1.62M TEUs and it decreased in two years to the minimum point of the graphic (1.2M TEUs in 2009). Last year, it was moved in PoB a traffic of 1.58M TEUs, only 400.000 TEUs less than before the crisis appears. Therefore, the tendency of the traffic that is moved seems to be growing and it is expected to overtake the figures of 2007.

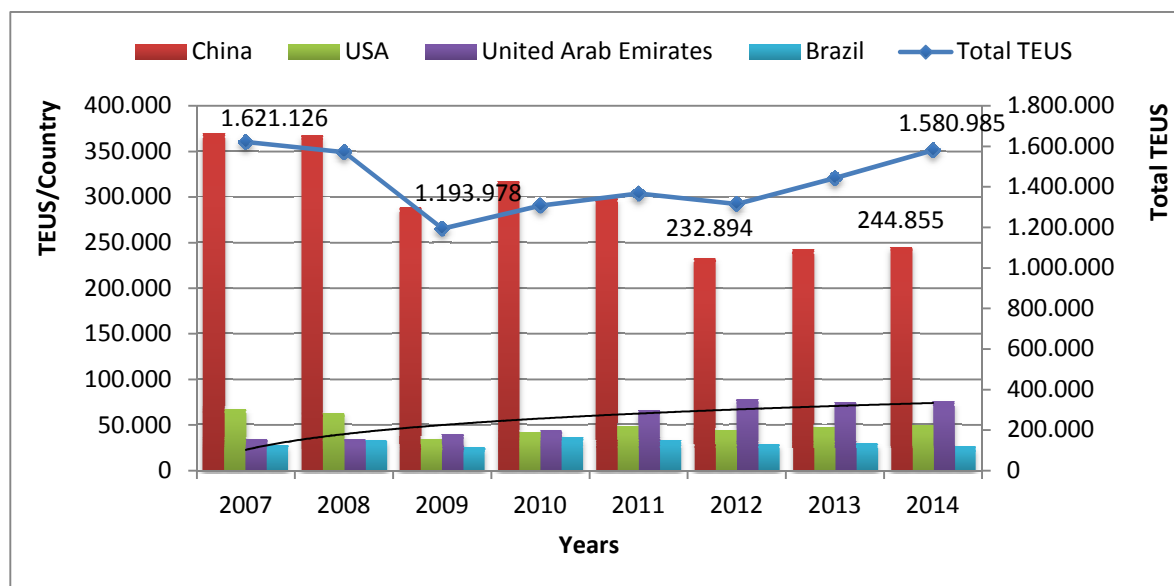


Figure 11. Evolution of the traffic in PoB from/to main countries and total traffic 2007-2014.¹⁸

Now, having a deeper look into these countries we can see that there is a big relationship between the total TEUs and the traffic of each country (China especially, being United Arab Emirates the exception). Starting with China, we can see that, as commented during that entire chapter, is the principal route that PoB has and it is highly important to strengthen it in order to grow easily. Anyway, the crisis has made PoB lose about 35% of the traffic that was moved in 2007.

The instance of United States of America is the same example as China but with less traffic than the Asiatic giant, having the financial crisis the equivalent effect. In a similar way is positioned Brazil that we included in order to analyze a traffic that is growing globally and that is every time more important. In contrast to what we thought, Brazil is not a traffic that has grown in the last years and it is still not an important area to focus on.

Lastly, we represent the evolution of the traffic to/from United Arab Emirates and we can conclude that is a traffic that PoB must take profit of. The line that is drawn shows the tendency of the traffic that has been growing in last 7 years but it seems that in the future it will be stabilized. For avoiding that situation, Barcelona should study the best way to catch more traffic in order not to let the increasing tendency stop.

¹⁸ Transit is not considered.

2.5.1 The case of Africa, South America and Far East + Japan

Now it is time to study the cases of the regions that can be considered strategic markets because its importance in the past or in the near future. First of all, Africa is one market that is said that will grow in the near future because the growth of the economy in the continent and it is the only continent that has not lost traffic during the economic crisis.

In Figure 12 we can observe the evolution in the African continent divided into North and West Africa. It is important to remark the fact that Barcelona has been continuously increasing the traffics to/from North Africa (represented in the trend line), affecting very little the crisis. The matter of West Africa is very different from the north because it has decreased a lot since 2008 when the crisis started to hit the economy worldwide.

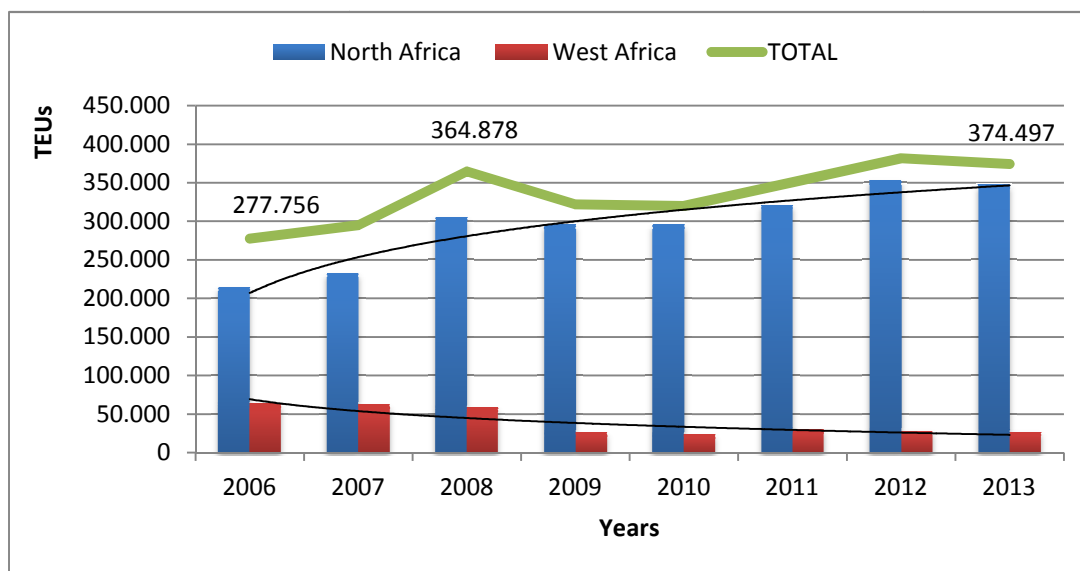


Figure 12. Evolution of TEUs PoB-Africa 2006-2013 (transit included)¹⁹.

For PoB it is urgent to catch traffic to/from West Africa taking into consideration that probably it is the economy worldwide that will grow quicker if it starts to develop soon. The ports that have now, or in the following years, good connection with Africa will probably benefit from the growth of traffic expected.

The case of the other regions (Far East & Japan and South America, the Atlantic side) is very different from the case of Africa. In Figure 13 it is represented the evolution of the traffic in both regions (including transit containers):

¹⁹ It was impossible to get the data not including the transit containers. That new data is being posted since 2014.

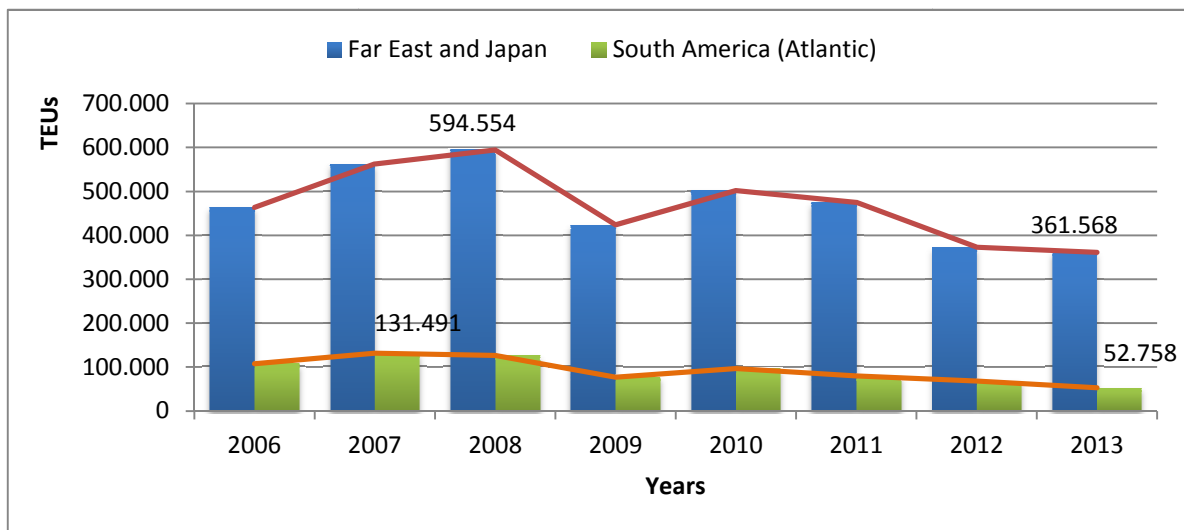


Figure 13. Evolution of the traffic PoB-Far East and Sout America 2006-2013 (transit included).

We have commented that it is very different to the previous case because the trend line, unlike Africa, is completely distinct, having a negative trend in both regions. The example of the Far East and Japan shows us that before the economic crisis the maximum traffic was achieved (594.554 TEUs) and after the year 2010 it has decreased a lot, arriving to the minimum of the decade in 2013 (361.568 TEUs). It is something relevant because now we are not affected by the crisis as before, and that decrease probably means that the traffic that is lacking is being caught by some other ports like Algeciras (in the case of transit traffic, Valencia or even Rotterdam thanks to its hinterland connections to central and north Europe. Despite all data already commented, it is also significant to comment that it is the main market of the PoB, being an extra reason for strengthen it and to avoid losing more traffic.

About South America, it is a third case different to Africa and Far East. In this case the traffic has never been very big and it is a region that has been growing in the last years. Therefore, it is another market that needs to be taken into consideration to make future strategies for the near future despite for now it is not an important market for PoB (being in the 8th place in terms of traffic per region). Moreover, we also need to take into consideration that for the countries located in South America may prefer to connect with Rotterdam or Hamburg because its transit time (being different from the other regions already commented, that are closer to Barcelona).

2.6 The port of Barcelona in the near future

2.6.1 III Strategic plan 2015-2020

In February of 2015 the Port of Barcelona published a new strategy focused on the following five years in order to increment the traffic of the port and become more powerful than in last years.

Firstly, during that study of the new strategy they tried to extract some important ideas that were needed to take into account so as to adapt itself to the maritime market:

-It seems clear that there will be an overcapacity in terminals around the world because of the big increase of terminals in the last decade. In order not to have empty terminals, PoB defined that new markets are needed for compensating that overcapacity and high added values above all. This type of market, which Barcelona has been leading during years, lets the port and the country to have a big benefit comparing to other traffics or markets.

-The cooperation that characterizes northern European ports needs to be also implemented in the Iberian Peninsula. Thanks to the cooperation some projects like Ferrmed (Mediterranean Corridor) could have a powerful sense.

-More terrestrial infrastructures may be implemented in order to increase the hinterland of the port.

-Barcelona has the characteristic of having small companies in the logistics sector, something that makes more difficult to expand in Europe. For that, promoting the growth of the companies and their internationalization may be something very beneficial for the port.

-The strategic alliances in the shipping companies (like 2M or Ocean Three) can have a big impact in terminals and ports, producing changes in the ports of call. Therefore, it is necessary to provide the customers a good service in order to attract their interest.

As we have seen, during the study all new trends that are being more important in the shipping market were analyzed in order to focus the new strategy and to create some goals that are wanted to be achieved in the year 2020. The most interesting ones that concern our study of the port are the following:

- a) Achieve 1,2M of new vehicles, 14M tonnes of hydrocarbons and 3 million TEUs.
- b) Increase the impact of the port in a 55% in the North-East of the peninsula, 20% of Madrid and 15% of Southern France.
- c) Encourage the use of intermodal transport to be a referent in environmental care.
- d) Reduce a 25% the handling costs of containerized cargo.

For all the proposals it is need to strengthen the importance of the ecologic transport. Horizon 2020 can be a referent when implementing the measures to achieve the maximum possible efficiency and cargo.

2.6.2 TEN-T network

It is a project launched in January 2014 by the European Union with the aim of building an infrastructure that connects the entire continent from the East to the West and from the North to the South of Europe using, above all, a clean mean of transports. Thanks to the Trans-European Transport Networks it is expected to remove bottlenecks produced by the trucks that are transporting goods using the same roads that normal inhabitants and to shift that traffic to railways or to inland waterways. Furthermore, it is planned that a budget of 26 billion of Euros up to 2020 helps the economy to its recovery and to grow in the near future.

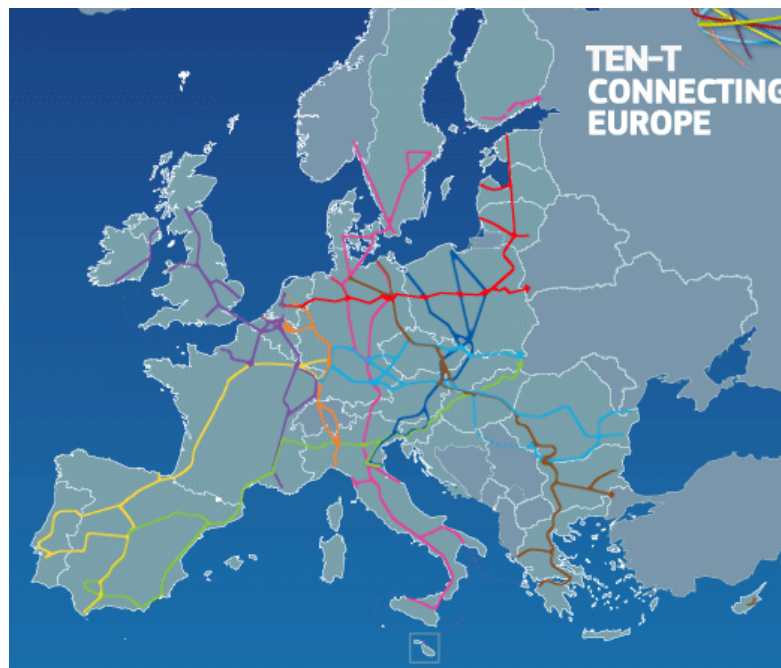


Illustration 8. TEN-T around Europe.

Source: TEN-T official webpage European Comission.

The project is divided in regions in order to study the different cases of each country and to detect the main weaknesses that need an urgent improvement if efficiency is wanted to be optimized. After studying the different characteristics of each region it is proposed different strategies or infrastructures that can contribute to TEN-T and to make a greener Europe. In our case, we are going to focus on the Spanish region that is the one affecting to the Port of Barcelona.

The specialists studying the TEN-T proposed to build two different corridors in Spain: the first one is the Mediterranean Corridor (green in Illustration 8) and the Atlantic Corridor (yellow in Illustration 8). The one that will affect more and is completely beneficial for the PoB is the first one that will be commented in the following part 2.6.3. Key benefits for those corridors are that they will contribute strongly to expand the hinterland to Europe of the surrounding ports and strengthen the internal market in Spain. Consequently, if the economy is improved it will produce more employment for the inhabitants of the country and probably more trade of

goods using respectful means of transports with the environment and it will reduce congestion on roads, emissions of greenhouse and polluting gases, shifting the traffic to a more safe and secure mean of transport.

It is true that the main corridor affecting Barcelona is the Mediterranean Corridor, but it is also indirectly affecting the Atlantic Corridor because its connection from Portugal to Madrid, being able for PoB to catch some traffic coming from the neighbour's country.

About the Mediterranean Corridor it is important to comment that despite its big initial inversion, the incomes for the PoB can be big enough to be profitable. In that way, the big problem is that having a Mediterranean Corridor could affect to the traffic of the Port of Valencia that could be caught by the PoB and probably they are not as interested as the Catalonian port.

2.6.3 Mediterranean Corridor

The Mediterranean Corridor is a project created some years ago with the aim of studying the case of having a link between South Western Mediterranean (Spain, from Algeciras) up to the Ukrainian border with Hungary. It means that that railway connection would cross some important countries for the European economy like Spain, France or the North of Italy.

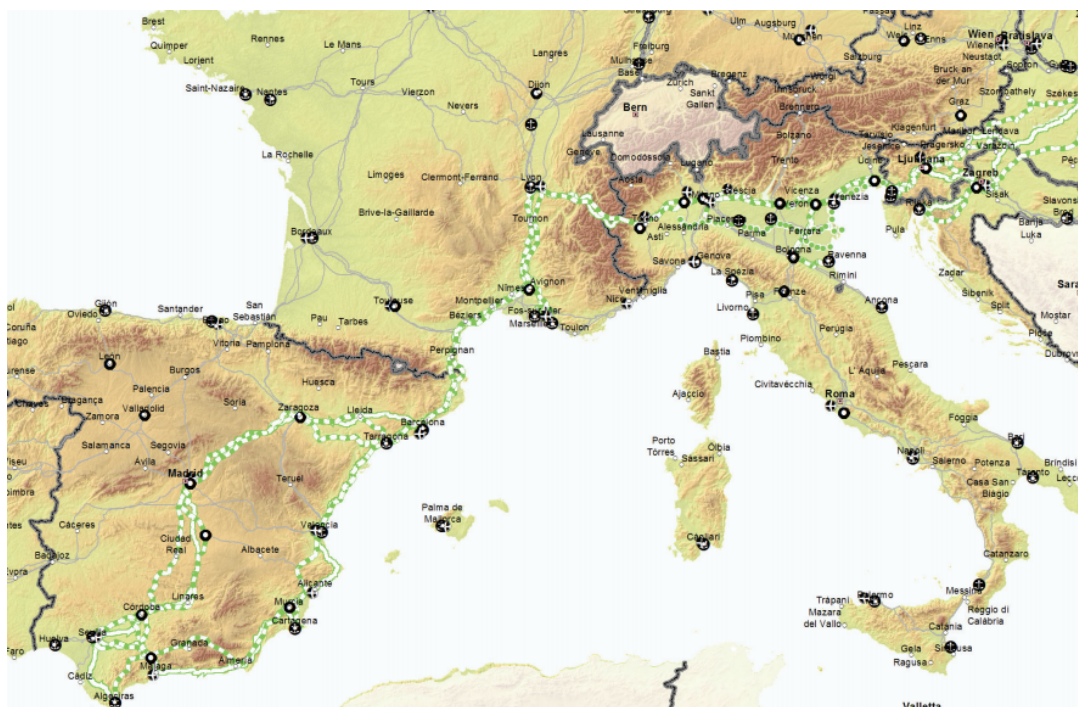


Figure 14. Mediterranean Corridor project, TEN-T European Commission

Taking part in the European Project TEN-T (Trans European Transports Networks) is something essential in the near future in order to expand the economy of the port. That is why for Barcelona it something vital to connect the port with other countries. For that purpose FERRMED, a non-profit association, was created in 2004 so as to study the project not only in

an economical way but also in a social aspect. We can extract some points to comment about Barcelona, thanks to Albert Ferré's final project²⁰:

-As already commented, having the Mediterranean Corridor in Barcelona means that PoB can export or import goods not only in Spain but also in all Europe thanks to the international gauge (UIC Gauge) of the railways. For now, it is very difficult for PoB to expand their hinterland because of the different gauge that is using Spain.

-Having better hinterlands in Algeciras, Valencia & Barcelona means that they can help to the development of the country. An important port means, usually, a strong economy.

-It would cross very important ports of Europe that can supply service to a big quantity of people.

-Having a hinterland linked with other countries in Europe means that Barcelona could attract traffic from Asia or Middle East, reducing transit times and giving a good service to its customers if a good infrastructure is built in order to connect the sea side of the port to the inland connections.

-Nowadays, ports are not only a sea platform to load and discharge the vessels that arrives to a place. The sight of the market has changed due to new needs that have been introduced in the ports. That is why increase the hinterland to other countries would let Barcelona to have more dry terminals to attract traffic.

-PoB could be a referent in the Mediterranean in Ro-Ro cargo (Short Sea Shipping) and containerized cargo. For bulk traffic it is not something determining because of the difficulty of transporting bulk cargo in trains.

-One of the most important factors: it is a more ecological mode of transport than other means of transport. Thanks to trains it can be transported more containers than only one truck (that is available of carrying one FEU²¹ container) and consequently the pollution per container is reduced. In addition, the corridor would reduce the bottlenecks that are produced in the city of Barcelona and also in the border from Spain to France.

-That congestion in the French border is something important to reduce. Last year it was predicted that about 10.000 trucks drive from one country to the other per day (45 million tonnes per year) and 10-12 trains were working every day (2,26 million tonnes per year). As we can observe, the amount of cargo that can be transported by train instead of truck is terrifying.

²⁰ Source: Albert Ferré i Pons. Anàlisi de la influència socioeconòmica del Corredor Mediterrani al Port de Barcelona.

²¹ Forty-Foot Equivalent Unit

-Using the same reasoning, it is cheaper to transport by train than by road if we focus on the price per unit.

-It was also proposed by EU in the TEN-T project to create an interconnection in the Port of Barcelona by rail with the port and the airport so as to make more efficient the intermodal transport once the cargo is unloaded of the vessel or the cargo that needs to be discharged from the train.

Therefore, PoB would have the possibility to grow rapidly if the Mediterranean Corridor was built. It is also important to comment one of the biggest “problems” that a corridor would have, and is that Valencia would be also linked. It means that Barcelona will not be the only port taking benefit of the infrastructure and the growth for PoB could not be as big as thought.

Moreover, Valencia is probably not interested as PoB because its fear of decrease their traffics. For the Port of Valencia the Mediterranean Corridor will let PoB to attract some customers located in the surroundings of the Valencian’s capital.

Chapter 3. Comparative analysis

The aim of the chapter “Comparative analysis” is to explain the actual situation of different ports and afterwards to compare it with the case already commented of the Port of Barcelona.

There are many ports that are competing all the time against Barcelona for catching new traffics, but for that purpose will be compared the following essential ports:

-Rotterdam is the leading port in Europe and moves the biggest traffic in the old continent. For that reason, it is important for Barcelona to focus on Rotterdam for policies that can be applied in the near future so as to grow and compete not only with the main Mediterranean ports but also the European.

-Valencia is the closest Spanish port to Barcelona and is the second leading port (containerized cargo) in Spain and the top port in the Mediterranean. Moreover, it is very important to compare it to PoB because of the distance and the competition between them. The one that has better equipments and hinterland will be the one that catches most of the traffic of the near future: as commented, companies only want to reduce costs and that small distance is not significant for them.

-Fos-Sur-Mer is one of the main ports in France and the Mediterranean Sea. In addition, if we focus on the ports that are closest to Barcelona, the first main port starting by the north is Marseille. Mainly, we can consider the Port of Marseille as a port specialized in liquid bulk cargo that also handles big amounts of dry cargo comparing to other ports. If we compare the containerized to the bulk traffic, it is obvious that it is a weakness of the port.

3.1 Port of Rotterdam (the Netherlands)

3.1.1 Description of the port

3.1.1.1 Containerized traffic

The Port of Rotterdam (PoR) is the main Hub of Europe and is growing the traffic from year to year, catching routes from companies and distributing the goods mainly to central and north of

Europe. At present, Rotterdam is standing in first position of the European Ports and is the 8th most important port worldwide. If we talk only about containerized cargo, Rotterdam is in the 11th place of the world, the first one from outside Asia, with a total traffic of 11.621 million TEUs in 2013²².

There is not a very big difference between the exports and imports that the Port managed in with only 500.000 TEUs, having roughly more imports than exports. The main areas where containers were exported or where the containers were loaded to be discharged in Rotterdam are the following:

-Asia is the most important route that connects central Europe with the main manufacturer of the world (Figure 15). The reasons are the same as Barcelona (Chapter 2) and it has the incentive that it acts as a Hub thanks to the geographical location. It is remarkable that there is not a big difference between imports and exports to the Asiatic continent and the variance is only about 200.000 TEUs.

-Europe is the second most important connection that Port of Rotterdam has distributing the containers to north Europe mainly. It is the benefit of being just in the middle of Europe and being able to attract all traffics from around the world that the final destination is any other place of Europe, creating scale economy and being the main port for many shipping companies.

-America is another important market to comment. As the location is beneficial for being in the middle of Europe, it is likewise for the exports and imports to/from America. It is the shortest distance between the two companies if we take into account that ports of Portugal are not capable enough for such traffic and Spanish Ports are located in the south of Europe.

-Finally, Africa is a route that, despite being much smaller than the others, continues connecting Europe and Africa. We can see how imports (162.000 TEUs) are bigger than the exports (80.000 TEUs), a very relevant fact if we take into account that in Africa there are not big manufacturers and most of the production are raw materials.

| | 2013 | | | 2012 | | |
|--------------|--------------|--------------|---------------|--------------|--------------|---------------|
| | Incoming | Outgoing | Total | Incoming | Outgoing | Total |
| Europe | 2,034 | 2,072 | 4,105 | 1,974 | 2,006 | 3,980 |
| Africa | 162 | 80 | 242 | 197 | 146 | 343 |
| America | 1,105 | 815 | 1,92 | 1,028 | 777 | 1,805 |
| Asia | 2,709 | 2,593 | 5,302 | 2,856 | 2,832 | 5,688 |
| Oceania | 22 | 29 | 51 | 22 | 28 | 50 |
| Total | 6,032 | 5,589 | 11,621 | 6,077 | 5,789 | 11,866 |

Unit: Number of TEU x 1,000 (Twenty-Foot Equivalent Units) Source: Port of Rotterdam

Figure 15. Incoming and outgoing TEU, grouped by continent, 2013 - 2012 – Source: www.portofrotterdam.com

²² Most of the information used during the comparison of the PoR is from 2013. The official figures of 2014 have not been yet updated in the website (when the work was done).

3.1.1.2 Bulk traffic

Talking about non containerized cargo (Figure 16), Rotterdam is clearly the most important port in Europe. Rotterdam is located in The Netherlands and is not a big producer of bulk so mainly it is incoming traffic from producers in the Middle East that needs to import their bulk into Europe. In 2013, the main dry bulks that were imported were Iron ore (33.2M mt) and Coal (30.4M mt), arriving to the figure of 81.8M mt of total dry bulk imported (91.7% of all throughput of dry bulk were imports).

| | Incoming | Outgoing | Total |
|-----------------------------|--------------|-------------|--------------|
| Iron ore and scrap | 33.2 | 2.8 | 35.9 |
| Coal | 30.4 | 0.3 | 30.7 |
| Agribulk | 8.8 | 1.5 | 10.3 |
| Other dry bulk | 9.4 | 2.8 | 12.3 |
| Subtotal dry bulk | 81.8 | 7.4 | 89.2 |
| Crude oil | 90.4 | 0.6 | 91.1 |
| Mineral oil products | 46.3 | 35.3 | 81.6 |
| LNG | 0.6 | 0.2 | 0.8 |
| Other liquid bulk | 19.8 | 13.5 | 33.4 |
| Subtotal liquid bulk | 157.1 | 49.7 | 206.8 |
| Total bulk goods | 238.9 | 57.1 | 296.0 |

Figure 16. Incoming and outgoing by commodity 2013 – Source: www.portofrotterdam.com

*Unit: Gross Weight x 1 million metric tones

If we talk about liquid bulk the circumstances changes a little bit and the difference between imports and exports are not as big as in dry bulk cargo. In 2013, the main incoming cargoes were Crude oil (90.4M mt) and Mineral oil products (46.3M mt). From the other sight, the main good exported was Mineral oil product with about 35.5M mt of mineral exported. Making the percentages we obtain that the exports of Mineral oil products considering the total liquid bulk were the 76% of all total traffic, very different to the dry bulk.

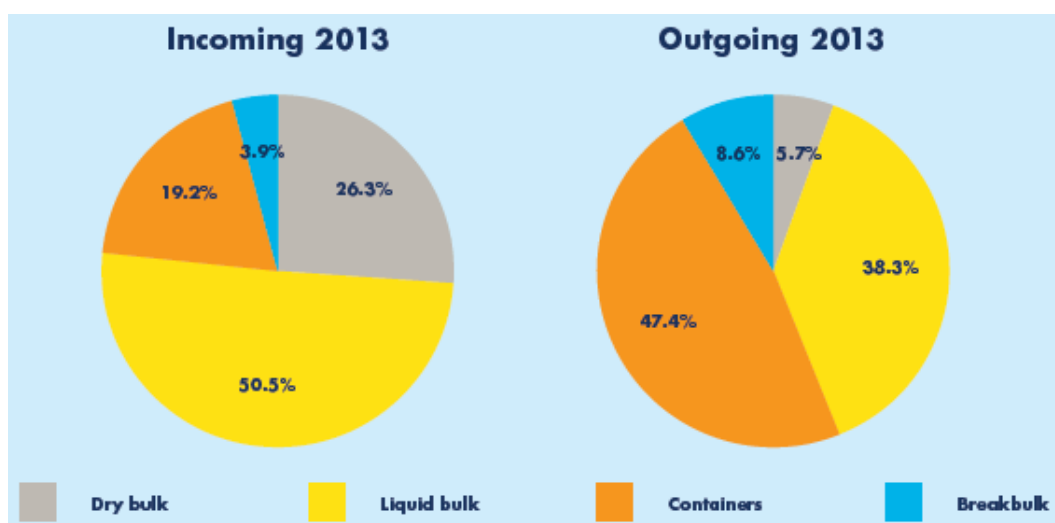


Figure 17. General overview of Incoming & Outgoing 2013 – Source: www.portofrotterdam.com

After all we can conclude that Rotterdam is a very powerful port in all world when talking about bulk goods and is able to move more than 296M mt in only a year. In addition, if we compare Rotterdam to the closest ports like Hamburg, Amsterdam or Antwerp, it is in all cases the main port in throughput and only in container traffic the difference is smaller (Figure 18).

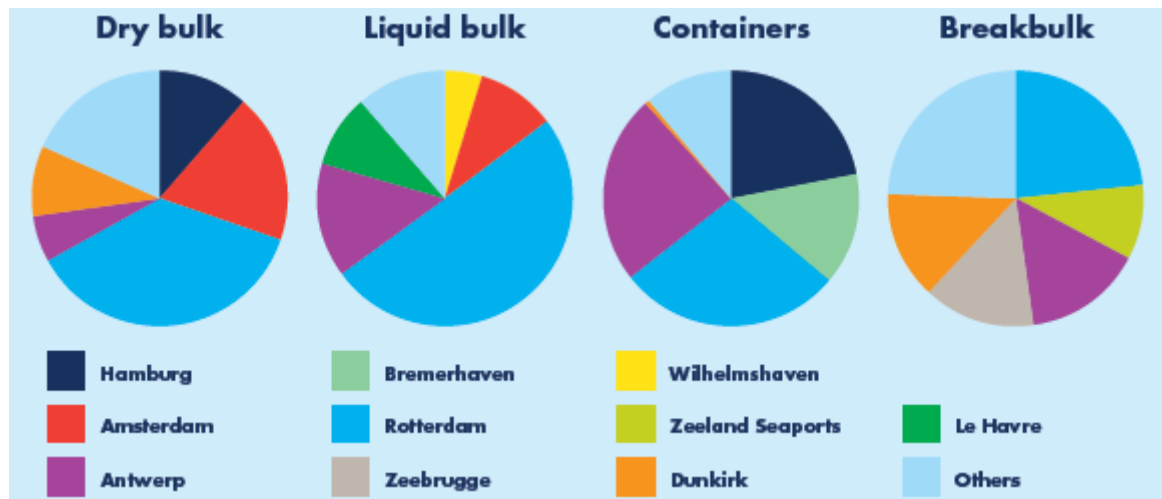


Figure 18. Comparison between Port of Rotterdam and other close ports – Source: www.portofrotterdam.com

3.1.1.3 Hinterland

Rotterdam, as the biggest port of Europe, is also a very important Hub for central Europe with a great number of hinterland connections. The main remarkable feature of the area where the port is located is the easy access to long rivers that let the port having an excellent network not only by road and rail but also by barge.

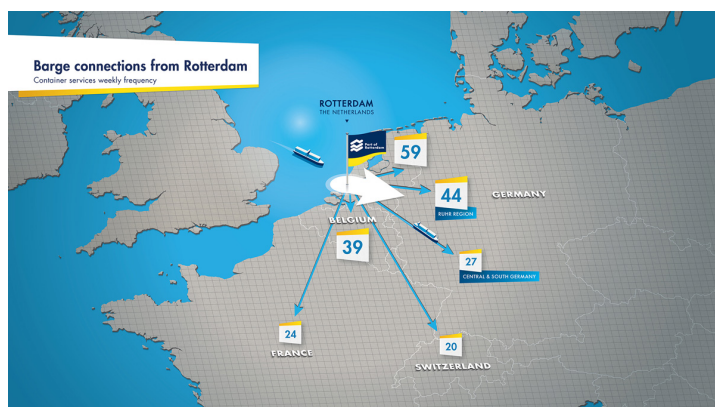


Figure 19. Barge connections from Rotterdam

Source: www.portofrotterdam.com

Transport by barge is not something that every port has, and it is a very powerful way of connecting the port with its hinterland. In Rotterdam is said that over 50% of all cargo that arrives to the port is forwarded to other European destinations by barge or is delivered to the destination port by barge for transshipment.

Apart from the barge, Port of Rotterdam as well has the hinterland connection by rail. In fact, rail is the mean of transport that has most of the connections because of the few river ports that can receive barges. It has connections to most of the areas in Europe and transit

times can vary from less than 12 hours (Belgium and Germany) to 48 hours (Czech Republic, Italy and Poland). Moreover, a cargo railway link to Germany is promoted and it is called the Betuwe Route with a frequency of about 80 connections per week.

Betuwe Route was built in 2007 and it was the project number 5 of Trans-European Transport Network (TEN-T), becoming the most costly and controversial project (because of the environmental impact) ever constructed in Germany.

To finalize, Rotterdam obviously has road connection to all parts of Europe and is used especially for short routes. In any case, the aim of the European Union is to reduce the transport by road and shift it to other means like train or barge.



Figure 20. Rail connections from Rotterdam

Source: www.portofrotterdam.com

3.1.2 Rotterdam vs Barcelona

For starting our comparison between those ports, we will divide our study into types of traffic. First of all, we are going to explain containerized traffic (that is growing continuously), bulk traffic and at last, an explanation of the difference between both hinterlands.

3.1.2.1 Containerized traffic

Talking about containerized traffic there are lots of points to comment:

- a) The main difference and the most important one is the number of TEUs that every port moves each year. The figure is very impressive but at the same time logical: Rotterdam moved in 2014 12.3M TEUs while Barcelona was only able to move a tenth part, 1.9M

TEUs²³. Dividing the total of traffic into imports and exports, we can see that in terms of percentage they are more or less equal and the relationship is nearby 50%.

- b) Comparing the incoming traffic is relevant to distinguish the quantity of containers between the areas where the imports are collected and where exports are distributed. The following figure shows the incoming and outgoing containers, excluding transshipments.

| | ROTTERDAM ²⁴ | | BARCELONA ²⁵ | |
|---------|-------------------------|----------|-------------------------|-------------------|
| | Incoming | Outgoing | Incoming | Outgoing |
| Asia | 2,709 | 2,593 | 310 | 255 |
| Europe | 2,034 | 2,072 | 40 | 102 ²⁶ |
| America | 1,105 | 815 | 30 | 110 |
| Africa | 162 | 80 | 21 | 85 |

Figure 21. Incoming and outgoing TEU by continent in 2013. Number TEU x1,000

We can see a big difference between all continents but there is one very important to comment. A big difference exists when talking about the traffic to/from Europe. Barcelona in spite of being in the south of the old continent is very far from the traffic that Rotterdam moves. Therefore, the geographical location is a handicap that Barcelona needs to compensate with better services or infrastructures to increase the hinterland. In any case, Barcelona has also worse hinterland than Rotterdam and new strategy must be introduced.

- c) Another important point that we can see in Figure 21 is that although for PoB the connection with Africa is very powerful for the port (with almost same exports), Rotterdam is an importer of African products. In that way, if we calculate the transit time of a container that is loaded, for example, in Cape Town (South Africa) it has 16

²³ In that figures we have taken into account both empty and full containers, transshipments are excluded.

²⁴ The information of Rotterdam is provided in Port Statics 2011-2013 (for downloading it: <http://www.changeyourperspective.com/downloads/statistics/>).

²⁵ The incoming and outgoing of Barcelona is a rough approximation because of the lack of information and the impossibility of accurate information. It is extracted from Figure 5 and Figure 6, adding only the figures of the main areas.

²⁶ It includes Spain, which has about 70.000 TEUs of exports in 2013.

days and 18 hours to Barcelona and 18 days and 8 hours to Rotterdam²⁷. That represents 1 day and 14 hours less if the vessel calls Barcelona, but shipping companies still prefer to call Rotterdam.

- d) The main world powers and strategic areas that connect both with Barcelona and Rotterdam may be compared in order to conclude where the imports of that countries are unloaded and exports are loaded:

| | ROTTERDAM | | BARCELONA ²⁸ | |
|--------|------------|-----------------|-------------------------|-------|
| | Throughput | % ²⁹ | Throughput | % |
| China | 2.481.263 | 22.5% | 316.363 | 24.2% |
| USA | 606.001 | 5.5% | 41.219 | 3.2% |
| Brazil | 229.212 | 2.1% | 36.173 | 2.8% |
| Africa | 370.161 | 3.3% | 127.524 | 11% |

Figure 22. Containerized cargo (TEUs) from/to China, USA, Brazil and the African continent in 2010.

In Figure 22 we can obtain some differences and some similitudes in terms of percentage, because it is obvious that if we compare the number of container Rotterdam is too far from Barcelona.

We can see that the two main world powers as China and USA, have more or less the same percentage of total traffic in both ports. It is remarkable the fact that Barcelona is located much more closer to China than Rotterdam and PoB may strengthen its position with the aim of catching traffic, reducing time and distributing the imports into Europe by rail if possible.

More difficult is the market of USA. It is the opposite situation because of the location of Rotterdam that benefits of being in the centre of Europe (talking about latitude) and is closer to America. Despite that situation, the percentage in 2010 was only 5.5%, what means that the connections between Europe and United States is not very big and that other markets like the Asiatic one is much more important for our economy.

²⁷ Calculation by www.searates.com.

²⁸ The statics of Barcelona has varied a little but the figures of 2010 have been used in order to compare with the most updated figures by country obtained of Rotterdam, which were made in 2010.

²⁹ Percentage of the total throughput of ports in 2010, transit not included: Rotterdam (11.051.325 TEUs) and Barcelona (1.307.725 TEUs)

Finally, it is very important to comment the situation of both ports regarding to the traffic from/to Africa. Rotterdam has approximately the double of number of containers that are moved but if we talk about percentages we can see a differential strategy for each port. In the case of Rotterdam, it only moves 3.3% of total traffic, an insignificant percentage if we compare to the 11% that PoB moved in 2010 and that is one of the main connections that Barcelona has. That situation for the Catalan port has been achieved thanks to the link between PoB and North Africa that signifies 296.045 TEUs in 2010.

3.1.2.1 Bulk traffic

It is not easy to extract big conclusions of the comparison between PoR and PoB regarding to the bulk cargo that each port move. In the container traffic Barcelona, despite being a small port comparing to Rotterdam, is competitive with smaller ports. In the case of bulk cargo, Rotterdam is even more in the lead and PoB needs to work hard if an increase of traffic is wanted.

We can see in Figure 23 that Rotterdam moved 296 million of metric tons while Barcelona was only capable of moving 15,1M mt. That means a difference higher than the containerized traffic, and the traffic of Barcelona is almost insignificant for Rotterdam. Consequently, we can determine that for Barcelona the PoR is not a direct competitor of the bulk market and some other smaller ports like Valencia or Tarragona are more important for PoB than Rotterdam.

| | ROTTERDAM | BARCELONA |
|-------------|-----------|-----------|
| DRY BULK | 89,2 | 4,4 |
| LIQUID BULK | 206,8 | 10,7 |
| TOTAL | 296 | 15,1 |

Figure 23. Total bulk goods in 2013. Unit: Gross weight x 1 million metric tons

Talking about the commodities that are moved in the ports:

- About dry bulk, we can see big differences of the most important commodities. For Barcelona Cement and clinker (materials for the construction sector) and Soya bean are the most important products, whereas for Rotterdam the leading traffic in dry bulk is Iron ore and Scrap and Coal. For Barcelona Iron Ore and scrap represents the 5th most important dry bulk cargo and there was no Coal traffic in 2013 (only 19mt were moved in 2014).
- For liquid bulk the situation is different from the previous one. In both ports the main products that are (especially) imported are crude oil, mineral oil products, diesel oils, natural gas... In conclusion, products that are derived from the petroleum. Therefore,

those petroleum products and natural gas are imported in order to supply fuels to the population and industrial plants.

3.1.3.3 Hinterlands

There are two main big differences that have made Rotterdam grow in a fastest way and has made possible for PoR to arrive to the top position of Europe. Both differences are non-variable factors that Barcelona needs to fight against if it wants not only to survive but also to grow in the long run.

The main one, which has been already commented during the chapter, is the geographical location of each port. Meanwhile PoB is located in the south of Europe, Rotterdam is in the west coast, very near to the north, the centre, the south and is a gate for international companies to introduce their products into the market. In addition, Rotterdam is surrounded by the most powerful European countries: United Kingdom (connected through the English Channel), France, Germany and Denmark. For example, in spite of the situation of Hamburg Port, lots of goods are discharged in Rotterdam and distributed by barges or rail to Germany. Finally, PoR signifies a strategic position for north Europe (Norway, Sweden, Finland...) thanks to Short Sea Shipping and small feeders.

The second main difference is the means of transport that they use. Rotterdam has the feature of being surrounded by rivers that let the port connect with other inland fluvial ports in order to reduce costs and to decrease the pollutant emissions. That mean of transport is carried by barges that have a small consumption because the small speed they can reach and the quantity of containers they can bring in every voyage. For PoB it is impossible to use such mean of transport due to the natural surface of Spain that doesn't have big rivers to sail through.

In light of the above, international gauge of the railways is an advantage that PoB is still achieving. Taking profit of the gauge and the geographical location, PoR has much more weekly connections than PoB that has only two international connections to France whereas Rotterdam has more than twelve international connections to different countries.

3.1.3 Brief conclusion of the comparison

It seems impossible to extract a clear conclusion of the short study between the main port of Europe and PoB. At the moment, Barcelona is very far from being a competitor of the PoR and it may focus on other smaller ports that move small quantities of cargo.

Talking about the containerized traffic there are some areas where PoB should try to attract more traffic implementing new strategies taking benefit of the geographical location. The most important one is the connections with Asia and most exactly with China. A better strategy attracting more traffic from that continent could mean a big increase in the incomes of the port that can reduce transit times of the cargo if a good service is implemented when discharging and changing the mean of transport. Very different is the situation of USA or countries in South America (Brazil, for example) because for shipping companies it is preferable to call in Rotterdam not only for the transit time but also for the big hinterland connections that it offers.

On the other hand, the African continent can be a strategic market for the PoB. As we have calculated during the comparison, the transit time to Barcelona is shorter from any point of Africa and the port must position itself to catch even more traffic, attracting some lines that are calling PoR. Moreover, the connection to the north of Africa is very and PoB should strengthen through the offer of Short Sea Shipping Lines that can operate respecting the environment.

The bulk traffic is more complex and it is very difficult to extract some points because the extreme difference that it exists nowadays. In addition, we have seen that the products that are imported are nearly the same (petroleum products and natural gas) so it is not easy to get some traffic that now is going to Rotterdam. Comparing more deeply the dry bulk traffic, we can see that imports of Barcelona (Soya bean, for example) are products that are used in the national industry and the only way to expand the incoming cargo is to import the products that France needs.

At last and the most important point of the comparison we have the big difference between the hinterlands of both ports. We have seen that while PoR has the main feature of the use of barges and many inland connections by rail, Barcelona only has few connections and most of them are established in the national territory (with national gauge). For this reason, PoB needs urgently an international gauge to open its gates into the European market and to increase the hinterland connections. If not, Barcelona is in danger of blocking its growth and to become incompetent for the actual shipping market, that is becoming more and more demanding.

3.2 Valencia Port (Spain)

3.2.1 Description of the port

Valencia Port (VlcP) is the sea port of Valencia and in most of the cases the gate of Madrid to the maritime trade. Nowadays, the port is the 10th European port in total throughput and the 6th if we talk about containerized cargo. In addition, it is a port that is completely focused on the containerized traffic, being that the reason of the growth of the port in the last years.

3.2.1.1 Containerized traffic

VlcP moved last year a total of 47,7 million of tonnes³⁰, which most of the figure was containerized traffic. In 2014 it was moved a total of 4.441.949 TEUs of which 55,7% were transshipments. It means that in general matters we can consider VlcP is a transshipment port because of the geographical location (later explained) and the strategy on being a Hub of the company MSC. That figures that were achieved signifies that despite Valencia is moving big amounts of containerized cargo, maybe it doesn't have the same benefits of other ports because the transshipment that signifies about 70% less of benefits than a typical import/export.

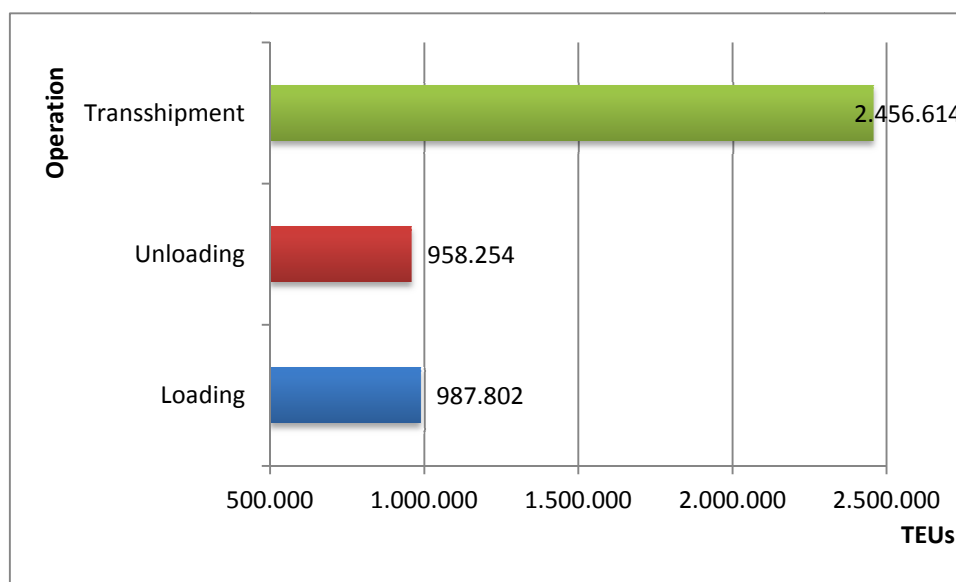


Figure 24. TEUs moved in VLC depending on the operation (2014)³¹.

³⁰ All figures are extracted from the program "Foreland 2008" that Valencia Port owns.

³¹ Empty containers are included. Empty containers in 2014 were: 277.532 TEUs of loading, 417.533 of unloading and 441.709 TEUs of transit.

In Figure 24 we can see the difference between exports/imports that we commented above and the significant difference among the different operations. More or less unloading and loading is the same so there is not a difference big enough in order to extract any conclusion. Talking about the areas that have more traffic to/from Valencia we are going to take only into account the loading and unloading³² (not transshipments):

-The area where most of the containerized traffic were moved were the Far East with 456.545 TEUs in 2014, most of which had as origin or destination China (44%), and were mainly imports to Valencia (63%). In the main producer country of the world, 328.756 TEUs were moved in 2014.

-The second most important area for Valencia if we don't consider transshipments were the Mediterranean and the Black Sea with 156.579 TEUs (exports were 68% of the traffic of the region). If we study deeper that case, Turkey is the main connection of the area (29%), followed by Argelia (24%), Egypt (9%) and Israel (8%).

-Spain is the third most important connection (64.555 TEUs) of VlcP but we are not going to take it into account because it is not an international market and we can consider most of the cargo Short Sea Shipping. Therefore, we are going to consider West Africa as the third most important region for VlcP that moved 62.435 TEUs in 2014 (mainly exports, 84% of the traffic to/from the region). Morocco is the main country of the region for exports and imports (45%) followed very far by Nigeria (8%).

Transshipments are less important for the port because of the fact about the benefits that we have commented during this chapter and we are going to extract only some points of the figures that we have obtained. Therefore, Valencia is a very important hub in the Mediterranean and it is also important to know the transshipment connections. 2.014.905 TEUs³³ were moved in VlcP in 2014:

-The main region for transshipments is the Mediterranean and the Black Sea. It is obvious that the reason of that region to grow is because the geographical location that MSC is taking profit of. VlcP acts as a hub for all the Mediterranean and it distributes the containers to other ports (spokes). In 2014, Valencia Port moved 624.414 TEUs what signifies about 31% of the total of transshipments. It is important to make an idea of the importance of VlcP nowadays and the importance of collecting all exports around Mediterranean in order to save costs, being Valencia the main port in the Mediterranean.

³² Only full containers are considered.

³³ Only considered full TEUs for transshipment. Empty are excluded.

Mainly, the traffic of transshipment of the region is coming or going to Argelia (40,7% of total transshipment traffic in the region) and Turkey (17,6% of total transshipment traffic in the region).

-The second most important regions are Far East (210.534 TEUs, 80% from/to China) and West Africa (209.491 TEUs, 46,9% from/to Morocco), using Valencia as the centre of the operations and the connection between different services of the company thanks to the proximity to all continents through Gibraltar strait and Suez canal.

-Finally, South America (Atlantic side) is another strategic location that is continuously growing and Valencia is achieving the goal of being one of the main connections from/to Europe (169.498 TEUs were moved in 2014). Obviously, Brazil is the main connection with VlCP and moved about 88% of the transshipment traffic in the region from/to Valencia.

3.2.1.2 Bulk traffic

The situation of the bulk cargo that Valencia Port moves each year is very far from the containerized traffic and in that instance VlCP is not a model to follow. The actual situation has arrived due to the efforts of increasing the containerized traffic and forgetting about bulk cargo, that is not the priority in the strategies of the port.

In 2014, Valencia moved only 2.821.438 tonnes of bulk cargo, what means less than the 6% of the total traffic of the port, an inconsiderable figure if we compare it to the containers that we have already talked about. In Figure 25 it is shown the traffic that Valencia Port moved in 2014 by type of operation. We can see that the unloading is the main operation of bulk traffic (81% of total bulk traffic) because of the little bulk produced in the country and the need of importing it. Moreover, we can conclude that it is not a specialized port neither in liquid nor in dry bulk because the percentages are nearly the same in both operations.

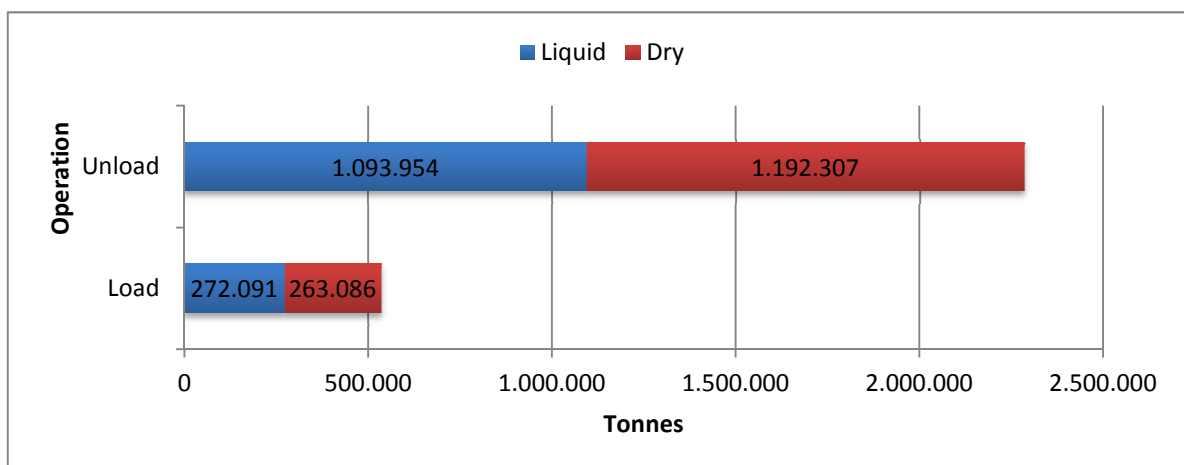


Figure 25. Bulk traffic by operation (2014).

If we talk about the type of cargo that is mostly moved both in liquid and dry bulk, following points must be remarked:

-In liquid bulk the most important type is Oil and coal products, mineral oils... that VlcP moved 832.704 tonnes in 2014, mostly diesel and fuel oil used for vehicles or industries in order to obtain energy. Organic chemicals are the second most important group (183.393 tonnes) followed by Beverages, spirits and vinegar that signifies around the 59% of the liquid bulk exported in 2014 (because of wine and other alcoholic drinks).

-In solid bulk the cargo that is much important are Cereals. In 2014 VlcP moved 851.334 tonnes of that cargo (mainly imports). The same happens with Fertilizers, phosphates, nitrosulphates and urea that almost all 256.157 tonnes moved were imports to the port.

At last, it is essential to know where are located the main regions that exchange goods with Valencia in order to understand how it is connected to other countries regarding to the bulk traffic. The main region is the Mediterranean and the Black Sea that VlcP moved in 2014 634.067 tonnes of liquid bulk and 996.323 tonnes. The principal countries of the region are Ukraine (420.524 tonnes, 100% imports to VlcP), Italy (320.847 tonnes, mostly liquid) and Rumania (189.857 tonnes, mostly solid).

The second most important region for bulk traffic is Atlantic Europe, principally thanks to Portugal. Valencia moved 286.533 tonnes of liquid bulk and 146.090 tonnes to/from the region, of which only from Portugal were imported about 241.025 tonnes of liquid (mostly Diesel).

3.2.1.3 Hinterland

The main feature of Valencia Port is the role that it plays of being the “port of Madrid” thanks to the geographical location. It is the closest port to Madrid and the good communication between both cities has let Valencia to be the gate of the Spanish capital. Therefore, Valencia is moving most of the traffic of Madrid that has the most important industries in the country as well as Catalonia. In the case of the autonomous region of Madrid, it corresponds about 18,3%³⁴ of total PIB of the country.

Regarding to the connections that the port has, Valencia has been built following the same characteristics of all other ports in the state. In that case, Valencia has the weakness of not having lots of railway connections. The main rail connections are the following:

-Madrid corridor: is the link that finishes in Madrid (Spanish gauge). It is the main connection, as already mentioned, and the advantage is that Madrid is the main hub of Spain due to the

³⁴ Figure obtained from “Instituto de Estadística de Madrid”, 2013.

centrality of the country that has built all the railway connections acting Madrid as a heart. It is very important for Valencia because exporting or importing to/from Madrid signifies that it is not only connected to the capital but also to many other places that are at the same time linked to Madrid.

-Aragón-Norte Corridor: Second most important connection of Valencia Port that connect the Valencian city to Zaragoza, crossing the dry port of La Plana.

-Levante Corridor: It connects Valencia to the south east of Spain (Murcia). Despite it is a strategic corridor, it is not very important because most of the Andalusian cargo is moved by Algeciras and the industry of Andalusia is not as important as Madrid or Catalonia.

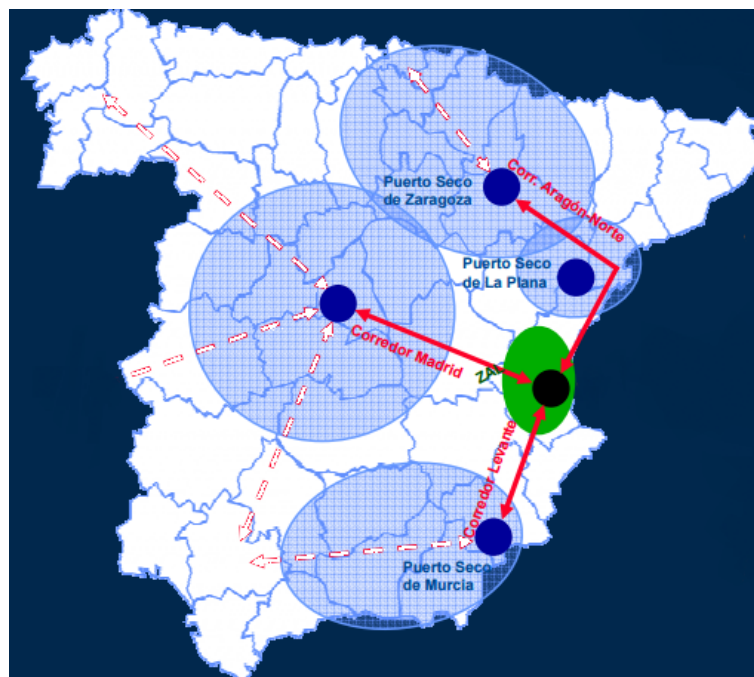


Figure 26. In red, the main corridors of Valencia Port

Source: Autoridad Portuaria de Valencia. *Primera convención hemisférica sobre logística y competitividad portuaria.*

About roads and highways it is obvious that the best highways are connected to the city of Valencia, and barges are impossible to be used because the absence of big rivers in the Spanish state.

3.2.2 Valencia vs Barcelona

PoB is a smaller port than Valencia Port if we compare all type of traffics and that is why Barcelona is 3rd in the Spanish ranking of containerized traffic and Valencia is located in the 2nd position.

3.2.2.1 Containerized traffic

For comparing the type of containerized cargo that each port has is very useful to make a comparative graphic between the two ports in order to understand exactly the main differences. In Figure 27 it is represented the comparison between both ports divided into three operational groups: Loading, Unloading and Transshipments.

- First of all, we can see that the difference of total containerized cargo that was moved is very different from one port to another. While PoB moved in 2014 a total traffic of 1.89M TEUs, Valencia moved 4.44M TEUs, 2.5M TEUs more than in the case of Barcelona.
- Secondly, if we compare the percentages of each operational group we can see big differences. The most important difference between the ports is the amount of transshipments that Valencia has that makes VlcP to have a big difference with its main competitor nowadays (PoB). The difference between transshipments is more than 2 million TEUs that mean PoB is not very far from Valencia if we consider the loading and unloading of containers (the difference is about 4 million TEUs).
- Those figures about transshipments means that Valencia is not having as high benefits as it seems in a first view because the benefit is much more when a container is entering or leaving the country of the port. In any case, Valencia may have more benefits because of the little difference in “Loading and Unloading” and the big difference in transshipments.

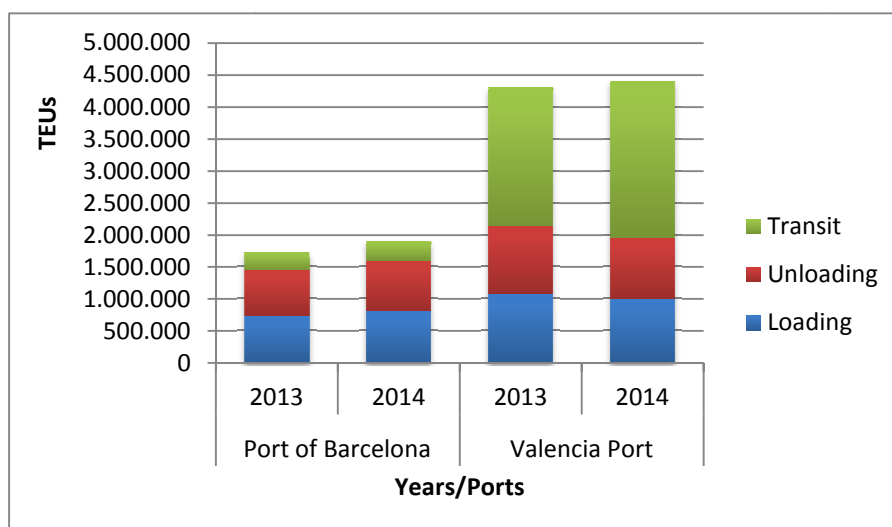


Figure 27. Traffic by Loading, Unloading and Transit in Barcelona & Valencia (2013-2014). Empty included.

d) The Figure 28 and Figure 29 shows the difference between the regions where exports of each port were delivered and where imports were collected. We can see that in the case of the incoming cargo the percentage is not very distinct because of the importance of the Asiatic continent in both figures (66% for Valencia, and 77% for Barcelona). We can find the most important difference in the percentage of cargo from America because for VlcP it signifies about the 17% of all imports (92 million tonnes approximately, while Barcelona is only moving 8%).

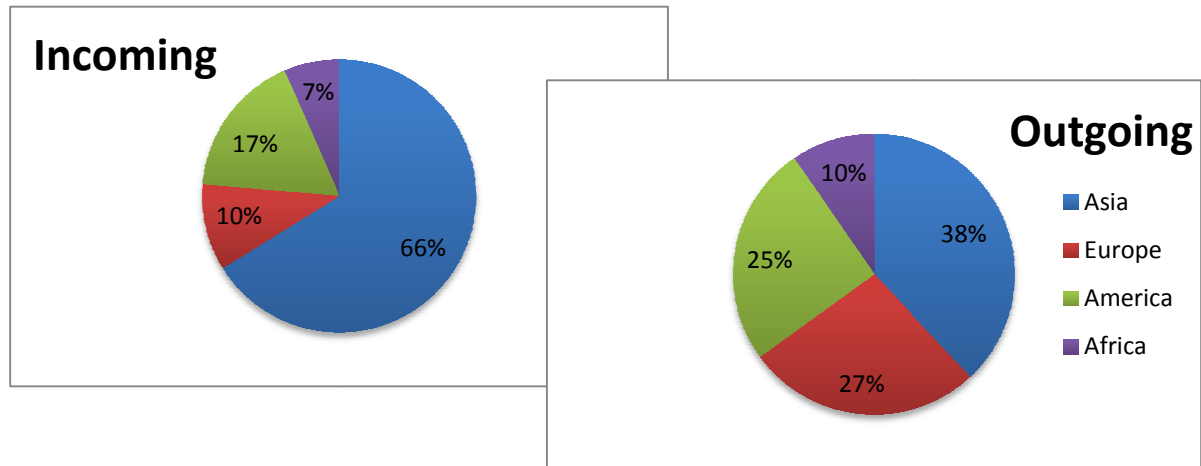


Figure 28. Incoming and outgoing containers percentage from/to Valencia (2014). Empty and transshipment containers excluded.

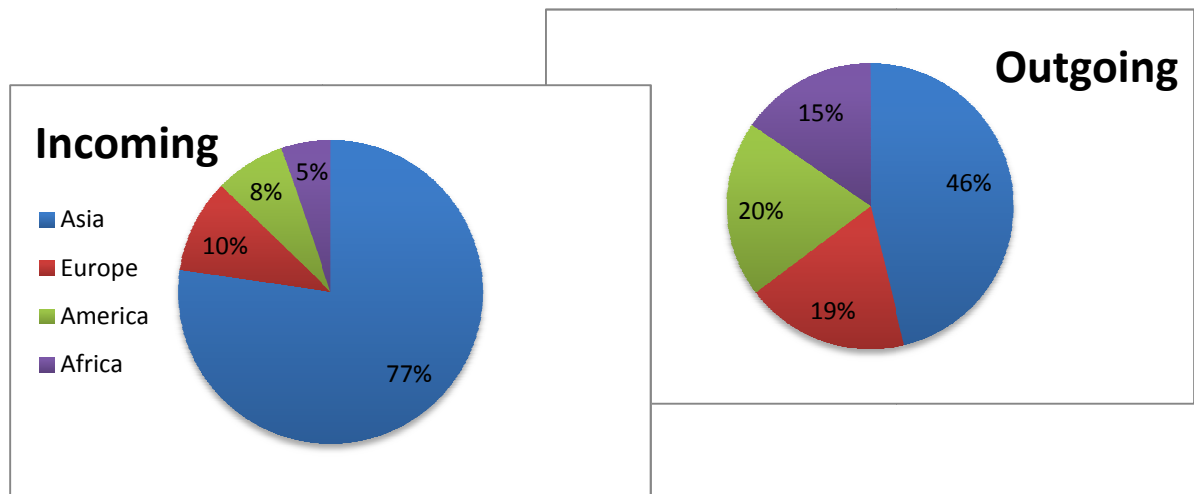


Figure 29. Incoming and outgoing containers percentage from/to Barcelona (2014). Empty and transshipment containers are excluded.

e) In the figures of the outgoing containers (exports) we can observe that there are some slightly differences comparing to the imports. We can see that in both cases the exports to Asia are smaller than the imports (Barcelona has higher percentage, with about 46% of all exports). In any case, the percentages are almost equal regarding to the exports to

the Asiatic continent. In this example, we can see that Valencia is a bigger exporter to Europe (27%) and to America (25%), but in contrast Barcelona exports little more to Africa (15%).

- f) In general, Asia is the leading market of both ports (exports and imports) so special attention must be taken when studying new strategies for the ports in Spain.

3.2.2.2 Bulk traffic

In the case of bulk cargo the situation differs a lot from the comparison between the containerized traffic of both ports. In that case, Barcelona is a more important port and Valencia is very far from the figures of PoB.

- a) As represented in Figure 30, the difference between Barcelona and Valencia is very big in dry and liquid bulk. Valencia moved in 2014 5.22 million tonnes of liquid bulk and 2.68 million tonnes of dry bulk, less than the half of the traffic of PoB. Anyway, the percentage of dry and liquid bulk cargo is more or less the same in both ports, being liquid bulk the most important traffic.

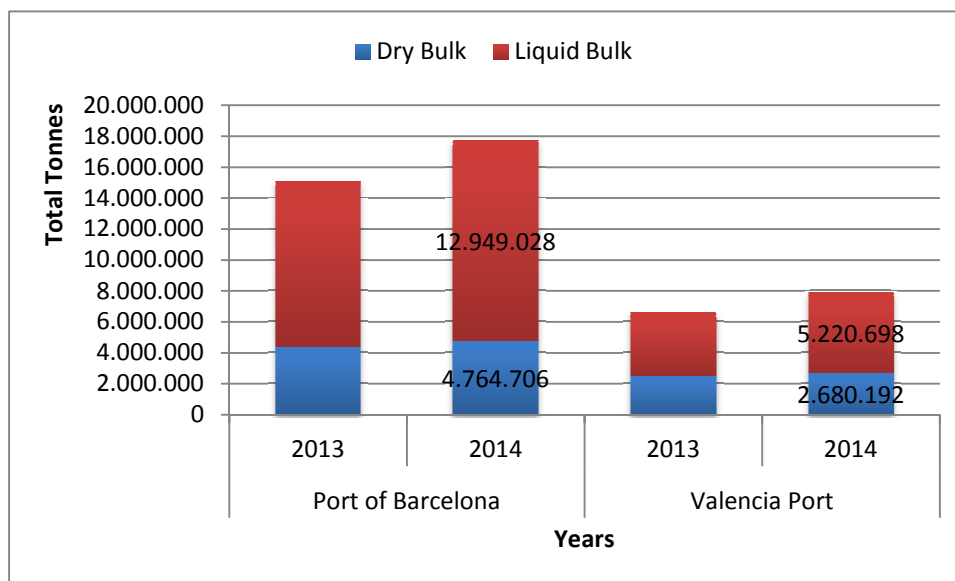


Figure 30. Tonnes of bulk cargo 2013-2014 (PoB & VlcP).

- b) The growth of the two ports has been similar from 2013 to 2014, what signifies that we can predict a new growth during the following years taking into account that the financial crisis is being recovered.
- c) If we talk about the type of cargo that was moved in 2014 we can extract the subsequent points:
 - a. Liquid Bulk: The most important cargo due to the need of energy production are hydrocarbons (fuel oil, natural gas, petrol, diesel...). Nonetheless, the difference among them is huge: while Barcelona moved about 9M tonnes of that type of product in 2014, Valencia moved only 832.704 tonnes.

- b. Dry bulk: in that case the cargo that each port moved is distinct. The cargo that Valencia moved most in 2014 were cereals and its flours (851.334 mt) whilst for Barcelona the main cargoes were Cement and Clinker (1.58M tonnes) and Soya bean (1.53M tonnes). In Barcelona were moved 425.310 tonnes of cereals and its flours, the half of VlcP.

3.2.2.3 Hinterlands

In that comparison between two ports we cannot find big differences because of the similarities they have regarding to the hinterland and the port connections. It is important to comment again the geographical location similarities: they both are located in the east coast of Spain, the west Mediterranean and only 350 kilometres separate the cities of Barcelona and Valencia.

Firstly, the railway connections have the Spanish gauge making almost impossible to connect Spain with the rest of Europe neither from Barcelona nor Valencia. It is the mainly inconvenient. About the extension of the hinterlands we can see some particularities depending on the port. For VlcP it is essential the connection that they have with the Spanish capital that enables them to increase the hinterland and to be a potential port in the Mediterranean. On the other hand, VlcP depends too much on Madrid and its industry, while Barcelona has his own industry. Accordingly, PoB depends mostly in the market of Barcelona and has the benefit of the connections to Zaragoza and Pamplona (Noain), having as a hinterland all north of Spain.

Secondly, Barcelona has an important point on its favour. It is located very near to France what makes easy to connect PoB if it had the international gauge. However, despite VlcP is not very close to any other country, it has two main benefits of the location: it is much closer to Africa and what is more important, it is closer to Gibraltar.

Finally, the road connections are practically the same in VlcP and PoB so it is not a reason of moving more or less traffic during a year.

3.2.3 Brief conclusion of the comparison

Valencia is a direct competitor for PoB if we talk about containerized cargo but it is not if we compare the bulk traffic. Barcelona has seen how in the last decade the growth of VlcP has been constant and it has arrived to the second most important port in terms of total cargo.

On the one hand, PoB needs to face new strategies in order to revert the situation that has been created. Talking about the containerized cargo it is something very important in order to understand the actual situation. VlcP bet for being a hub of an international shipping company (MSC) and it has some advantages and some disadvantages. It is obvious that if a shipping company bet for your port it will increase surely the amount of cargo that you move but probably it will make your strategy to focus on containers, forgetting about other types of cargoes. Furthermore, being part of the ports of a company means that the strategy and the rules that they want must be applied in order to make the company grow in the area where the port is located.

On the other hand, belonging to a company also means probably increasing the transshipments of the port but not the exports/imports. We have seen in the case of VlcP that the big differences to PoB are the transshipments what do not signify a big benefit for the port. Accordingly, Barcelona should find new strategies in order to revert not to the transshipment but the imports/exports and to be the leading port in the Mediterranean in terms of benefits (and it is not far). In addition, having the amount of transshipments as Valencia has force the port to have big capacities in order to be capable of moving such amount of traffic but without having big benefits.

If we take a look in the distribution of the containers by continent, Barcelona is very powerful in the African market so an important care must be done in order to catch traffic that goes to Valencia in order to convert Barcelona into a centre of the African market in Europe.

In the case of bulk cargo, it is more difficult for PoB to catch traffic of VlcP because of the type of goods that are moved. As we have seen during the comparison the type of cargoes that are moved are principally the same and it means that most of the energetic products that are imported are for industries located in the hinterland of each port, what makes the competence of the market more difficult to manage with.

At last, Barcelona must benefit of the geographical location in order to be the gate of Spain into central Europe entering through France. In order to achieve that goal, it is required an international gauge of the railway to enable the PoB grow and not to have problems in inland international trade.

3.3 Port of Marseille – Fos (France)

3.3.1 Description of the port

Port of Marseille (PoM) is nowadays the most important port in France, the 5th port in the ranking of total cargo in Europe and the 3rd largest crude oil port in the world. It doesn't move a lot of containerized cargo but the bulk traffic is its strength.

3.3.1.1 Containerized traffic

Fos-Sur-Mer is located very close to the city of Marseille, in the north-west of the Mediterranean, what makes possible to be very near to central (Germany) and south Europe (Spain and Italy mainly). As all other international ports it handles hydrocarbons and bulk liquid (oil, gas and chemical products), general cargo (containers or other packaging) and dry bulk (mineral and cereals). In total, Marseille handle a total of 78,45 million tonnes of cargo, divided in the following percentages:

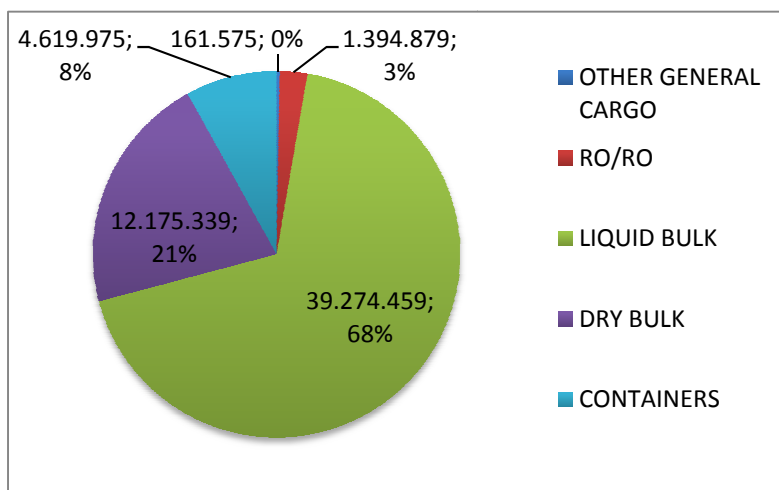


Figure 32. Import cargo in tonnes and percentages.

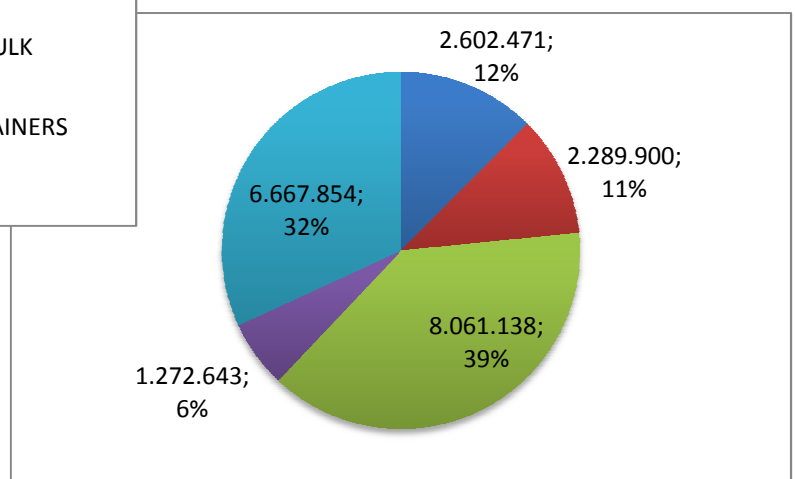


Figure 31. Export cargo in tonnes and percentages.

We can see in Figure 32 and Figure 31 that Marseille is not a port specialized in containerized cargo and liquid bulk is its main cargo. In 2014, Marseille was able to move a total of 981.544 TEUs of which 460.250 TEUs were discharged and 521.285 TEUs were exported. It means that

when talking about containers, we can consider that the port of Fos-Sur-Mer is an “exporter” port.

In addition, if we take a look of the percentages that are represented on the figures, we can see that in the case of the imports the containers are only a 8% of total traffic. In contrast, in the exports the importance of containers are much more important because it represents about the 32% of all cargo, only 7 points in percentage less than the most exported cargo (Liquid bulk in that case).

3.3.1.2 Bulk traffic

Bulk traffic is the strong point of the French port and in particular the liquid bulk that as we have seen in the distribution of all cargo in 2014, it moved 47.3M of metric tonnes (78% of total bulk traffic) against the 13.4M mt moved of dry bulk.

If we focus on the type of products, we obtain the following Figure 33 that represents in percentage the type of bulk that was moved in 2014. Firstly, we can see that Crude oil is completely dominating the scenario (53% of total liquid bulk traffic, all of it was imported). It is followed very far by refined products (25% of total liquid bulk traffic) and liquefied gas (14% of total liquid bulk traffic). Finally, all other bulks only represent the 8% of the liquid bulk traffic.

We can observe that 91% of the traffic consists of petroleum products, being the basis of the port and the most important product not only for liquid bulk but also for all total traffic. Moreover, in the stats obtained³⁵ it is very significant the total amount that is imported comparing to the cargo exported. If we only take into account the petroleum products, we can see that in 2014 it was imported 37,6M of tonnes comparing to the 6M tonnes that were exported in Fos-Sur-Mer.

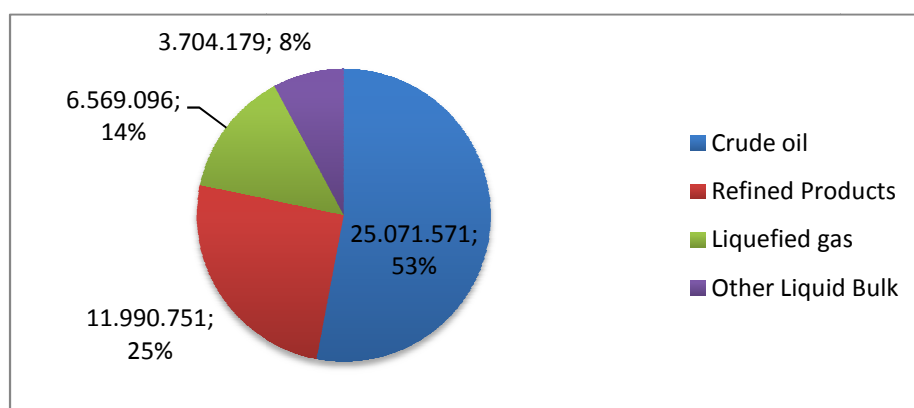


Figure 33. Liquid bulk traffic in Port of Marseille (2014).

³⁵ Statics extracted from www.marseille-port.fr (2014).

The situation of the dry bulk traffic is not very different from the liquid bulk in terms of percentage. In Figure 34 we can see represented the distribution by type of products. The dominating product is ore and scrap with most of the traffic (62% of dry bulk traffic) followed only, and very far, by coal that represents the 23% of all dry bulk cargo that was moved in 2014. Finally, cereals represent the 6% of the dry bulk, fertilizer only the 1% and other dry bulk a total of 8%.

As in the liquid bulk, most of the traffics are imports (exports only represent about the 9% of the traffic). However, we can see that cereals is the only product of all bulk traffic that has more exports than imports, what signifies that France, and more exactly Port of Marseille, is an exporter of cereals. The exports of that product signify more than the 96% of the traffic of cereals.

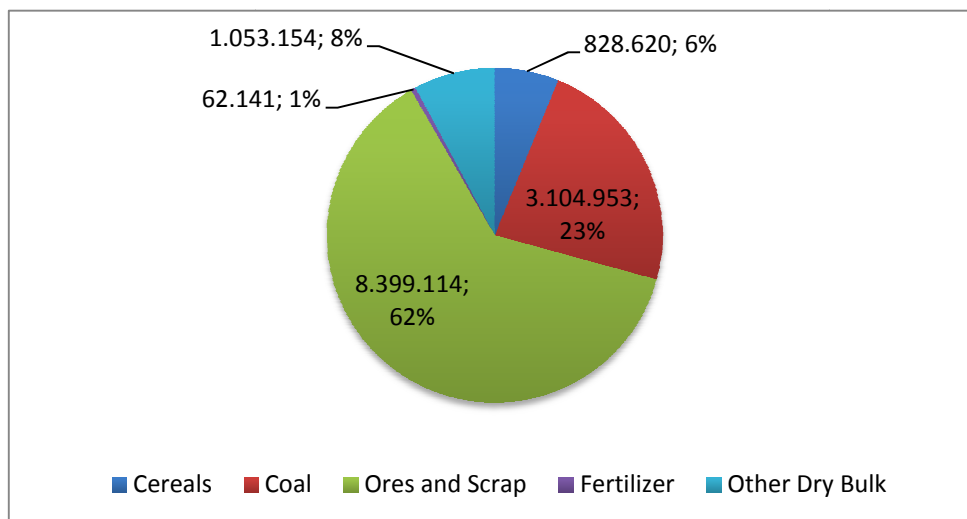


Figure 34. Dry bulk traffic in Port of Marseille (2014).

3.3.1.3 Hinterland

Marseille is located in the south-east of France facing the Mediterranean, in the middle among the border of Spain and Italy (about 270km to Italy and 370km to Spain). The strong point that the location has is that Marseille can act as the gate of Lyon because despite being very far, it is the nearest port of the second French biggest city and is serving the third city of France in terms of population (Marseille).

One of the features of Marseille is the inland waterway connections that it has thanks to the river Rhône that can connect from Fos to Antwerp (crossing through Lyon), the most important navigable waterway in the EU. In 2013, the traffic that was moved through inland waterway connections was nearly 3,1M of tonnes, increasing the percentage of containerized traffic in 4% (78.218 TEUs were loaded or unloaded, new record for inland waterway transport). Nowadays,

it is considered that about 7,4% of all cargo that is moved in Fos through inland connections are transported by waterway.

That aspect of having fluvial connection is a strong point of differentiation with other ports located in the west of the Mediterranean that doesn't have a river to increase the hinterland in an environmentally friendly way.

Anyway, for Marseille as all other ports the railways connections are the most important way of transport in order to increase the hinterland and to attract more traffic. For that purpose, it has several services with the aim of combining the maritime service of the port with the logistic chain that is needed for giving the best service to customers. Nowadays, the train operator *Naviland Cargo* has established 5 round trips/week between Fos and Toulouse so as to attract the traffic of the south west of the country. Furthermore, it has 10 times per week a connection to Valenton and Bonneuil (very closed to Paris, in the north), 3 times per week to Le Mans and Rennes (in the west of France) and 1 time per week to Cognac (south-west of France).



Figure 35. Port of Marseille hinterland. - Source: Marseille Fos annual report 2013.

Therefore, we have seen that Marseille doesn't have big connections to other countries located in the European continent (as Switzerland, Germany or northern Italy) and all its hinterland is focused on southern regions in France (according to the French Ministry of transport it represent the 60% of all its traffic). In addition, most of the traffic of the north of France is usually transported to Rotterdam or Le Havre, the most important port of France in terms of containerized cargo.

3.3.2 Marseille vs Barcelona³⁶

3.3.2.1 Containerized traffic

In general, Marseille is a more important port than the Port of Barcelona if we talk about total volumes that were moved during 2014.

- a) Regarding to full containers, Barcelona is handling more traffic than the Port of Marseille. In 2014, PoB moved about 180.000 more TEUs than the French port thanks to their equipments in terminals and the high added value industry that is located in the region.
- b) Focusing on the exports and imports, we can conclude that PoB achieved that difference thanks to the exports (702.336 TEUs), what confirm our hypothesis that the region of Catalonia has high added value industries that need to export their products. We can also see in Figure 36 that imports in both ports are more or less similar.

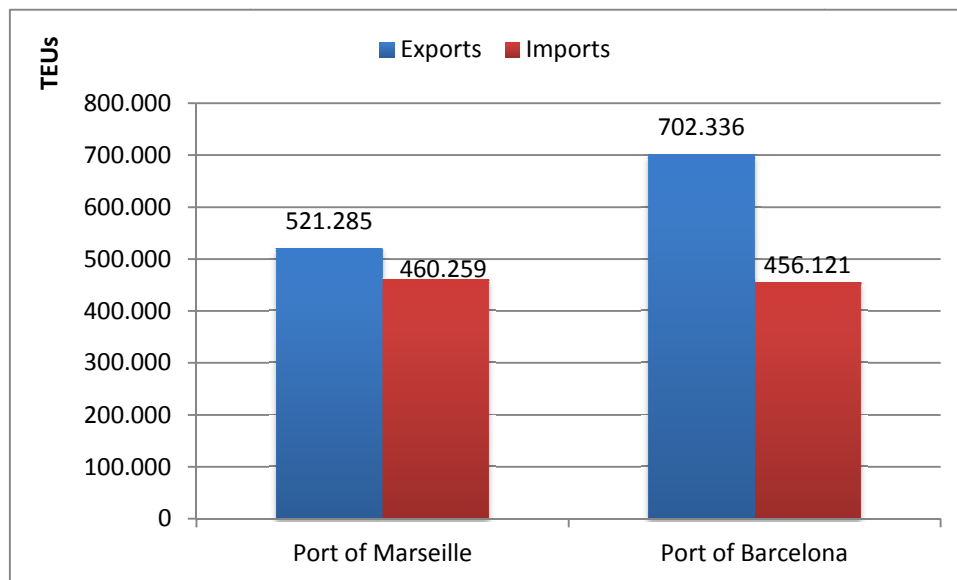


Figure 36. Exports and Imports in 2014.³⁷

- c) Finally, it is curious to remark that in the case of Port of Marseille the empty containers are almost the half of PoB. In both cases empty containers are imported above all, but the difference is substantial: in 2014 Barcelona moved in total 334.670 TEUs and Marseille only 198.366 TEUs.

³⁶ In the case of the Port of Marseille, the origin/destination of the cargo was impossible to be found, forcing to make a more superficial comparison.

³⁷ Full containers only considered.

3.3.2.2 Bulk traffic

Talking about the bulk cargo the situation differs a lot from the case of the containerized traffic because of the big amounts of volume that changes from one port to the other. The difference is about 34 million tonnes when comparing the liquid bulk traffic, and 8,7 million tonnes if we focus on dry bulk traffic³⁸. Consequently, the comparison can only be done in types of bulk but not in terms of volume.

- a) Regarding to the liquid bulk it is not easy to extract some conclusions because of the similarity of the products. Most of the cargoes are petroleum products that are imported into each port. In the case of PoB, it moved 9 million tonnes of petroleum products in 2014 and the Port of Marseille moved 43,6 million mt.
- b) The dry bulk is easier to compare because of the big differences of products that they are handling. In addition, the difference of volume as already commented is not as big as in the liquid bulk, what makes easy to extract some conclusions.
- c) While in Barcelona the main products are Cement or Soya bean, Fos-Sur-Mer is depending especially on Ores and scrap (8,4M mt) and Coal (3,1M mt). It means that the markets of each port are very different.
- d) In Marseille no fodder or oil seeds were imported or exported in 2014, while in PoB, despite not being its main product, it represented a volume of 166.240 tonnes.
- e) The product that both ports handled in 2014 was Cereal. In the case of PoB, it moved 425.310 tonnes of that product while Fos moved 828.620mt. The big difference remains that in the Spanish port most of the cereals were imported and in contrary, the French port is a clear exporter of that product (96,6% were exports).

3.3.2.3 Hinterlands

We have found some substantial differences between the Port of Barcelona and the Port of Marseille. First of all we must comment that despite they are not very far one from the other, we can say that they hinterlands are not in contact and each port is focusing on its own market.

Marseille has the advantage of being very close to central Europe and at the same time in the Mediterranean. We have already seen that it is not promoting the containerized traffic, but for the Asiatic market it could be a benefit if they could discharge in France in order to reduce transit times. Therefore, we can say that most of the hinterland of Barcelona is considered Spain, and for Marseille it is East France mostly.

³⁸ Data from 2014.

Talking about the intermodal connections that they have Marseille is little more advanced comparing to PoB because of the river Rhône. Thanks to the fluvial navigation they can give to their customer not only a more efficient mode of transport but also a non pollutant one. Moreover, it is also an advantage in order to expand the hinterland, not depending only in railways as other terminals that can't benefit of a river (the case of PoB).

About the trains there is not a big difference among them. Indeed, railway connections are the mode of transport that they are depending on when defining their hinterlands because of the high costs in the transport by road. In that case, they are conditioned by their connections and that is why we have said they hinterland are not converging.

Finally, it is obvious that in countries like Spain and France the road connections are very similar in the two cities so the traffic is not influenced by that type of roads.

3.3.3 Brief conclusion of the comparison

Marseille seems to be a direct competitor because of the distance and the geographical location where they are located but it is not completely true because they strategies and they terminal facilities are very different among them.

The most significant fact that needs to be highlighted is the amount of volume that PoM is handling, being able to cope with big quantities of bulk cargo, and especially liquid bulk. It means that it is a port that has been focused on that type of cargo instead of centre its attention in containerized cargo. That explains why Port of Le Havre is a referent of containerized cargo in France, having Marseille the status of bulk leader.

In addition, we have seen what are the main products (referring to bulk cargo) that both ports are moving and there are more differences than similitudes. It is true that in liquid bulk Barcelona is moving more or less the same petroleum products, but the difference in volume is extremely big, what makes impossible for Barcelona to compete with its French opponent.

In the case of dry bulk the difference remain in the point that each port has its own industrial area. For Marseille, it is very important to import types of coal and other materials in order to supply the industry located in the country, and for PoB it is important to handle with Cement (for the construction industry) or Soya Bean.

At last, we should also comment that, as in the Port of Rotterdam, having a fluvial river to sail through is an advantage that PoB cannot compete because of the geographical location. In order to compensate that big disadvantage for the Catalan port, it would be completely necessary to have better railway connections so as to arrive to more places and to provide a more efficient mode of transport when doing intermodal transport through the country.

Chapter 4. Horizon 2020

During all chapter number four it will be explained what is exactly the project promoted by the European Commission called Horizon 2020. The aim of that topic is to understand what are the new proposals to reduce the pollution not only in the transport field but also in all areas and to know how new policies can be applied in the case of Port of Barcelona.

4.1 Introduction

Horizon 2020 is a financial project promoted by the European Commission that was created with the goal of creating more job occupations and to research in innovative instruments to let the EU become a smart and sustainable territory.

Therefore, the goal is to emphasize efforts on the excellent science, industrial leadership and tackling societal challenges. Consequently, one of the main sectors that the project is encouraging is the transport. The efficiency is something essential in order to create a sustainable Europe. Moreover, it is something essential for people that uses means of transport and for cargo transport that is becoming more important in the last years, representing all the industry about the 6,3% of total European Union's GDP.

The big problem that the humanity is having these days is the dependency that the transport has on oil, one of the main pollutants of the planet that wants to be reduced applying those measures. Nowadays, it is estimated that about 63% of all oil consumption and 29% of all CO² emissions are a consequence of the transport. In addition, it is said that traffic congestion will increase about 50% by 2050 if nothing is done, what means that every year the pollution is believed to grow.

4.1.1. Pollution in the shipping industry

Pollution in the maritime transport is something to be taken into account if we consider that 90 percent of the world's consumer goods have been transported by sea thanks to ships or what is the same, maritime transport is estimated to contribute about the 2,7 percent to the total world greenhouse gases emitted. It is a percentage that has not been almost reduced in the last

years due to the absence of strict rules regarding the emissions of ships or emissions produced in terminals.

On the other hand, sea transport is considered one of the most efficient mean of transport if we focus on the emissions per unit transported (or tone). It is a completely true sentence, but it doesn't mean that sea transport is a green mean of transport. Therefore, vessels have the benefit of transporting lot of cargo but it is still a big contaminant nowadays. For that reason, a small change in the regulations regarding to vessels, operational transfer of goods or the accesses to the ports can affect directly in a reduction of the emissions making the sea transport a green mode of transport, being involved not only the vessels but also the ports.

The case of the ports is important because they need to handle with enormous ships, trucks, trains and other polluting equipment like the cargo-handling equipment. Moreover, we need to remark the fact that many ports are next to cities which can be affected by the air, noise and light pollution increasing the risk of illness. Likewise, the growth of the ports have done the pollution increase, but the governments have focused on the pollution of the industries, forgetting about the importance of the emissions generated by sea transport and all the actors that are making possible the supply chain.

The main pollutant in ports is considered the air pollution generated by diesel engines (from ships, trucks, trains...) that affects to the people living nearby communities or the workers of the terminal. The main air pollutants affecting the human health and increasing the risk of cancer or asthma, for example, are particulate matter (PM), volatile organic compounds (VOCs), nitrogen oxides (NOx) and sulfur oxides (SOx). In the following Figure 38 and Figure 37 it is shown the importance of the pollution in ports, being much less regulated than other sectors and being in fact an urgent matter to change the regulations.

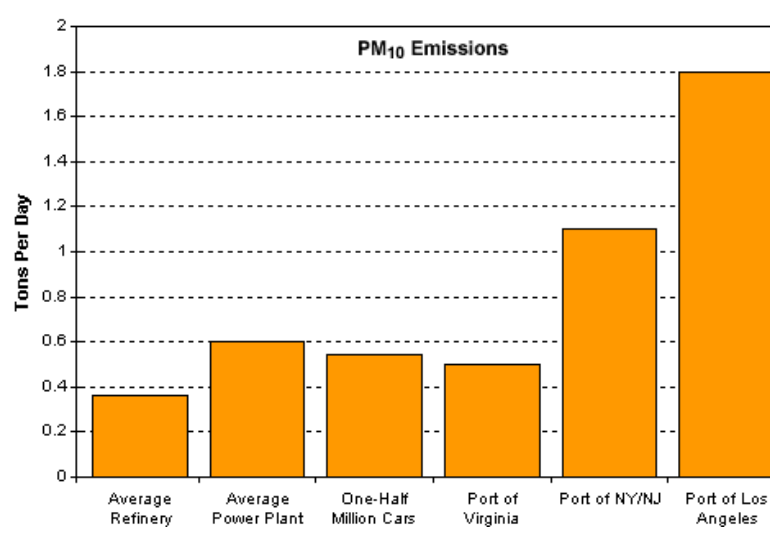
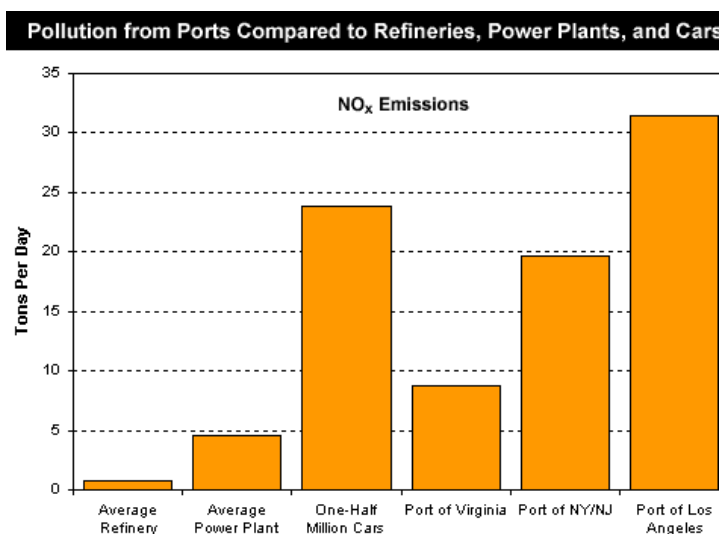


Figure 38. NO_x emissions from ports compared to other polluters. Figure 37. PM₁₀ emissions from ports compared to other polluters.

Source: Natural Resources Defense Council. *Harboring Pollution: strategies to clean up U.S. Ports*

Source: Natural Resources Defense Council. *Harboring Pollution: strategies to clean up U.S. Ports*

The growth of the ports worldwide is not only affecting the pollution emitted by the ships or in ship operation but also the traffic jams are increasing. All trucks or trains that are waiting for loading or unloading are contributing to the emissions in a wrong way. Thus, the ports have a high responsibility in order to minimize the traffic jams improving the efficiency, reducing the waiting time of the drivers and improving the accesses to the port, avoiding it to be connected to the same roads of the normal citizens.

Another way of polluting is the water pollution that damage the water quality and indirectly the ecosystems or human health (in the end the fish that a person is eating can come from those waters) but actually the ports are not able to reduce easily the emissions because it is something that needs to be focused from ships' point of view. In the following section, it is explained some measures proposed by Horizon 2020 and how can it be applied to the Port of Barcelona, not forgetting about the big impact that a port can have to the earth or to the cities located nearby.

4.2 Some of the Horizon 2020 proposals applied to the Port of Barcelona

Horizon 2020 focus above all in transport by road because it is the most used mean of transport for its accessibility for all users (you only need to have a vehicle to move around). Otherwise, the maritime transport is essential for the international exchange of goods and nowadays vessels are big pollutants due to the fuels used. Moreover, port terminals can have an important role when linking the two means of transport from seaborne to the inland transport, making possible the door-to-door trade and acting as one of the most important actors in the supply chain.

That is why Horizon 2020 is also focusing on terminals when trying to reduce the pollution and making an efficient transport from one point to another. The following items are some proposals done by Horizon 2020 (H2020) that are going to be compared to the Port of Barcelona in order to highlight where should it focus on in the near future in terms of efficiency and sustainability.

For that purpose, we are going to divide the different proposals in some topics in order to make easy the understanding and the classification. Some personal proposals would be also included in order to contribute to make cleaner the Port of Barcelona.

4.2.1 Efficient transport

The aim of the program H2020 is to reduce the CO² in a 60% until 2050 if we compare it to the levels of 1990. Therefore, it is essential for achieving that goal to reduce the consumption of the vessels and to search for other fuels in order to reduce the emissions of that gas. With that change, it is planned to reduce the dependence in fossil fuels, the impact of the transport in the biodiversity and contribute in the preservation of the climate change.

| PROPOSAL by Horizon 2020 (or personal proposal) | SITUATION in the Port of Barcelona and possible improvements |
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| <p>1- Use more clean and noiseless vehicles It refers to vessels, but we can also apply to vehicles used in the terminals (Stacking cranes, Straddle carriers, RMG, Terminal tractors, Reach stackers...). The proposal is to use electric engines or batteries, hydrogen batteries... to reduce the use of fossil fuels.</p> | <p>Nowadays, most of the vehicles that are used in terminals are using fuel as a source of energy. It is also the case of Barcelona that despite the modernization during the last decade (BEST especially) is still using vehicles that depend on non-renewable energy as fossil fuels.</p> <p>One innovative option could be the use of electric vehicles which are not emitting greenhouse gas or if it is too expensive, vehicles that use other alternative non-harmful fuels which have a concentration of less than 15 part per million.</p> |
| <p>2- Improve the mobility in urban zones The ports also have a big influence in all its surroundings regarding to the traffic congestion and the atmospheric pollution.</p> | <p>The case of Barcelona it has a particular feature different to other ports. The PoB is located next to the city, without any distance dividing them. It is a problem for the port that needs to handle the situation with the goal of not having many vehicles stopped in the roads.</p> <p>The proposal for this aim consists of having a direct link from the port to the highway in order to avoid the roads coming from the centre of the city. This measure could help not only to optimize the traffic but also to reduce the atmospheric pollution caused by the traffic congestions.</p> |

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| <p>3- Guarantee the use of alternative fuels Nowadays, it is being promoted the use of clean alternative fuels to reduce the effect on the environment. For that reason the new guideline of the TEN-T demand that the most important ports of the network must have at least two points with the aim of supplying LNG.</p> | <p>The PoB should improve its facilities to give service to the vessels that use fuels like LNG and to be a referent port of preservation of the environment.</p> |
| <p>4- Replace 10 years old cargo-handling equipment This change could contribute to reduce the emissions. Another option is to include diesel particulate filters (DPFs) with lean NOx catalysts (LNCs) with the aim of reducing the emissions in the old equipments.</p> | <p>It has been impossible to get the information about how old are the different equipments that are being used in the main container terminals of Barcelona (TCB & BEST).</p> |
| <p>5- Requirements for vessels It is important to reduce the emissions produced by the vessels while they are berthed or entering the port in order to minimize the negative effect to the surroundings of the port.</p> | <p>We can talk about different measures in order to reward those green vessels that contribute to protect the environment:</p> <ol style="list-style-type: none"> 1- It can be required the vessels that are berthed to plug in to shore side power while they are berthed and the operations of loading/unloading are taking place (Cold Ironing system). Thanks to that measure it can be avoided the continuous idling and the emissions while it is stopped can be deleted. 2- Require ships to use the cleanest diesel fuel possible in order to reduce the impact of the gases. The negative part is that now lots of vessels are exceeding the 15-20.000 parts per million of sulphur content and it is a handicap for that vessels. Probably that regulation should be implemented by IMO worldwide, not only in a specific port. |

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| | <ul style="list-style-type: none"> 3- Create incentives for those vessels that control the emissions, reducing the taxes with a discount (T1-Vessel tax, for example) or reducing the tariffs (Towage, Pilotage...). 4- Create an award for ship owners that are using cleaner fuels than Heavy Fuel Oil (HFO) when entering into the port. |
| <p>6- Green railway</p> <p>The railway is the most efficient mean of transport if we talk only about inland transport. For that reason, it is very important to promote a green railway in order to make possible the cleanest transport possible.</p> | <p>For ensuring the cleanest railways, some measures are proposed to promote the green transport:</p> <ul style="list-style-type: none"> 1- Enlarge the tariff to all trains that don't comply with the Environmental Protection Agency (EPA) standards about the engines. Despite it is a regulation from the USA, it will be very beneficial to implement a similar control to avoid locomotives with high level of pollution.³⁹ 2- Apply discounts to the trains that carry engine emissions controls and automatic engine shutoff controls in order to avoid unnecessary idling while stopped. |

4.2.2. Global leadership

Nowadays, the growth of a territory in terms of economy and employment is depending on the technological development and the improvement in competitiveness. In fact, according the statistics of the European Union the transport sector is representing about the 6,3% of the PIB in the EU and is giving employment to almost 13 million people. For that reason, is important to strengthen new methodologies in order to become leaders in efficiency, environmental output and safety.

³⁹ More information about EPA can be searched on:
<http://www.epa.gov/OMS/standards/nonroad/locomotives.htm>

| PROPOSAL by Horizon 2020 (or personal proposal) | SITUATION in the Port of Barcelona and possible improvements |
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| <p>1- Advanced productivity processes</p> <p>The automation is essential for increase the efficiency in the ports thanks to the integration of complex systems.</p> | <p>Barcelona Europe South Terminal (BEST) is nowadays one of the most advanced terminals in Europe when talking about automation. As already commented during the study, it is a semi-automated terminal that makes possible to optimize to the maximum the operations from the sea side (productivity) to the gates of the terminal (optimization). Moreover, that automation of the system also affects to the flow of entrance to the terminal when entering the trucks that only need to obtain a ticket and the system order them to place its vehicle in a specific place of the yard, reducing the waiting time to receive/deliver the container that they are carrying.</p> <p>It is also important to comment the fact that other terminals do not have automated vehicles, so it would be important to renew the systems in order to compete with all other competitors around Europe.</p> |
| <p>2- Development of next generation connections</p> <p>The aim of that proposal is to become leaders in the sector applying easy accesses to other means of transport.</p> | <p>For the time being, the connections of the PoB to other means of transport are good enough to handle with the amount of traffic that it has been working in the last years.</p> <p>The problem appears when most of the cargo from/to the hinterland is carried by truck, being the trains a not common mean of transport in Barcelona despite its good connectivity in the terminals. The cargo carried by railway could grow if an international gauge was available in the port.</p> |

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| <p>3- Regulation of concessions contracts</p> <p>The Port of Rotterdam in 2008 applied in the concession agreement between the Port Authority and the Terminal Operator the obligation of not exceeding maximum limits of pollution for all containers that arrive/leave the ports.</p> | <p>That method of controlling the emissions through the operator of the terminal can be applied to the new concessions of the Port of Barcelona. It is known that the concessions of Barcelona usually last about 35 years, but it should be applied for future agreements with the aim of reducing the air pollution.</p> |
| <p>4- Develop infrastructures and intelligent services</p> <p>Optimize the process in the transport operation is something that can be achieved thanks to the planning (IT solutions), the use (taking into account the life cycle) or the accesses to the ports (reducing the consumptions caused by bottlenecks in the surroundings).</p> | <p>About this proposal we are going to divide it in different points in order to talk about different aspects:</p> <ol style="list-style-type: none"> 1. Thanks to PORTIC, already in use, the transport operations are optimized. It allow among others: <ol style="list-style-type: none"> a) The Shipping agent to control their communications with the Port Authority and send the required documentation (CargoList, Manifiesta, Consignatario...). b) The Freight forwarder/Custom agent to communicate or request for something (Forwarding, Porticon...). c) The road carrier to control its cargo and communications (Transportista, Transportic...). 2. The new investments done in BEST are long term investments what means that it is intended that the infrastructures last for many years having a large life cycle. 3. We can consider that the accesses to the port are now correct but improvements could be promoted. One possible improvement is to have a direct link to the highway from the port, without the need to create bottlenecks in the roads that circle the city of Barcelona. |

4.2.3 Mobility improvements

The aim of that topic is to optimize the output and the efficiency in a demand in mobility that is continuously growing and needs to be strengthened. Moreover, the proposals are done in order to increase the safety for customers and employees, avoiding any accident not only in ships but also in the yard.

| PROPOSAL by Horizon 2020 (or personal proposal) | SITUATION in the Port of Barcelona and possible improvements |
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| <p>1- Reduction in the traffic congestion</p> <p>Having an intelligent and multimodal door-to-door transport is essential for avoiding congestions. An ideal way of achieving it is to promote a greatest integration among the different means of transport, the optimization of the transport chain and a more efficient integration of the operations. The goal is to optimize the traffic.</p> | <p>If the Port of Barcelona wants to be a model in the Mediterranean or in all Europe (still very far from the ports of the north) some improvements should be done:</p> <ol style="list-style-type: none"> 1. In order to promote and contribute to the best door-to-door transport that is the most common type used, it could be great to have a shuttle between the different terminals in order to integrate the transports and to make more efficient the operations. The ideal model could be to have a railway shuttle because it is one of the cleanest mean of transports that in a small space could work without problems. Another option is to have electric vehicles, but the operations are more difficult comparing to the railway. 2. Having a Standard Track Gauge of 1.435mm could contribute to optimize the transport chain. It is true that for exporting or importing in the Spanish country it is something irrelevant but when transporting to France or any other country of Europe, it is essential to have the international gauge so as to avoid having to transship in an intermediate point in the French border. In addition, the international gauge will make easier the reduction of road |

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| | <p>congestion (in the border to France, above all) thanks to the increase of goods transported by train that is expected.</p> <p>3. Promoting the train is very important to reduce the emissions in the inland transport. Moreover, if the international gauge is able from the terminal, you can attract more customers with a cheaper and green transport.</p> <p>We have to say that a reliable service must be performed if the customers that transport now by truck are wanted to be attracted by the rail option.</p> |
| <p>2- Improvements in passenger and goods mobility</p> <p>The use of apps in the transport or intelligent management systems can drive to a total integration of the information flows.</p> | <p>A complete integration of the information in all transport chain is essential for controlling the cargo that is being transported. As already commented during the chapter, the app Portic, which was produced by the Port of Barcelona, lets the customers of the port know in detail the information about its container or vessel. For example, it makes you possible to know if the container has done the Gate In/Out, if it has been dispatched or if it is already loaded/discharged onboard (and when).</p> <p>Additionally, the aim of the proposal is to have a better technology of planning and management, in order to make possible what is called “Blue belt”. It receives that name the idea of having interior navigation routes (like SSS) surrounding Europe so as to reduce congestions in road transport.</p> |
| <p>3- Development of new concepts in transport</p> <p>The use of vehicles that are able to work not only efficiently but also a low environmental impact is indispensable</p> | <p>The first proposal for the PoB has already been commented and is the fact of having semi-automated vehicles. For now, it is only applied in BEST so it is need to expand this strategy to other terminals in order to make</p> |

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| <p>if it is wanted to reduce the emissions. In addition, having an electronic system to control the goods or to empower the paperless transport.</p> | <p>operations more efficient and reduce the environmental impact.</p> <p>The second point of that scheme is to have an electronic system, international if possible, in order to make easier the paperless transport. It is now possible thanks to the electronic customs dispatch that has been applied in the Community Customs Territory (in the European Union). The agreement makes possible to have free transit for that cargo that has been dispatched or has been produced in an European country.</p> |
| <p>4- Reduction of accidents, number of injuries and mortal casualties</p> <p>New instruments are planned to be developed with the intention of evaluate, anticipate and reduce the impact of the weather conditions or natural phenomenon.</p> | <p>It is not usual in Catalonia the appearance of any natural phenomenon that makes difficult the usual work carried in the Port of Barcelona. In any case, when there is strong wind the operations are stopped for security.</p> <p>In the same way, during 2014 Barcelona had thick fog and the operations were finally stopped during some hours. A new methodology should be studied in order to counteract the effect of the fog and to continue with the usual operations. The strategy could be copied from any English port that is used to working with that important factor when a vessel is entering or leaving the port.</p> |
| <p>5- Incentives for trucks</p> <p>As we have already commented during all the study the trucks are the most polluter mean of transport if we consider the emissions per unit as one truck can only carry a 40 feet container. The main problem that the ports have with that type of vehicles is the continuous idling emissions while waiting for the start of the operation.</p> | <p>In order to minimize the truck idling it can be proposed to offer incentives to that companies/truck drivers that install pollution controls (DPFs, DOCs... already commented for cargo-handling equipment) and to enforce idling limits thanks to idle shutoff controls so as to avoid being emitting to the atmosphere if they are stopped.</p> |

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| <p>6- Security</p> <p>Regarding to the security in the supply chain it is needed to have a exhaustive control of all the goods that are entering or leaving the country so as to avoid possible attacks or other threats.</p> | <p>The case of the European system is very powerful thanks to the implemented system after the attack to the Twin Towers.</p> <p>The Single Administrative Document (SAD), which is needed to import or export any kind of good, has two main functions: act as a declaration of the taxes and to state the goods that are being transported. Using a electronic system, the goods that seem to have something strange will be inspected. Therefore, the Spanish ports already have an effective security system.</p> |
| <p>7- Promotion of the TEN-T network</p> <p>It will be considered an efficient port the one that promotes the most efficient means of transport like SSS or railways, so as to strengthen the inter-modality making easy the exchange of information about traffic flows.</p> | <p>As we have already seen about the near future of the PoB, it is planned to create the Mediterranean Corridor. It would suppose an incredible advance for the port that could encourage the use of other means of transports in order to reduce the congestions in a city like Barcelona that is very closed to the Port.</p> |

Chapter 5. Conclusions

The conclusions of the study will be divided in different parts. First of all, it will be explained the different conclusions of each main chapter (introduction not included) in order to see the main important facts to remark. After all parts are explained, it will be proposed the final conclusions including the different proposals for helping the PoB in the near future.

5.1 First impression

When I started my work I didn't know how long it will be or if I would arrive deeply to my purposes. After some months later and after having developed a work that I am proud of, I think the initial purposes haven't changed too much and the aim of the work has always been the same. It was not an easy work because its extension could be huge if I would have not specified the topic to focus on some specific traffic and some ports.

Obviously, before starting my work I knew Barcelona had a big port but it was very far from the big ports that are global powers nowadays. I have realized that the PoB is a very familiar port that can take much advantage of its position if some improvements are done. Moreover, after analyzing the different ports that were compared to the port I recognize the lack of care to the environment in ports, being most of the traffic transported by truck. It also explains the usual congestions that are located in the surrounding of Barcelona and especially in the surroundings of the port.

5.2 The Port of Barcelona

After the huge analysis of the PoB we can extract some important conclusions. Firstly, the PoB have a perfect actual scenario for being a leader port in the South of Europe. It has the features of any other important port like location, terminals (especially BEST, operated by the second most important port operator worldwide), space (being the expansion of the port in progress), infrastructures and the productivity. Is it true that some of the factors are not essential and we need to remark the hinterland, maybe a debt of PoB.

Despite having good connections to the entire country, PoB is far of being an international importer/exporter when talking about inland transport. That is the main reason why some companies prefer to avoid the Catalan city in order to discharge the container in other ports because its landside connections. In this way, Barcelona must put pressure on the government to build the Mediterranean Corridor. It will signify the expansion to central and East Europe by train, reducing also the congestion and arriving to other markets that nowadays are unachievable. For this reason, it is also urgent for PoB to build the international gauge, its main weakness, to expand their market to France and being able to be an international port. Now, Barcelona can almost use only trains in Spain because its width.

Secondly, PoB has good figures when talking about the traffic. We have seen that it is mostly a containerized port and is every time more important because the expansion of the containerized terminals of Barcelona. In addition, PoB and the region has the benefit of being characterized by the high added value cargo that makes richer the place and it doesn't have a big quantity of transit containers. About imports and exports, PoB should focus on the imports because exports, definitely, are focused on the productions of the region. However, imports can be caught if it is improved some features of the ports as the hinterland or the international gauge.

For the port it is important to focus on the relationships with the exporters located mostly in Far East and Japan (its main market) and Southeast Asia, having a special look to the potential markets that have been growing in the last years or will grow in the short run. We talk mainly about United Arab Emirates that have been growing quickly and Brazil that is increasing its exports worldwide, being PoB far of benefiting from it. On the other hand, we have to comment the case of Africa that Barcelona needs to focus on because of the growth that will happen any day. Nowadays, PoB is taking good advantage of North Africa but something must be done to catch the traffics from West Africa that is decreasing every year in spite of not being now an important market worldwide.

About bulk traffic it is also important to maintain the growth that is occurring in last years but probably for PoB is more important the containerized cargo. Furthermore, we need to take into account that Barcelona is located next to Tarragona, being the port a leader in the market of bulk traffic and better equipped thanks to its infrastructures.

Thirdly, the strategic plan for the near future detects more or less the different points that PoB needs to improve for catching more traffic and being a more efficient port. It is, for example, the aim of shifting inland transport from roads to rails in order to pollute less and to be more respectful with the environment. That is why the Mediterranean Corridor is completely essential for the future in order to increment traffics to/from Europe crossing France and also catching traffic of a big competitor such Valencia Port.

5.3 Comparison between ports

During all the comparison we have seen how PoB has lot of work to do if it is wanted to catch its competitor in terms of traffics. We have had the opportunity of studying three very different ports starting by a leader in the containerized traffic and finishing by a leader in bulk traffic. In all cases, they are ports that are competing for the best position because they are located in Europe. Obviously, the cases of Marseille and Valencia are direct competitors because they are very close one with each other but we must not forget Rotterdam, which has not stopped growing and is the main hub of Europe. We can extract some main points of the whole analysis to detect the main strength and weakness of the ports comparing to its competitors:

-In terms of total traffic, PoB needs to establish urgently a new strategy if a big growth wants to be achieved. Apart from Rotterdam, which is a particular case, we have seen that VlCP has overtook Barcelona in the last years despite much of the traffic are transshipments.

-Barcelona has the main weakness of not having a river to navigate through and the use of barges is completely impossible. This non-variable factor makes Rotterdam and Marseille more competitive ports that are able to expand their hinterland thanks to that green mean of transport.

-To counter this negative position, it is needed that PoB insists on the building of the Mediterranean Corridor. This will be the unique method of expanding the hinterland using railways and will let the port to be the gate to Europe. Nowadays, it is also a main weakness for the Port of Barcelona not to have the international gauge that stops the growth of the port comparing to other ports in Europe that are able of using barges or more railway connections.

-The Corridor will let PoB attract the traffic of Valencia Port because its proximity and would be important to attract traffic (imports/exports) because its economical benefit. We need to remark that VlCP has nowadays such traffics thanks to its cooperation with Mediterranean Shipping Company (MSC) and the high number of transshipments that they have.

-After studying the three other competitors, Barcelona needs to focus on the market of Africa. We have seen that for now it is a potential market for the Catalonian port and it is important to strengthen its position cooperating with ports of the other continent and taking profit of its situation. Comparing to the other ports, PoB has a privileged position because its proximity and VlCP is not focusing on this market.

-About bulk traffic we have confirmed that PoB is very far of being a model mostly because of its infrastructures. In addition, we have to take into account that is completely surrounded by two ports specialized on that type of traffic: Marseille to the north and Tarragona to the south.

-Finally, remark that the main competitor of PoB because the typology of the traffic and the proximity is VlCP, and every strategy must be analyzed in order to compensate their decisions.

5.4 Horizon 2020

After looking the reasons why Horizon 2020 was promoted, we can extract some conclusions about the pollution worldwide and the pollution in PoB (despite we don't have objective figures about it). We have seen that the environment is the most valuable thing that the society has and we must do something to preserve it if we don't want to destroy it. For this reason, H2020 has lot of work to do in Europe.

We need to take into account that the pollution is growing continuously in all sectors and the transport is not a exception. Moreover, the transport is coming more and more important because of the increase of the exchange of goods and that means that it is a sector that needs to be urgently regulated because of its big impact to the sea water, the air and the noise pollution. Therefore, ports are a subject of the supply chain to consider gravely for their positions that are usually located next to important cities.

The case of Barcelona is a clear example and that is why it is essential to apply some new measures in order to protect the inhabitants that are living in the surroundings of the port. Accordingly, H2020 policies about efficient transport, global leadership and mobility improvements must be applied in order to reduce pollution while vessels are entering/leaving the port, while berthed or the pollution produced by cargo handling equipments during the operations. In the same way, it is needed to optimize the connections with other means of transport (truck above all) to avoid big queues while waiting for receiving their cargo.

For now, we have verified that PoB is still very far of being an ecological port because of its bad railway connections to other parts of Europe, the absence of awards to "green users" or the lack of control in trucks (considering that almost all inland transport is carried in this mean of transport). All problems that the port has could be improved by shifting the transport to other means of transport applying all the measures already commented that would let PoB to become a leader like Port of Rotterdam, which is a perfect example to follow.

Finally, we need to remark that despite PoB can improve their respect to the environment by applying those measures commented in Chapter 4, it is urgent an international strict regulation regarding to the pollution provoked by sea transport. It is the only way of reducing the emissions and the big impact of that enormous sector by forcing the ports and shipping agents to control their emissions and to fee to those carriers that doesn't comply with the minimum required. We must not forget that saving the world is in our hands and a small change in the sector can be a big change for the environment.

5.5 Total conclusions

During all the work we have studied the different situations of the PoB from different points of views in order to detect its weakness and strengths to promote the positive situations of the ports and to improve the deficient matters. For this reason, we are going to extract some conclusions/proposals in order to make the Port of Barcelona a leader in Europe not only in traffic but also in respect to the environment.

- a) We need to begin the conclusions by saying that PoB is very far comparing to other ports like Rotterdam or, in a different way, Valencia and Marseille. Because of that, it is important to try to catch some traffic of other ports to improve the actual situation of PoB.
- b) PoB should focus on its main market to make it stronger. We are talking about China and in general all Asia that for PoB it signifies the most important market far from all the others. Consequently, it is important to benefit of the position of the port and to try catching traffic going to other ports (Valencia, Marseille or even Italy). By improving the situation of the port with this market would let the port to increase in traffic, benefits and to have a financial cushion in case of urgency.
- c) It is as important as the last market to comment the case of Africa or the United Arab Emirates (UAE). During the study we have seen that for PoB it is essential to become a hub for the traffics to those regions. In the first case, the traffic to/from North of Africa has not stopped growing and it is important to catch even more traffic that for now is going to other ports. Barcelona has the benefit of its geographical location and that is the reason of the growth to this region. For West Africa, PoB should try to catch the traffic that has been decreasing during last years.
- d) In the second case, the traffic to/from UAE despite not being as important as the African, it has grown during the last decade. For Barcelona it is also important to position itself as an importer/exporter to this country that is continuously growing and is an economical power.
- e) For PoB it is important to focus mostly on containers. We can affirm it because of the tonnes that are being moved each year and its geographical position. Being geographically located between Tarragona and Marseille makes almost impossible to become a leader in bulk cargo, taking also into account the infrastructures that are mostly focused on containerized cargo.
- f) It is completely urgent to promote a complete change in railway policy. For PoB it is totally necessary to have the international gauge that will let the port mainly to shift inland transport from trucks to railways (less congestion and pollution) and to expand its hinterland to all Europe through France. It is significant that this measure already appears in the Strategic Plan 2015-2020 and in the policies applied in H2020, what means it is a critical point for the port.

- g) In the same way, the Mediterranean Corridor (with international gauge) will let PoB to increase its traffics by two different ways. Firstly, by catching traffic from the connection to Valencia Port that will let Barcelona increase the hinterland in the region of the competitor port being better located than Valencia (because its distance to France). Secondly, expanding its hinterland to Europe thanks to more efficient railways and better connections to many other countries already explained during the work.
- h) From a green point of view, it will be very beneficial for the surrounding communities of the port to empower the use of low fuels with low concentration of pollutants like LNG, applying a reduction of taxes to those vessels respecting the environment. Moreover, applying this measure the port will ensure that the cleanest companies call PoB.
- i) For being a model it is also very important to value the impact of the connections to the port. For this purpose it is needed to reduce waiting times of inland carriers by creating a direct link from port to highway (without sharing the road with usual users), promoting the railway above all and creating an incentive for the trucks using pollution controls and automatic idle shut off in order to minimize the pollution while waiting for its turn.
- j) Like the idling of the trucks it is also important to control the idling of the vessels that are berthed waiting for finalizing the operations. Accordingly, it will be important to award those ships that use automatic shut off to minimize the idle and require using cold ironing system to avoid unnecessary pollution.
- k) We do not need to forget one of the main strengths of the port regarding to the productivity, efficiency and respect to the environment. We are talking about the semi-automated terminal BEST that is one of the most modern terminals around Europe. PoB must take profit of this situation and to strengthen SSS routes.
- l) Regarding to the semi automation of the port, it will be also very beneficial to have a rail shuttle between different container terminals in order to optimize the operation (mostly SSS) and to make the cleanest service possible.
- m) Looking to the near future, it will be important to apply requirements to future concession agreements. We talk about the obligation of not exceeding the maximum levels of pollution established like the case of a terminal in Rotterdam that applied this clause in the concession contract.

I would like to conclude by saying that despite those measures are not taking into account the economical point of view (costs) it is important for PoB to improve not only in tonnes but also in efficiency, having the possibility of being a pioneer in Europe applying green measures to increase traffics.

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