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Antwerp and Rotterdam: one sea, two ports

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Introduction

Antwerp and Rotterdam represent two doors on the World for the European market.
The purpose of the paper is to provide data, information and knowledge of the dynamics that move the business of the two biggest and most important ports in Europe under different aspects, to provide a possible fair comparison and, from various points of view, considering the specialisation of the two ports and the different actors that should choose one or the other (or both of them).
After a view on the expansion and evolution, on general basis, of the ports in order to understand the topic and synchronise the dynamics of the World and European commerce, the aim is to bring the focus onto the two specific countries (the Netherlands and Belgium) and, whether is possible, provide data of the specific port of Antwerp and Rotterdam, considering international standards and specific developments.
The general view of a port's development is then adapted at the two specific harbours with political, spatial and economical influences, showing the constrains and the motor of the balance between the public and the private sector, the necessity of space availability and the economic choices for the land and city development. The models of port's and regional's development of the majority of the seaports will be presented in order to understand the past and future of the ports, noticing that their evolution is in line with the specific one of Antwerp and Rotterdam, with deviations of course, but also with the possibility to analyse the importance of a common movement.
It will be shown the tables and roles of the people operating in the ports, trying to understand the balances and compromised agreements between the forces that operate and interact with the internal and external relationships, bringing considerations on the diagram of the responsibilities.
After the vision of the principal decision-makers, the attention will pass on the dock workers and practical actors of the job in the ports: those people that decided in the past and are deciding also nowadays the reputation of the ports, the role of their additional value and development not only of the harbour, but the entire city that hosts it. Moreover, regarding the city and its development, will be pointed out what does it mean to be a port-city, what are the pros and cons, not only for the planners, but also for its citizens, considering that if there is the necessity to start a relation with a certain actor (in this

case, the port), it is also important to understand what lies around it, what are the dynamics and conditions of the inside and surrounding areas.

The analysis will then pass to the consideration on what is the port's business under a global and regional observation. The presentation of the current trends and the hypothesis of the future ones, with the possibility offered in terms of costs saving and connection modes, considering the location of the two ports and the influence of the international flows. With the presentation of the data, it will be then provided the overview of the European's commerce via waterways (either it seen under the hinterland shipping or via sea), compared with the other methods of transportations, taking into consideration what are positive influences (and negative ones) of one method or the other. The Netherlands and Belgium will be then put under the microscope, considering the ways of connection a surplus (or, in some cases, a deficit) for the ports due to the evolution of the logistic role in the value chain of the two gateways of Rotterdam and Antwerp.

In the end there will be the analysis of the data regarding the two ports in detail, considering what are the advantages of one over the other. The comparison will be done by bringing the differences with the national levels and comparing the data of the two ports with each other in terms of quantities and volumes, considering an adaptation by the additional value with job creations and tasks that a particular type of cargo needs in order to be handled in the harbour, taking into consideration also the importance of the infrastructures.

The paper, in this way, is trying to answer to the questions that allow to identify any port, and, more specifically, due to the capacity and similarities of the port of Antwerp and Rotterdam, is pointing out the advantages of one over the other in the global (or regional) competition, without forgetting their cooperation (for example in the liquid bulk sector). The movement of the cargoes and the type of cargoes itself, the possibility of acting as gateway from and for the hinterland and their competition represented in the quality of the accessibility of the ports, the space that they can offer and the connection with other nodes are the conditions that contribute in the choice.

It is fundamental to keep in consideration the different points of view. It will be given an overview of the various influences that a port can have, with the aim of enabling different type of actors in considering what, subjectively, can be considering the "best port", remembering the bond between the harbour, the industries, the city and the people. In

this sense, there could be the preference of a big shipper, possessing enormous vessels, in choosing the port of Rotterdam thanks to its possibility to welcome bigger ships than the close competitor or the possibility for an industry to locate in Antwerp thanks to the land policies adopted.

The analysis will then be done with the consciousness of objective characteristics, but also with the consideration of the fact that not always what is better is also the best.

Chapter 1 “The ports”

There exist many definitions of “Globalisation”. Some refers to globalisation as a process after which Nation States get more connected, limit their powers and are influenced by transnational factors. Other are more specific and mainly refers to economic aspects (both national and local), they overtake the boundaries (physical and ideological) and organise their affairs with a World view. In one sense or the other, the globalisation is certainly something that allowed the raise of new fields to study, new interconnections and new problems to solve.

In this context, the evolution of the port activities is one of the most affected, starting from politic, going through economic and ending into social aspects. Nevertheless, this subject is one of the “new fields” raised with globalisation. In fact, only from the 1960, when, for the first time, the study of the maritime history has been namely pointed out (*“Recent trends in maritime and port history”*, David M. Williams, 2003) we have the introduction of the “Port history” as a speciality to study, passed from a geographic matter to an historical one, more related to social sciences and economic aspects.

It has been understood that looking into the past in order to see in the future of the maritime economy is necessary and a flash back only from the late sixties (when also the first container has been shipped from America to Europe) would not be enough to understand why the two main European port, specifically the port of Rotterdam and the port of Antwerp, became what they are today. An analysis on the evolution of the ports during the years, starting from the first usage as centre of commerce for the goods is necessary. It is since the 15th century that the two ports started to acquire reputation, then, it is from that far away period that they started to grow.

The definition of Kuiler and Verhoeff (1973) and Notteboom (2000), reported by Reginald Loyen (2003), defines what can be considered a seaport: it “ *can best be described as a logistic and industrial junction in the global transport network with a strong maritime character, where a functional and spatial combination of activities takes place*”.

Even if the two north ports did not start their history of domain in the international economy by the sea, but they developed their borders in the hinterland, on the banks of two long rivers such as the Scheldt and the Rhine, they increased their power, and, nowadays, their development allowed them to be considered within the definition of “sea”-ports. In fact, the both cities are a centre of logistic (especially for the region of

Benelux, with particular attention to the historical province of the "Kempen", or "Campine"), industrial activities (with the factories that arrived in this area since the late 50s) and are both considered cities with strong maritime character, with the old town facing the water.

It is important to remember that the port of Antwerp does not even touch the cost of the North Sea and the port of Rotterdam only conquered the National costs from the 1970, with the construction of the Maasvlakte and Maasvlakte 2.

The port of Antwerp is situated in the beginning of the estuary of the river Scheldt within the Belgium borders, mostly on the right side of the river. The city of Antwerp developed during the 15th and 16th century with the growing commerce given by the trades with the Portuguese and Spanish people and the easy connection with the German hinterland. Helped by the decline of the close competitor, the city of Bruges, Antwerp had a growing of glory followed by decline (as the how territory of Belgium and the Netherland) due to the control of the Spanish army and only in the 17th century, the commercial power of the Belgium city started to rise again. It is interesting to notice that the river Scheldt, source of prosperity for the city, due to political reasons, does not end within Belgium borders, but, the municipality of Antwerp had to face the proximity with the Netherlands territory and limit the expansion of the port to those constrains.

Rotterdam, instead, was built on the river Rotte (that gives the name to the city), an inlet of the river Maas that unifies with the Rhine in a big delta allowing the port to have direct access to the North Sea. The city, as most of the territory of the Netherlands (and Holland in particular) is situated under the sea level. For this reason, the citizens had to fight against the water and, in order to acquire the profitable land of the low country (Rhine–Meuse–Scheldt delta), built dams and allowed the city to start to be recognised as it is (in 1340) and becoming a centre of trade between Germany and England. As it happened for Antwerp, the commercial phase suffered by the Spanish control, however, that was not the hardest moment for the city. The Second World War brought destruction to the town, with several buildings that have been demolished by the bombs. The only monuments that survived (surely with damage) were the townhall, the post office, the financial centre and the St. Laurenskerk but, from the end of the War, the city started to raise again. Rotterdam became than the reference and major shareholder of the biggest port of Europe and a base of modern architecture, achieving the position of second biggest city of the Netherlands.

1.1. Steps for Network

The port of Antwerp and Rotterdam, as any other port, are changing. The influence brought by politic and economic developments and the new technologies of any kind (from infrastructure to communication) modified the spatial structure of the ports, the role of the Port Authority and its own functions. Through the years, it is possible to observe an evolution that can be visualised in four steps pointed out by the Dr. Arjen van Klink (1995). This evolution is the result of three main breaks in the evolution of the economy of the World, where only the ports that were able to adapt as fast as possible to those variations, have been able to survive. This is the reason why some ports that in the past were considered powerful centre of command and trade, nowadays cannot afford anymore the traffic of goods and information that transit through them.

Table 1: Stages in development of seaports

	Stage 1	Stage 2	Stage 3	Stage 4
Fundamental development	Rise of trade	Industrialisation	Globalisation	Informatisation
Main function of the port	• Cargo handling • Storage • Trade	• Cargo handling • Storage • Trade • Industrial manufacturing	• Cargo handling • Storage • Trade • Industrial manufacturing • Container distribution	• Cargo handling • Storage • Trade • Industrial manufacturing • Container distribution • Logistics control
Dominant cargo flow	General cargo	Bulk cargo	Containers	Containers + data
Spatial scale	Port city	Port area	Port region	Port network
Role of port authority	•Nautical services	•Nautical services •Land and infrastructure	•Nautical services •Land and infrastructure •Port marketing	•Nautical services •Land and infrastructure •Port marketing •Network management

Source: "The Kempen nexus", 2003, Arjen van Klink, (Van Klink 1995)

In Table 1 are presented the steps of the time-space evolution of a general developed seaport that can easily be referred and has a lot in common with both the port of Antwerp and Rotterdam.

The evolution from the 1st stage, where the economy is based on trades, to the 4th stage, where the ports had to adapt in the sharing, controlling and managing the information, is divided in four periods and can be modelled by relating each of them to a particular condition for the outside and connected economies.

1.1.1. The rise of trade

The first stage is the longest one. Identified as the trading period, it can be referred to the very first moment of activity of the ports and it can end with the beginning of the Second World War. The reason why it is considered such a long period is because the "shape" of the port did not change much in the considered time or, to be more precise, the configuration of the port as a "City port" did not change.

The period itself could also be divided into other sub-period. It can be considered the beginning of activity of the two ports, where, while Antwerp started to operate as a town with maritime activities, Rotterdam was focused on fishing and, after, both businesses moved towards trade activities. Another transformation could occur in this step: the good/row material that was traded changed in this period, especially with the colonialism and, after that, with the first and second industrial revolution. However, in terms of spatial scale, the both cities remained the same (of course with normal development due to the average increase of population) and did not encounter evolutions or, to better say, did not bring evolution, but the development was given for example, by the country where the two ports were operating.

The "port city" is that moment for the city when the activities (any kind of), due to limited mobility, start to see their affairs growing thanks to the ports and the benefits (job opportunities for instance) are limited to the city, which is constantly growing (and in the case of Rotterdam and Antwerp, annexing the surrounded villages).

The biggest increase of business has been brought from the colonialism and the colonies that both Belgium and the Netherland were owing, with the increase in trading of general cargo. It is due to that period that Antwerp, nowadays, is the centre of diamonds of the World: the possession of the Congo State as a colony brought a huge amount of diamonds to the city, that specialised in the sector and, still today, has the primacy.

It is clear to see how much the cities started to depend on the ports. A strong impact had the industrial revolutions. The success, in this case, was due to the strategic position of the two ports. The evolution of the Belgian Walloon region and the close rich German

economy with the availability and necessity of the new important raw material such as iron and coal were focal points for the growing economy of the two ports.

As it happened for the colonialism, that saw the empowerment of trades, it is possible to state that during the industrial revolution, the configuration of the city did not change much and the main focus for the ports stayed connected to exchange in goods. Also the configuration for the working economy did not change: the employees in the port were mainly dockworkers with low necessity/possibility to move away from the city and, as far as the docks were close to the centre, the more working possibility there were for the inhabitants.

As shown in Table 1, the main activities, for all that period are good related, with the main functions in handling the ship's cargo, storage the goods and find good markets where to trade the material, the difference during those years can maybe be individualise in the markets where those cargoes were directed to/coming from, which, through the years, continued to grow.

1.1.2. Industrialisation

The transformation in the port's economy arrived with the evolution of the port's infrastructure from a merely trade centre into an industrial centre.

After the Second World War, the port's landscape changed: the construction and dedication of the port's area to petrochemical plants reshaped the both port of Antwerp and Rotterdam (the second one before than the first one).

The industrialisation era came with the necessities of having oil manufacturing plants in the old continent. Before the Second World War, the factories that transformed the crude oil in usable product, were in the countries where the oil was extracted. That was no longer possible, it was necessary to bring the manufacturing closer to the users/consumers, and the best places were to do it, were those territories close to sea access.

The installation of refineries started from 1960 in the ports and, as it is easy to imagine there were necessities of spaces where to locate the large implants and the same structures were not placeable, for safety reasons, close to the city centres (important was the blaze in the chemical implant of Chemie-Pack in 2011). It is possible tehn to say that the second stage started: the port expanded in the empty spaces through the two rivers,

still accessible by the large vessels that were bringing crude oil and by the people leaving in the city.

Another fact is interesting in this stage: the connectivity between the two ports under observation started. The connection by pipeline between the new industrial centres allowed private investors to build structures in both ports and, it permitted also the formation of the internal centre of Moerdijk, in the Netherland, 40 Km from Rotterdam and 50 Km from Antwerp, that allowed more integration between the two cities.

This phase of port's evolution added the industrial manufacturing to the functions of the ports and the Port Authority had to take care not anymore only of the Nautical services, but land and infrastructure policies began to be under focus. In this topic, the two Port Authority had different vision: for one, the land was only rented (Rotterdam) and for the other the land could be sold (Antwerp).

The stronger position of Rotterdam in the second phase was anyway undiscussable: the presence of the Dutch royal company Shell, operating in the oil industry, gave to Rotterdam way more strength that Antwerp could have possible achieve. It was indeed only thanks to the "selling policy" adopted by Antwerp that the Belgium port could follow the growing of Rotterdam and stay within the new multinational environment that was growing around the ports, with the starting necessity to predict the future for the planning of new possible businesses.

1.1.3. Globalisation

The introduction of the container as a new methodology of transportation of the goods (rather than general cargo ships) brought the third (and maybe the biggest) change in the city-port configuration and let the development the port-region.

The possibility to group the goods together and allowing the stevedores to manage in the same way two different type of cargoes without any complication regarding the inside wares, had strong consequences in the port's infrastructures, work forces and economy, as well as the Port Authority's duties.

The globalisation of the World economy and the easier connection between one country and the other, gave the possibility to gain bigger markets. The facilitation brought by the containers gave also the opportunity to make shorter stops in the ports by reducing the time of cargo handling and moving from the main ships the boxes to the other type of transports in a faster and cheaper way. Also, the customers could be better: the

immediate hinterland, close to the ports, started to develop by creating storage hubs where the containers could be left and opened with a strong impact on both the costs of transportation (and final price of the goods) and on the job opportunities of the area.
In particular, the port of Rotterdam, which invested much more on the automation of the port in the container-cargo handling and in the container business in general by giving more space (spatial) to the new inventions, saw an extremely decreasing level of job opportunities port related. If on one hand the boxes, helped by the globalisation, allowed the increase in the global throughput of the port, on the other hand they decreased the necessity of dockworkers, stevedores within the port jurisdiction. Different is the case of Antwerp that, due to the not fully automation of the new cranes and structures that handle the containers, even if the jobs diminished, the impact was not as much as in Rotterdam. That is also since the port of Antwerp continued to dedicate an essential part of its business to the trade, handling and manufacturing of the row material and general cargoes.
To have an idea about the strong impact that the container industry had on the job economy in the Dutch port, is better to point out some data: the jobs in Rotterdam in 1966, when the first container was shipped to the port, were more than 120 000 and in Antwerp almost 60 000; in 1999, after 33 years, the jobs in Rotterdam decreased more than 50%, arriving till less than 60 000, while Antwerp lost "only" few thousands of jobs (*"The Kempen nexus"*, Arjen van Klink, 2003, with data from the Port Authorities). One solution that has been adopted in order to do not have a complete work crisis, has been start opening and manage the ware of the containers within the port territory by adding necessity of employees. Of course, this solution cannot really be seen as a long term one.
The real problem was that the configuration of the port started to be regional: the facility of carrying the container to the port and move them in a very easy way to the immediate hinterland where the rent loans (any kind of) were much lower than in the city, brought the possibility for people, industries and companies to move in those new areas.
In this situation, the evolution of the role of the Port Authority had the new duty of Container distribution management and the role was not anymore merely of landing and nautical management, but it added marketing operation, since the management of the container could have been considered the same in every port all around the World.

1.1.4. Informatisation

The informatisation era is the step that follows the introduction of the container and is the normal consequence of the growing influence of the port in the region and the expansion of the economic region of the port itself. A "problem" is that, while with the other steps of spatial-space evolution, there was the possibility to sign specific moments when the changes happened, due to dramatic reaction and introduction of new elements in the "way of doing business", in this case, the change happened gradually, but fast, with more changes in the way of thinking than way of acting. As last step, it is the one that is still continuing nowadays, while the starting point can be referred to 1990/2000, when the new advance technologies started to play an essential role in the modern society.

The change is due to the incredible evolution that the containers had, with an incredibly increase in the throughput given by trades, globalisation, more freedom in trades and the era of consumerism.

The other factor that allowed and made necessary the introduction of another step in the stages of development, is the increasing use of technology, the evolution of it and the new interconnection that it allowed. More specifically, the new ways of communication (physical and technological) allowed the constitution of a completely different and integrated supply chain. The possibility of higher number of railways (for Antwerp) and waterways (for Rotterdam) communications, the integration of software in the managing of the shipped goods by knowing on time the starting point, the way and the destination, allowed the shipping companies to develop a just in time delivery concept. The waiting time in the port has been reduced, the possibility of easily manage the container cargoes allowed the possibility to dislocate the operational moment away from the port and the possibility to carrying higher quantities to the hinterland decreased the prices for the final consumers.

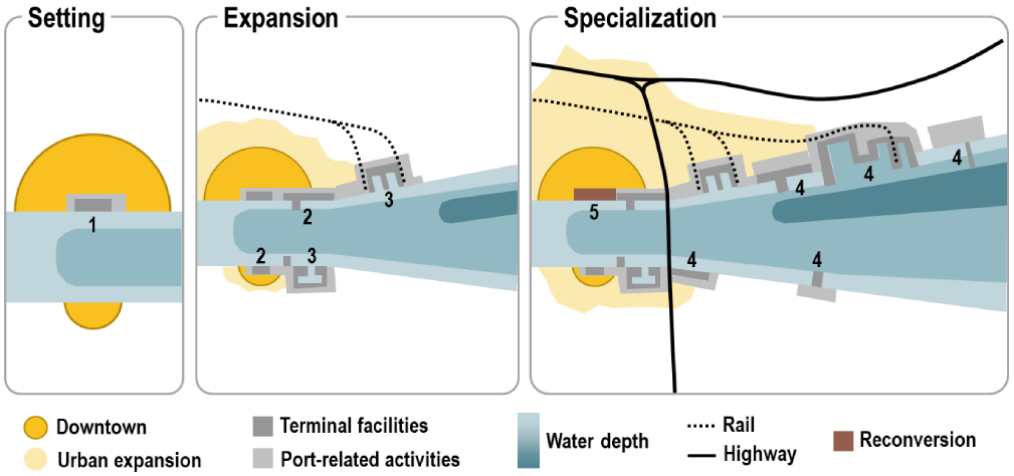
In this way, the role of the port and, more importantly, the decision in choosing one port or the other, is more and more referred to the possibility and services of connection with the network made by the hinterland hubs, reachable either by water ships or cargo trains, the sea hubs (in some cases, the goods are shipped to the majors port of Antwerp and Rotterdam that, for reasons of economy scales, can offer lower prices in welcoming the big transoceanic ships and then send smaller ships to close smaller ports-hub on the costs) and the companies directly. In this way the ports have the additional need to care about the logistical organisation of the territory and the network management duty: for

the port is not possible anymore to guarantee the communication ways, but it needs also to facilitate them, helped by superior entities such as public authorities.
Not only good are any longer traded, but information and data make important influence in the decision-making process.

1.2. The space evolution

The basic evolution of the port as an infrastructure and source of connection has been pointed out in 1963 by Bird: the Anyport model.

Figure 1: The Anyport evolution model



Source: "The geography of transport systems", Jean-Paul Rodrigue, 2017, New York

The model, reported in Figure 1, represents the structure evolution of a random port, that can be chosen as representative for many of the ports in the World, and it could represent the five time-steps reported by Van Klink and the development of the port's buildings, connections and the extension of the canal basin.
During the setting phase, there can be visualise the city as a port-city, with the basic operations of the internal port and the basic work activities, where the city is connected and live thanks to the port. The connected activities are limited, the city survives thanks to the fishing and ship building and the location and decision of the "businesses" are merely relied to the geographical position. The connections to the surrounded area are almost non-existent and the port could have been considered as a centre of aggregation for the beginning of demographic incrementation and urban settlements.
The second phase of expansion includes the necessity of the port to annex the surrounding areas with the construction of new docks and warehouses for the incoming general cargo. It refers to the beginning of manufacturing processes within the port's

border, the need of transhipments with more centres outside the port's area and the construction of both industries and ways of connections. If it would have been referred to the port of Antwerp and Rotterdam, the draw, should include in the second phase the exploitation of the inland waterways in addition to the railways.

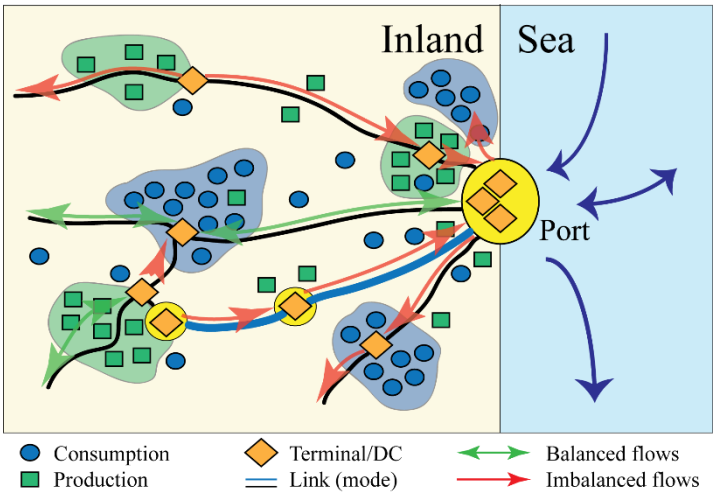
The third phase represents the specialisation of the port driven by industries and petrochemical implants and the increasing necessity of moving the cargoes and the finished products away/in the city. Moreover, in this moment, the initial settlements of the port in the centre of the city change their original role and start to be dedicate to other cleaner and more free-time activities, such as museums and offices. It is the phase of redefinition of the centres of the city in an optic of a more sustainable view, where the life of the citizens starts to be in centre of the political actions of the Cities.

The numbers between "1" to "5" in the Figure 1 are referred to the components that are added to the port time by time by the necessities of the evolution of the phase. In particular, the "1" refers to the quays that were necessary for the port's basic operations; the "2" represent the need to expand these quays and the "3" the construction of docks, both for the beginning of the industrialisation and the transhipments; the number 4 and 5 are respectively the identification and destination of special docks to specific type of cargoes (such as petrochemical products or ores) and the conversation of the already existing one for other destinations (such as offices).

The model pointed out by Bird is one of the most complete, but it has a big limit: it refers to 1963 and does not take into consideration the big change brought by the introduction of the container and the actual phase of informatisation brought by a network connection of the infrastructures. The truth is that the business and the influence of the ports can no longer be limited to the spatial and political border of it, but it need to be amplified and embrace the pro and cons given in the entire area and the organisation has to consider a broader limit, or, for an easier representation of what is "the network", a larger number of nodes and links. This evaluation is especially necessary in order to understand how a port and the political/technological/ infrastructural/economic actions can influence all the back and forwards points and how the harbours are becoming an always more complicate hub and gateway.

The regionalisation of the ports can be pointed out in the model presented by Theo Notteboom & Rodrigue, Jean-Paul (2007) in "Re-assessing port-hinterland relationships in the context of global commodity chains".

Figure 2: The regionalised port



Source: Notteboom, Theo & Rodrigue, Jean-Paul (2007) "Re-assessing port-hinterland relationships in the context of global commodity chain"

As shows in the Figure 2, the development of different centres both logistic and of consumption that allows the generation of urban centres (most of the times), can be (and are) strictly connected with the presence of the main port. This model can be referred to both the port of Antwerp and Rotterdam, of course with some modifications. These adjustments are, for example, that the port of Antwerp should be considered, by definition, an inland port, while Rotterdam has more productive, consumption and terminal bases located on the sea or on the estuary of the river Maas. Moreover, the connection with the inland hubs and centres is, in the case of the Dutch and Belgian ports, with many more waterways than the possible simplified representation that consider only one way in and three times more of railways/road connection.

Anyway, the utility of the two ports considered as main hubs and gateways and adapted for the specific situation of them is surely well represented. It is in fact possible to notice the necessity of the port has an unbalanced way of transhipment with the external locations that allows, for some regions, to have the possibility of an opening for the finished products (as most of the products that are exported from the two ports, and Europe in general are already manufactured) and for others, to have economy of scale for the raw materials.

Another implementation to the model that could have been made, is the consideration, on the sea cost, of another docking point as another port, for example. The possibility to choose one port instead of another give also the opportunity of doing transhipments through vessel of bigger dimension and identify the port that can welcome the ships in

terms of size. In this sense, sometimes, the important ports are considered a hub also for smaller ones that cannot receive some vessel, and then need an intermediary that will handle the bigger ships, manage the cargo, dive it and send to the smaller hub, which most of the case is a warehouse port or a subsidiary of the central gateway.

In the end, the Figure 2, does not represent an important element, such as the pipelines that interconnect (or possibly could interconnect) all the nodes by bringing around one of the most important elements in the shipment industry, such as the liquid material.

Chapter 2 “A war and peace between forces”

Every State is proud and jealous of his own possessions and ports have a strictly relation with the political life of the society. On one hand, ports can be seen as a connection thanks to which the ideological prospective of “open” economy can be achieved by let the “every possible user” to come in, use the facilities offered and increase their own affairs without fall in the trap and accommodate one actor more than another. On the other hand, the usage of the various resources presented and interconnected with an increasing number of additional services would provide an income by taxes for the economy where the port is located, with a benefit also for job opportunities, investments and so on. Nevertheless, a well operating structure, that can give a sufficient added value to the possible users and can be seen as a conglomeration of efficiency and effective operations, is also a stimulus for the “feelings” of the public by making “the object” (the port) a part of everyone’s possession. A clear example is the way that citizens of Antwerp see their own city: “Antwerpen stad en al de rest is parking” (Antwerp is the city and the rest is parking) and surely this proudly motto is powered by the strong influence of the port that makes this city a centre for the world trade economy.

But if the public is focused on the interest of his own citizens, the private sector aims to a completely different goal. As everyone imagine, the objective of investors is not for the best of the public, but for the maximum income and, surely, this can be seen as an opponent objective than the ones of the governmental forces.

The Public Authority that should rule the port and being in charge of the big investments that a single private subject could not afford by himself (due to the high costs and risks of the investment itself) is, from the private point of view, considered too slow. In fact, it is well known the high level of constrains that the public faces. In particular it is necessary that more than half of the people could recognise the necessity to improve the already available services, vote for the improvement and then start a long period of bureaucratic procedures in order to stay within the limitations of the rules that concern the investment.

The private sector is, instead, fast, predictive and ready to the action. It is, as said, a pro-active actor in the global economy: it doesn’t wait the change and then it adapts to it, but it generates the change and try to anticipate the future trends of the economy.

To apply this difference between the public and private sector it is a well example the explosion of the container traffic and the necessity of the ports (both Antwerp and Rotterdam) to find precarious solutions for the placement of the boxes in the beginning of the expansion, only later dedicated docks and infrastructure could arrive.

The "war" between the private and public sector is systematic: as Henk Molenaar (2003, Struggling for Leadership: Antwerp-Rotterdam Port Competition between 1870 –2000, 180) describes, there are three fields of interest for the public sector and those are, in order: "safety and order", "planning" and "capacity-management of available infrastructure". As it is clear, the first and most important aim for the governmental institutions is not the accommodation of the private sector, but the public one. To do so, several rules and regulations from the public authority have been pointed out, concerning both environmental and economical aims (the size of the vessels, the size of the container, the dig of the vessels through the canals, the possibility of new implants port-related that could have affect the health of the citizens, the possibility of the usage of the available land). As it is specified, however, not only the rules could give the possibility of the public authority to achieve its goals, but additional involvement of the governmental institutions (such as trying to cover the lack of economic necessities that could exist within the private sector around the port) had to be put in agenda. In this situation, for example, the national authorities had to offer the possibility of an integrated logistic chain by providing national connection, both by trains and by inland shipping from the sea port (or river port in the case of Antwerp) to the internal hubs, in order to avoid the congestions of the traffic through the road transport. Paradoxically, this intervention could have been a better option for both the private and public sector because, while the public could prevent also the higher pollution given by the transport by trucks, the investors could use economy of scale to bring their products closer to the final consumers (most of the time, Germans) thanks to the higher number of cargo that a single train or ship could carry.

However, even if the actions of the governmental institutions could have a good impact on the private sector operating in the port, they could never be able to fully satisfy the requests that could be pointed out. Central point is the presence of a specific governmental institution that has the aim to interact between the municipality forces that have the jurisdiction within the port territory and the private stakeholders. To better explain, it is necessary the presence of a subject that could understand, mediate and act in favour of the private sector, within a time-range that is suitable for the stakeholders

and, at same time, consider the public interest of health, green areas, suitable-for-living spaces and environmental constrains (considering also the increasing importance of the eco-friendly way of doing business).

The trend, in the past years was to adapt a privatization process to have more freedom of choices within the port. However, that couldn't be the final solution: privatization can surely have a time saving effect in the operations and an increase in the income of the port, but it also risks to diminishing the level of work offered (one of the main aim for the public authority can also be considered the job opportunities that a managed site can offer), have monopolistic consequences by favouring a more remunerative shipping company then another and, in the end, it could bring to a lower standard living clime.

The solution should have been a constitution of a modern port-authority, directly generated by the public authorities, independent from them (so with private powers), but financed from public funds. In this way, the possibility of actions (and on-time actions) could increase significantly and, at the same time, the interest of the public authority is kept into account. As it is for a private executer who must achieve the aims of the holder with the objective of the maximum profit, also in this case the interest of the public ("the holder") could be satisfied (and in this sense, the attention is on the social care) with the possibility to accommodate the private sector by acting with economic purposes.

However, the two ports end up with a different organisation by adapting during the years and respond to the evolution of the economy. Surely both ports have a Port Authority, in charge of the management of the port and all the activities that it concerns. The difference between them is that, while the Port of Antwerp is recognised (nowadays) as a limited company, the Authority of the Port of Rotterdam is under control of the municipality of Rotterdam. This demonstrate that does not exist a better form then another, since both ports have their own proud incrementation in business, specialisations and profits, but it must be adapted to the port, keeping in mind the characteristics of it and the trends of the outside world. In this topic, the evolution of network economy is posing more and more the focus not on impersonal relations between forces, but on trust and combined aims. This means that while in the previous years, the possibility of interaction that could exist between the private sector of the ports and the port's Authority could have had an impersonal characteristic, now, more than ever, the decisions are taken by considering the precise person that is on the other side of the table. For a public subject, which can

constantly change due to the political cycle, this is for sure a bad-ending type of relationship. The possible agreements can fall with the change of one person (or, to be more precise, a group of persons) and the seek interest that could have been arise between two actors could no-longer exist between the two new ones. The network economy moves step by step, without looking at the long term ending, and, the trust has to be built slowly. Surely this can be considered the hardest challenge for the ports, that, somehow managed to grow day by day.

2.1. The policy of Antwerp

Only the 1st of January 1997 the port of Antwerp became a subject identified as a "limited company". Before that day several types of governments ruled the port. As a starting point (as every port) we have a period of municipality management: all the investments and earning were made and taken by council of the city in combination with the National State. Each of the two grades of power had a difference influence: while the municipality forces were in charge of the management of the port and they collected the taxed payed through rents or loans, the central State had the duty of the biggest investments on the quays and giga infrastructures that municipalities could not afford. Only in 1923 the port acquired more independence by separating the balance sheet from the one of the City and, by doing so, starting a long walk to independence. The separation brought to a possibility for the port to point out the performances of the port, helped by the expansion of the economy during the twenties. It was in those years that the policy of the Port started to pass from transport to industry: new infrastructures for industrial purposed started to be built in the port. In ten year of industrial policy, where space was loan to private investor to increase their port related businesses, the city of Antwerp saw the born of new refineries and warehouses. The main aim was to ensure a less volatile economic cycle, create new job opportunities and ensure an economic development.
However, as we all know, the thirties were around the corner: the great depression pointed out the lack between the port of Antwerp and the close ports of Ghent, Rotterdam and Hamburg. The disadvantages were mostly due to the lack of new equipment (that the new activities needed) and the increase in losses. The debt of the port had to be covered by the central government (which points out the still high relation of the port with it). The possibility of increasing taxation was not an option: the existing taxes were too high

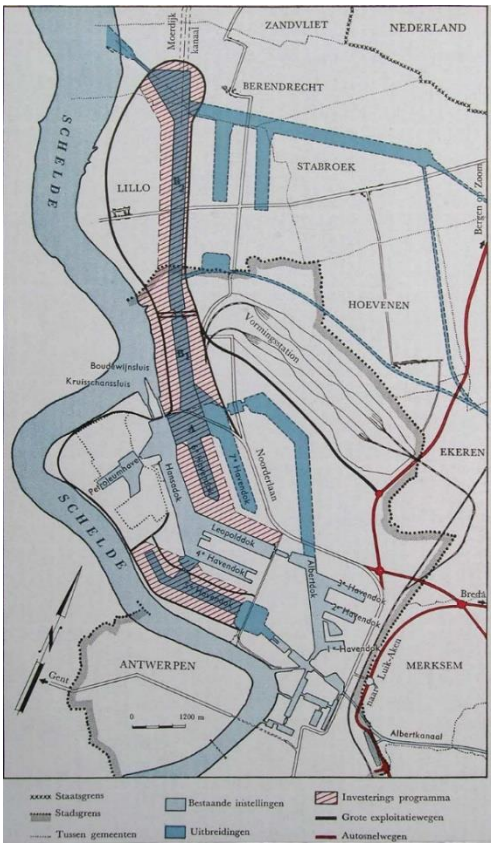
for the private sector that was facing a period of recession and the competitor ports mentioned before could have attract the industries.

Trying to find any solution, the economy of the old continent was all interrupted by the Second World War.

The cities were destroyed (Rotterdam especially) and the new governments had to find a way to restart. In this situation, the Belgium Government pointed out the 10 years plan (1956-1965) with the aim to reassess the entire look and relationships of the port.

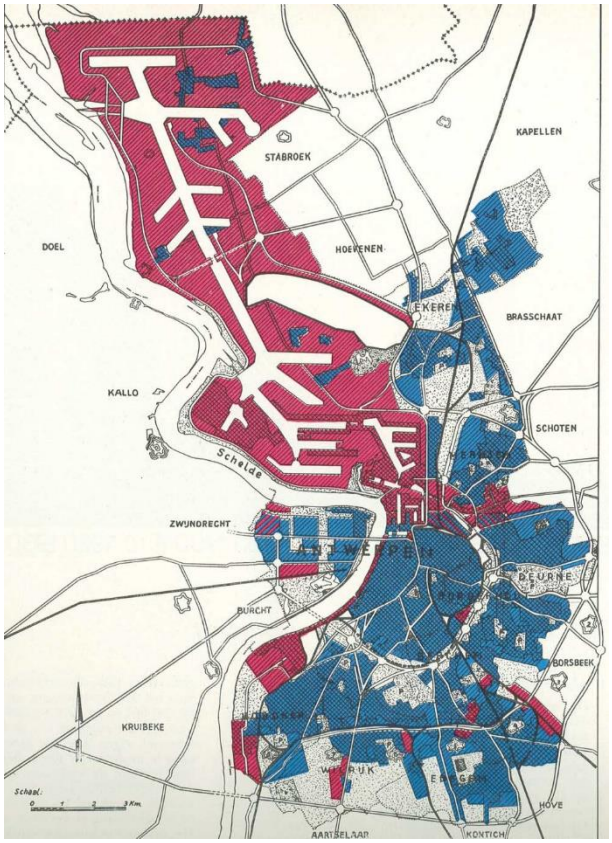
The 10 years plan can be considered an investment not really in the port itself but more on the infrastructure that allowed a constitution of a new industry zone developed along the right side of the river Scheldt. As it is possible to see in Figure 3, the afford of the investment was enormous. The surface area for production added 3 260 hectares to the already existing 5 340 and the water surface area passed from 592 hectare to 1 321 (2003, Greta Davos, Struggling for Leadership: Antwerp-Rotterdam Port Competition between 1870 –2000, 199-2014) with a lot of positive consequences for the throughput (used as an indicator for the productivity of the port).

Figure 3: 10-Years Plan of Antwerp



Source: original picture, De Kesel, "Havenuitbreiding. Redenen vormgeving", 1956. Source: M. Ryckewaert, "The Ten-Year Plan for the port of Antwerp (1956–1965): a linear city along the river", 2010.

Figure 4: General plan for Antwerp agglomeration



Source: original picture, Cooreman, 'Stedenbouwkundige problemen', 1960. M. Ryckewaert, "The Ten-Year Plan for the port of Antwerp (1956–1965): a linear city along the river", 2010.

The true advantage, however, was the cooperation between the private and the public. The final result, thanks to the flexibility of the project was something that was not expected. The project continued to evolve and embrace the surroundings of the development area through the north of the right side of the river Scheldt. The inclusion of the villages into the project, the reassessment and the construction of new connections with the previous rural area allowed the formation of a big city composed by several district having (still nowadays) their own part of municipality powers.

The success of the port in the half of the 20th century comes from the possibility of the shipping agencies to invest and benefit from the long concession-terms decided by the public authority and, in this way, build big and expensive infrastructures such as warehouses, cranes and sewers that gave additional value to the port.

The 50s are also characterised in the port of Antwerp by the intervention of two different but connected plans: the Marshall plan and the 10 years plan. The first one, thanks to the funds given by the United States, helped the economic boost related to the petrochemical sector, by taking advantage of the many connection existing with the hinterland and

creating one of the most important cluster in the world. The second one refers to the construction of the Kanaaldok alongside the right bank of the river Scheldt till the Dutch border and, with it, the Marshall dock and Heaven dock.

With the intervention of these two programmes, bigger shipping cargos could now come in the port and the business of the port started to turn around too few big companies such as Hassenatie and Noord Natie that were managing products like oil, fruit, iron, steel, forest products and so on.

However, if we see the data provided by the city of Antwerp about the year 1966, we could see, as Greta Devos reports (2010), that 54.8% of the Right Bank was dedicated to Chemical and petrochemical plants, while the second in scale share was only the 26.5% of the oil refineries.

The petrochemical products were important for the development of the port (huge important have still the pipelines that connects the port of Rotterdam and Antwerp with the hinterland of Germany, ended in 2003) as well as the chemical plants, by making both Antwerp and Rotterdam two of the main hubs for these products.

The concentration and effort of the State and regional public actor in renting/ leasing/ conceding industrial sites was enormous. The objective was to do not have any unused spot. Sure, the main multinational companies that were investing by starting operations as close as possible to the river (mainly due to the new types of power engines available and the efficiency of having a direct connection with the sea) couldn't use the space at the maximum capacity in the beginning, but that was no problem for such big names as BUYER, BASF and General Motors Continental, that were predicting a raise in their businesses.

While the right side of the river almost ended up fully occupied, the left side was still intact and only in the mid-sixties we could observe the settlement of the first industries, still sometimes connected with the already existing partners on the right side by pipelines.

The seventies are the years of containers and oil crises. On one side we have an increase in transhipments thanks to the introduction of the modulate transportation that, from that moment, was already expected to arise, and on the other side we have a compression of the chemical and petrochemical activities that were still more than a half of the surface of the port land. Times were bringing to a situation in which (as nowadays) the proximity

to the port is not as much important as in the past, but the need of implementation of a logistic chain within the hinterland is crucial.

From this point the trend of the port is decided. While it still remains one of the most important centres for the petrochemical industry in the world and in 1994 it was only second in the World list, after Houston (Greta Devos, 2010), the main effort in the last year has been made in favour of the so profitable Containers, in order to allow bigger ships, better transportation to the hinterland and better services within the port with the new Its.

All during the eighties and nineties the development of the port was focused in providing new docks for the handling of the containers and providing additional services to the stevedoring and shipping companies. Only in 1997, as said before, the port of Antwerp became an independent municipal company. This allowed more freedom for the port while it still remains in direct contact with the public authority (proof of that are the four treaties that has been sighed between the Flanders government and the Dutch government).

In his own way, the Port Authority of Antwerp is doing his best within its possibility to catch up with the market and enable the investors to come in a well provided territory of services (crucial was the project for a railway connection between the right and left side of the Banks of the river).

2.1.1. Port of Antwerp organigram

A good way to understand the Port's and policies of interaction within the Port community and with the outside world, can be considered (after a brief history of the evolution of the relationship dynamics in the past years) the analysis of the internal organization, the decision-making people and their subordinates. To do so, a well explained representation is the Organizational Chart.

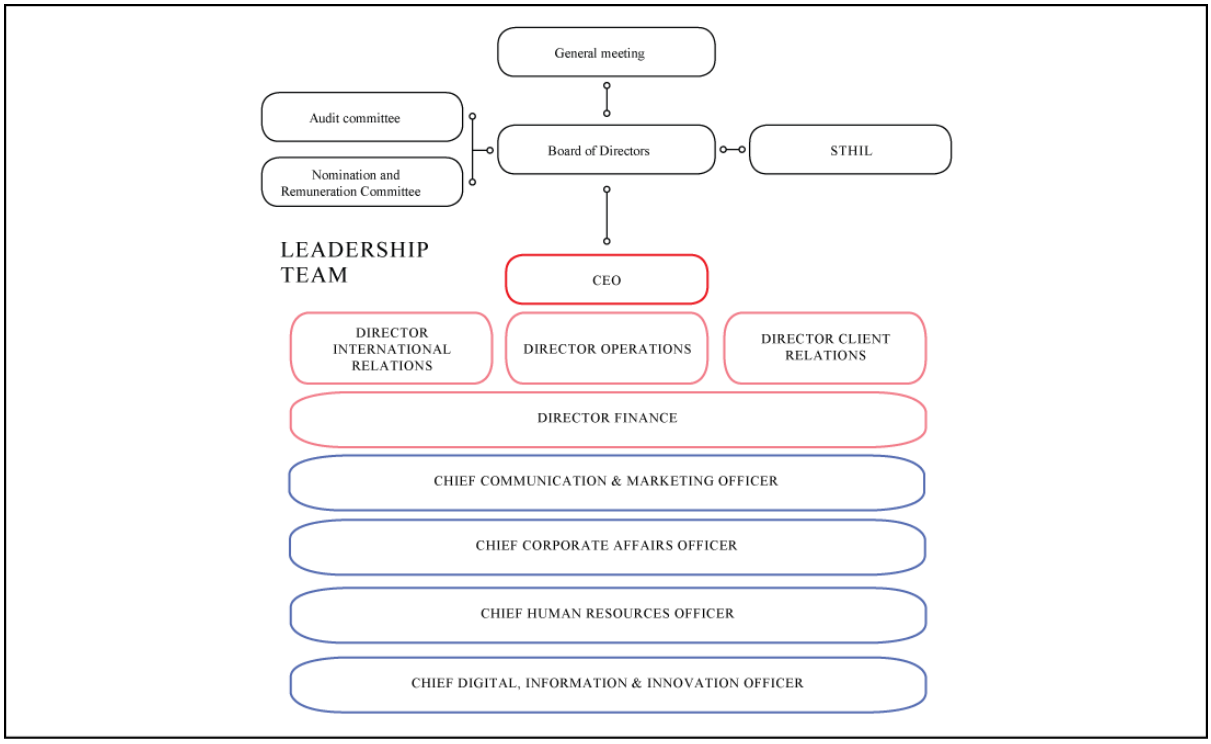
The organizational chart can group together and well represent the important leadership teams by pointing out the level of responsibility that every single subject oversees. Surely a mere graphic representation won't be enough.

It is important also to remember that only from 1997 the port became independent from the directives of the Municipality of the town and, only from the moment, the general manager was not the major of the town anymore, but a proper CEO.

However, the Port Authority remain an independent municipal company. This aspect can be seen in the top-level of the Organisational chart (Figure 5): the CEO is not the main subject of the organization, the Board of Directors is, composed by the CEO itself and other actors.

The Board oversees the main port policies and is mainly composed by the members represented the City Council, the association of the private actors, the chamber of commerce, and local-development association (with also the one focused on environment issues, the Natuurpunt association). All these actors, and the Remuneration Committee (in charge of the remuneration of the executive committee) compose the Board of Directors for a total of 18 members (2011), giving a political prompt to the decision taken, since most of the members are representants of the City council's political parties (at least 10 of them).

Figure 5: Organigram Antwerp Port Authority



Source: Antwerp Port Authority

If then focus passes on the internal leadership organization of the Port Authority, it is possible to see, after the CEO, the direct competences of the Director of the internal relations, the Director of the operations and the of in charge of the client's relations, all of them at the same level and assisted by the finance Director. Every one of these directors has his own staff and team in order to achieve the objectives designated by the Board of Directors and communicated through the CEO.

The International relations team works in strictly cooperation with the Customer relations department. While the first one is in charge of maintain the relationships with the already existing partners worldwide and represent the port in strategic positions with representatives, the second one is involved in the daily necessities of the already existing and future customers. In particular, the International office, together with other entities of the port (such as the Port of Antwerp International [PAI] and the Antwerp/Flanders Port Education Centre [APEC]) is focused in overseas port projects and specialist training in order to offer the better port-experience to the foreign customer. The customer relation office, instead, has to develop customised solutions for the new customers (both national and international) and, to do so, it is strictly necessarily having the guidelines from the international relations department.

The operator director is responsible for all that regards the operation that happen in the port. It is at the same level of the two previous mentioned and in charge of every operation that can happen in the port. Since the number of responsibilities is enormous, the Operation department delegates activities to three other teams: the Nautical Operations department, in charge of every aspect that regards the shipping operations (in particular the management and organisation of the procedures for the approaching and leaving vessels and the safeness of every step); the Asset management, focused on the management of the essential infrastructures during the approaching of ships (the preserving and well of locks, quay walls for example) always by safeguarding the sustainable development; the Port Projects team that is in charge of all the future technical projects having impact in the port area.

As said, every one of those team works is in charge of an activity that allows the well ending of the “port experience” for the ships using the port services (remember that the time spend in the port for a cargo ship, is the most expensive cost that the shipping company has).

In the same group of importance of the International and Customer relation director and the operations director team, we find the Director of finance. This subject is in charge of every financial activity such as the managing of the investments (in coordination of course with the other team in order to understand the necessities of the port) and keep track of the incomes.

After the first four Directors, we have four other Chiefs with the role of complementary activities that are fundamental for the business of the port itself, but they are not the core business.

As the Port Authority can be considering operating as an enterprise with his own competitors, the Marketing and Communication office is the one that interact with the outside world to keep the image of the port high. It is the one that mange the web platform for the visibility of the opportunities offered, it organises exhibitions in and outside of the country. Nevertheless, the marketing team is the one that allows a good communication within the Port Authority itself. As in every company, the communication (especially for a so diversified environment) is essential for have a time-saving economy and a proper order of actions, in this sense it needs to participate and support every phase and division. While the Marketing and Communication office is in charge of promoting the brand "Port of Antwerp" and coordinating the subject within the port, the Corporate Affairs has the delicate task of represent the Port with the outside, in Official national and international institutions. It brings the interest of the port on the decision tables of the institutions. There is always to keep in mind that the Public Authority still has an important influence in the port's decision and financing, in this sense is important that the "voice" of the port is listened.

Even before the 1950, the strength of the port of Antwerp were the abilities of the so-called "naties", those workers that were charging and discharging the vessels in the port and, thanks to them, the technological disadvantages of the port with its major competitors (Rotterdam and Hamburg) was not that marked. Thanks to the employees, the port obtained the reputation of a fast-delivery port. In this logic the Human Resources team is an important component of the chart. Being in charge of the selection of the employees, the office is also responsible for the training of the new personnel and is responsible to represent the worker unions with the top directors.

The last but not least is the Digital, Information and Innovation office. In this era of continuum changing, the necessity of fast adaption to new technologies of information, communication and management is crucial. The office is the one in charge of funding the new possible technologies and it operates to develop them within the port environment. One of the core values of the port is "guts", this slang word is used to point out the necessity for the port of trying-for-doing, otherwise the competitors con become too powerful and will that advantage over you.

2.2. The policy of Rotterdam

The Port of Rotterdam has always been (and still is) a Municipality port. That means that every final decision is in the hand of the Municipality.

In 1932, from a pure municipality management, the Port passed under the control of the "Rotterdam Municipal Port Management" ("Gemeentelijk Havenbedrijf Rotterdam", the Rotterdam Port Authority, RMPM), which, in theory, it is shown as a separate Municipal entity.

The RMPM is in charge of three main activities or, at least, it should be (it will be explained further that in one way or the other, the port still tries to control every aspect of the port life).

The first task is the planning of the development of the future infrastructures within the port territory. In this sense, the port is responsible for the projecting of the new large-scale operations that have to occur for the growth of the port both in terms of area-space and technological advantages.

The second responsibility is to manage the financing of the port, by collecting taxes, decide whom is allowed to benefit from a particular rented space and be sure that the balance of outcome and income does not show negative numbers.

The third task is the port management in term of safeguarding the activities, impose rules for the port's operators, inspecting and control the actions of the subject under the port's supervision.

In a country like the Netherland, the space is limited. The Municipality of Rotterdam, for the development of his Port, had to consider the possibility to incorporate within its border (as it happened for the port of Antwerp) the surrounded villages and towns. To do so, it was necessary the Authorisation of the central Government that, not always, was willing to accomplish at the embodying of the town's neighbours. The port managed anyway to continue to growth and arrived at the actual conformation with every section of it that can be considered part of the municipal territory of Rotterdam.

In the Figure 6, is represented the evolution of the Port of Rotterdam from the 1800 (period when the port was entirely in town) till 2010. For each colour is shows the building year and the name of the respectively series of docks.

Figure 6: Development of the port of Rotterdam

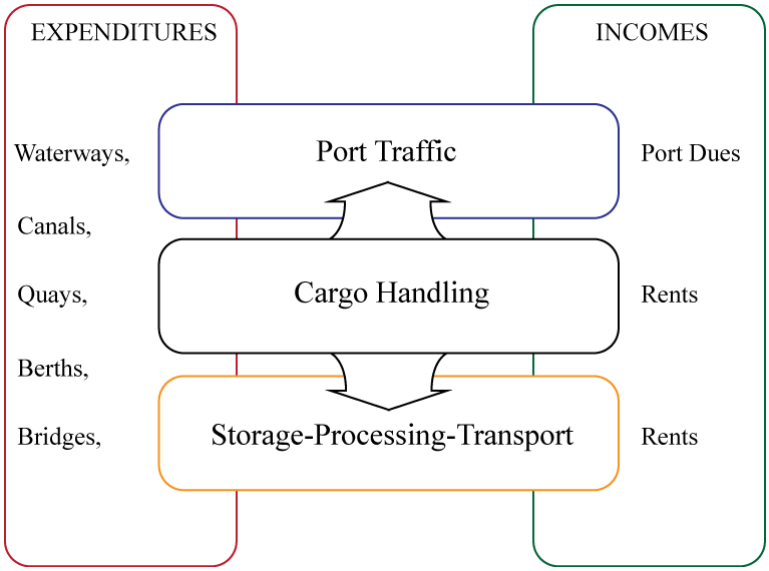
Source: "Development of container handling in the Port of Rotterdam", January 2010, J.G. De Gijt, J M Van Kleef, P. Taneja, Han Ligteringen

From the initial part of the city, where the Old Harbours are located (black area on the right of the Figure 6), the port continued to develop on the banks of the river Rhine (to be more precise, on the branches of the river, that mainly compose the Maas) in West direction, towards the sea.

Only with the construction of the Europort terminal (1960-1970) the port and the city territory officially faced the North Sea and, with the planning and construction of the two Maasvlakte terminals (green and yellow areas), quays of the port have been even built on the sea itself thanks to a system of dams and drainage and without using, as far as it was possible, any lock, in order to avoid limitations in size and reduce even more the time and difficulties in the vessels handling. In the end, despite the opposition of the central Government, the port arrived at 30 km of length by inclusion of the villages on the border of the Maas and a surface of the municipality of about 319 square kilometres.

The policy used for the possibility of the port to require more and more space to the national Government it has purely financial and economic reasons: in the Figure 7 is presented a basic summary of the port expenses and expenditures.

Figure 7: The port economics: expenditures and income



Source: "Port of Rotterdam: land-use policy during the twentieth century", Ferry de Goey, 2003, Struggling for leadership: Antwerp and Rotterdam Port competition between 1870-2000

It is possible to see, that (and that is the model that could summarise the financial focuses of the ordinary administration of the financial section of the RMPM) most of the incomes are earned thanks to rent and dues. In particular, Ferry de Goey, based on the data from the RMPM, states that in 1980, almost 70% of the total incomes were made thanks to port dues and more than 20% from rents. In this situation is clear that the focus of the port for the evolution of the business (and in particular for the decisions of renting either than investing in other opportunities) was mostly concentrated on the possibility of increasing the volume of transhipments within the port. This object was the central point for the policy's port (at least till the 40s). To achieve it, new harbours were built, the private sector started (after receiving the possibility to use the land) to build on their own cranes, weighted bridge, etc. Surely, a private investor could do so only whether had the possibility of a sure profitable opportunities in the future. That would have mean that it needed long-lasting rentals for the usage of the port's land. In addition, the construction of the new harbours with more water surface on both norther and southern side of the river, allowed the interconnection between the inland waterways and the open sea. Thanks to the hundreds of channels that connects (nowadays and in the past) the port of Rotterdam with the hinterland (mostly Germany), the transhipments became faster and more efficient. The in-land shipping vessels, thanks to the large length of docks, could load the goods directly from the sea-going ships: "seagoing ships were moored directly to mooring posts and chains in the harbour basins, while inland boats could lie alongside"

(Van Driel H, de Goey F, 2003, Struggling for leadership: Antwerp-Rotterdam port competition between 1870-2000, 228).

As said before, the Port Authority is in charge of the main activities of the management of the harbours. This means, however, that it should not be responsible of "super-structural infrastructures" and, that business should be entirely in the hand of the private sector that decides to invest in warehouses, cranes, storage tanks and any other infrastructure that is used for a specific business in a specific segment of the rented area. The port should be in charge instead of all the connection ways (here, the port, is considered specifically the port of Rotterdam, and, in this sense, a municipality entity), such as railways, road, waterways, quays, locks and so on. However, only after the 60s (Ferry de Goey, 2003), the port decided to act as a true landlord port (as it always had to do) sell or scrap the possessed tools. Before that it was used to rent the possessed equipment in order to have additional incomes.

The attention to the "balance sheet" was the central focus of the interest of the port. However, after the Second World War, the port could not manage to execute the ordinary administration without losses. The deficit problem was giving troubles to the Municipality till 1972, when, the balance sheet of the municipality and the one of the Port have been separated.

The great investments between the 50s and 70s as shown in the Figure 7 with the construction of the Europort, Maasvlakte and Botlek gave the possibility to the port to increase its business.

The availability of new large space and the high quality of the services started to give to the port a real good reputation and more and more private subject started to demand space for the utilisation of the public port's land. Moreover, the sixties and the seventies, as in the port of Antwerp, brought in Rotterdam the installation of the petrochemical and chemical industry with an additional request of space. A clear policy was needed.

First of all the port (that before had the only aiming to increase the transhipments) is now interests in the possibility of profitability of the land that could be longer sold, but only rented for a maximum of 99 years (Ferry de Goey, 2003). The interest passed also on the possibility of favouring the settlement of industries that could create a large amount of tonnage handling and, in this way, favouring the possibility of an increase in the necessity of labour forces.

However, this policy, as the time moves closer to new millennia was no longer possible. The great investments and constructions that took place during the period 50s-70s were made without a consciousness for the environment and with only to the possibility of "doing business". From 1975 the decisions to whom could rent the lend were made with more attention on the climate impact of each private actor. The high demand of space that has been created thanks to the efficiency of the port, gave the possibility to choose between the possible actors.

But the oil crises started. The plan to continue with an eco-friendly policy had to suffer the lower presence of requests. The petrochemical industries settled on a great part of the territory and, with them, many related activities. The project of the construction of the Maasvlakte 2, that already in those years was in plan to be done, had to be postponed (and of course, later on, adjusted).

After the crisis, and with the introduction of the container transport system, the port started to raise again and, in 1999, for the first time after the Second World War, it signed a profit in the balance sheet.

The port policy had to change again. The great automation possibilities that the new container industries could provide, with the high investment to be done and lower necessity of labour forces brought the RMPM into focusing on the network.

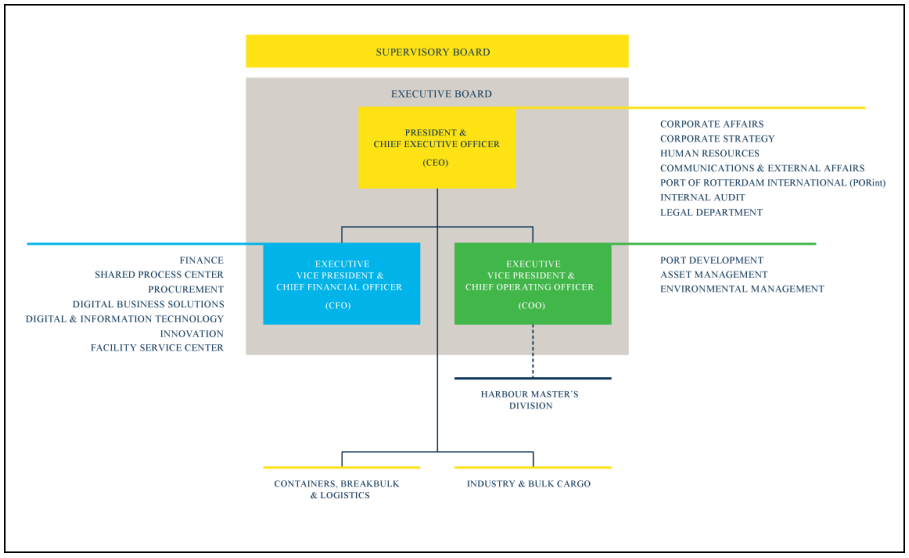
The port (as any port nowadays) started to be conscious about the necessity to aim to the added value that can be generated by the network, the possibility of logistic solution for the users of the ports and the orientation to the industries that can process the goods within the port territory.

2.2.1. Port of Rotterdam organigram

The port of Rotterdam is not a pure municipality port. It is owned by almost 70% from the Municipality of Rotterdam and the remaining part by the Government of the Netherlands. It is safer to say then that is an unlisted public limited company, shared by the Municipality for its majority part and the rest by the National Government.

In Figure 8 is represented the Organigram of the port of Rotterdam since, as it has been explained for the port of Antwerp, it is a good way to understand the decision process and the responsibility of each component of the Port Authority.

Figure 8: Organigram Rotterdam Port Authority



Source: Rotterdam Port Authority

First, as it is possible to see in the Figure 8, the organisation is different than the one of the Port of Antwerp. The three executive divisions are under the control of the Supervisory Board. In this case, however, the composition of the Board is not made by proper components of the municipality council or the representants of the Port's associations or Port's industries, is, instead, made up by independent people properly elected for this specific role. This does not mean that the interest of the actors of the port are not taken into consideration. The main aim of the Supervisory board is, in fact, the overseeing and consulting of the Executive Board by the concerns of the stakeholders and shareholders. In this way, both the public (shareholder of the port) and the private sector (stakeholder of the port) will see their interests satisfied.

The Supervisory Board is an independent body, which means that it is self-responsible for the actions that it takes. The role of the Board is annually assessed in order to achieve the best performances: every year, the people that compose the body, change (or modify) their role in order to orientate the attention to a specific problem/opportunity/necessity given by the times. In particular, the actual board (2019) has a background in business (logistic/industry), affinity with nautical-maritime matters and corporate finance and is oriented to the public institution and public concerns and social impact of the port itself. This can be seen as the core values of a normal company, the "philosophy" of the port.

The operational activities of the Supervisory Board are, instead, mostly regarding the reportage of the executive board, financial reporting processes and analysis of internal/operational risks with constant attention to the legal aspect of every activity.

The members of the Supervisory Board are appointed every four years and can be reappointed three times with a possible overall ruling period of 12 years.
The Executive Board is under the control of the Supervisory Board and is made up by a President and Chief executive officer and, under that, by two executive vice presidents and the respective offices, one in charge of the Financial aspects and the other one of the Operating aspects.
The CEO of the port, in charge of the executive office, is the responsible for the client's relations. In particular, is the CEO (and its team) that keeps contacts with the old customers of the port, tries to find new ones and allows the possibility to individualise the ones that could only have a small interest in approaching the port. The CEO is the one that has more responsibilities, but the commercial aspect (the most operative ones) are under control of two other department (kept outside of the executive board) directly related to the CEO: the "Containers, Breakbulk & Logistics" department and the "Industry & Bulk Cargo" department. Together they operate in the commercial area to "build business clusters" (2019, Authority of Rotterdam).
The financial office is the one in charge of the finance, funding and risk management (referred to investment decisions). In addition, is the duty of the Financial department to decide in which kind of IT invest. The aim of building a digital connected port is something that the financial department has to take into consideration and, besides the investment in infrastructures, it must evaluate the intangible investment in other technological resources (digital business solutions, digital & information technology innovation, facility service centre).
The last component of the Executive board is the Chief Operating Officer. This role regards the physical port infrastructure and what is related to it, starting from the port development and ending with the environmental development. Under its supervision is directly connect the Harbour master. This figure is responsible for public duties: "Every year 30,000 sea-going ships and 105,000 inland vessels call at the port of Rotterdam. The Harbour Master of the port of Rotterdam is responsible for the safe, smooth, sustainable and secure handling of shipping in the port of Rotterdam." (Port of Rotterdam, Harbour master). Basically, the Harbour master is the one that is responsible for the evolution of the efficiency of the port. Keep in mind that the major cost for a shipping company is related to the time that a vessel passes within a certain port. The efficiency of the procedures of loading and unloading of goods from the ships to the docks is then the

crucial moment for a port to prove the necessity to be chosen and, this aspect, for the Port of Rotterdam, is in the hand of the Harbour master.

2.3. Port City

Every city lives and passes through stages. The stages of development of a port city are different than they could be in any other type of town, because the presence of the port drives and it is driven from the evolution of the city itself with, of course, positive and negative effects (direct and indirect). The Figure 2 regarding the regional configuration of the port and the Anyport port model (Figure 1) are good starting point for a consideration on the evolution of the port cities and, in particular, for the towns of Antwerp and Rotterdam.

The both cities have, within their jurisdiction, the presence of what are considered the two most important seaports in Europe. In order to consider their evolution for the development of the living area, the Anyport model could be a good example for both of them: the historical centre of the town was the port, built on a river, with a populated area surrounding it and considered the centre of the life of the town. During the year, the cities went more and more populated, thanks to the evolution of the port's business, passing from fishing, to commerce, to industrial areas and becoming "gateways" nowadays. The evolution, as clear in the evolving phases and projects of the port authorities happened alongside the rivers where the two cities settled first and bringing the industrial/working are port-related away from the city centres to the seas. This graduate process of incorporation and expansion and conquest of new areas alongside the banks brought more and more buildable spaces with a necessity of a clear building plan with specific orientation for which places were intended as living areas, industrial settlements or as nowadays necessity, store fields.

The plan that a city has to take into consideration is not only composed by the possibility that the city (or port cities in this case) offers in that precise moment and driven by the economies and specialisation of a specific time, but they should project the living and working places by trying to predict the social evolutions and future trends and adjust accordingly.

In this sense, due to the evolution of the times and the missed adaptation of the construction policies, in the port cities there are sites, even in important social or economic zones, that are unused or abandoned.

The social and economic evolution of a city are well expressed by Klaassen with the development of the graph reporting the phases of urbanisation-suburbanisation-disurbanisation and their subcategories. As definition, every city, sooner or later, is destined to pass all the stages of these development, passing after that, to a fourth stage of reurbanisation.

In the port cities, the influence of the social life and decision that move the location of the life of the citizens made by work and interest is not much different.

The period of settlement of the port (and the city) and first stage of commerce, created infrastructures that are no longer used and needed to be reinvented with new destination, like the old dock of Antwerp in the centre of the city, now a naval museum and the mooring hosting a restaurant. In both Antwerp and Rotterdam, and more commonly in the city ports canals entering in the city (like Ghent, Amsterdam, Bruges), the storehouses that in the past were used for example for grain, now have the purpose of proper houses or malls.

While the centres of the cities is being conquered back for the social life of the citizens, the need of space due to the enlargement of the markets and the increasing use of open areas for the movement of cargoes for the modal split is in the port's first problem of development.

The first problem brought from the ports to the lived city nowadays is the traffic. As said, the modal split, conquered and it is still conquering the commercial market and, as it will be explained, it does have benefits also in terms of additional value that it can generate. However, the mode of transportation for the containers that it is used the most, after the arrival of the boxes in the port, is via the road connections or, in other words, trucks. For the symbiosis of the port with the city, the real presence of a too high number of trucks on the same roads used by the citizens creates congestions on the ways to the work places, on the connection of the highways that surround the cities and in some cases also in the city centres. Moreover, the presence of the vehicles on the roads, especially around cities, creates a huge impact on the air quality, making the city ports poor in this sense. The construction of "the ring 1" in Antwerp, the presence of the Ridderkerk interchange close to Rotterdam are just examples of the complexity in the traffic and road management that the increasing port's activities generated. The traffic then, directly and consequently generated by the presence of the port in the towns, even if it is a direct

consequence of a good rate of commerce, represent a source of pollution, a lost of time and (why not), stress for the people who are living in these cities.

The urban projects have also to be adapted according to the necessities of the ports. In Antwerp for example, the connection between the two sides of the rivers that represent still part of the city territory, it is possible only by boat or by underwater connections (there are two tunnels going from one side to the other: two of them only for engine-moved vehicles and one only for pedestrians or bikers), due to the large basin of the river and the not-possible construction of bridges that would have interrupt the transit of the vessels. In Rotterdam the situation is not much different: the Erasmusbrug and the Willemsbrug are the first bridges on the Nieuwe Maas that block the advance of the big cargo ships toward the river that do not need to pass after these two bridges since the availability of the docks before them.

The second problem related to the presence of the port inside the territory of the city is given by the second function attributed to the harbours: sources for industries. To be more precise, the presence of the port and the factories/implants related to it have not only negative, but also positive contributions.

First of all, a division must be made, in order to consider the settlement of the different types of industries that could locate in or close or far from the port that take advantage from it.

The first ones are industries defined as “port required”, referring to those activities that need the port, the water connection in order to exist. A classic example are the fishing activities.

The second ones are the enterprises “port oriented”. This type of activities is probably the most important for a port, or at least they were so before the introduction of the containers, considered more as port require (or anyway more connected to the transportations mechanisms than industrial ones). An industry is considering port oriented when their existence is not essential for their activities, but “it is a crucial reason for their location” (“*Città portuali l’economia e il territorio*”, Enrico Musso, 1996). A practical example is the petrochemical sector that needs the supplement of the raw materials and the presence of a water source, but it does not survive only thanks to the port.

The third and last type of factories operating in the port city can be defined as “port induced”. This type is composed of the companies located in territory or region of the city

port that have benefits due to the presence of the harbour, but do not consider it as essential for their business. Examples are represented by all those enterprises that use the port as a communication way but could use other methods and transportation rather than ships.

Each of these types of business brings positive and negative effects to the port city and its citizens. The highest problem is that not all of these pros and cons can be calculated, or, in other word, it is hard to define whether a certain activity has more benefits for the area than the negative ones.

For the industries, the positive contribution to the city are, of course, the creation of job opportunities, the possibility of investment and generation of cluster that can increase time by time the quality of live also for the citizens by the utilisation of the taxis and consequent organisation of the area also for the free time. As more as the city gets populated, also the services offered increase and from the previous occupation that are connected to the port, other work opportunities are generated: shops, financial and insurance agencies, network service economies. Moreover, thanks to the evolution of the technologies in every field, port included, the development of the mansion, knowledge and education for the workers is constantly increasing and, with it, the average salary as and the standard of living.

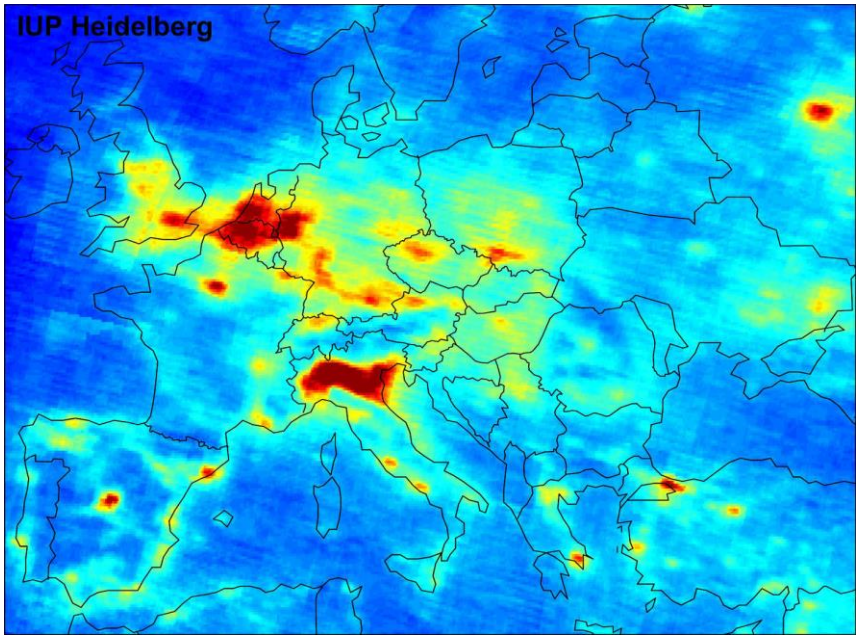
Everything is then connected and, for a city that made in the port its initial asset, lot of benefits can be said to arise from it, however, as said, not only benefits comes from the ports.

Without considering the already mentioned traffic problems, generated not only by the modal split, but also by the workers direct to the respectively job places that too many times in a port city have bad connection to the living places, there is the pollution problem, the space problem, the rental problem (with prices for the houses too often too high) and the construction problem.

First of all, has to be state that in important port cities as Antwerp or Rotterdam, the space represents one of the most important and limited resources. In this way, deciding whether a certain space should be destined as industrial or living area is dramatically important and has to be balanced considering both the interests of the entrepreneurs and citizens (example of this well balanced urban plan is the evolution of the left side of the port of Antwerp, with its high number of parks and places where to practice outdoor sports). Second of all, the presence of green areas is more important in a port city than

the other place. The pollution driven by the enterprises have a huge impact on the territory and the necessity of "filters" is higher in these places with concentrated living and working areas. Indeed, in the Figure 9 is representing in red the European level of NO2, irritating for the through and dangerous for the health.

Figure 9: European mean tropospheric nitrogen dioxide (NO2) vertical column density (VCD) between January 2003 and June 2004.



Source: European Space Agency. Image produced by S. Beirle, U. Platt and T. Wagner of the University of Heidelberg's Institute for Environmental Physics.

Helped by the low position of the two Countries of Antwerp and Rotterdam and due to the emission of cars, heating of the houses, industries' production and the ports, the pollution of these port territories is higher than the others, with consequences (not probably immediate) for the inhabitants.

The third problem is related to the infrastructures. The moving tendency of the activities of the port from the city centre toward the seas for the port of Antwerp and Rotterdam left, on the docks of the rivers, buildings, cranes and other structures that were used in the past for the operations of the workers in the port and, now went abandoned and, in some cases, in a situation of deterioration, ruing the landscape of what became the centre of the social life. The challenge, this time, is to transform, readapt, modify these buildings and infrastructures, invent new ways and new purposes for them like, for example, the old buildings on the dock facing the entrance from the river in the city in Antwerp that are being transformed in bars or restaurants, or even disco clubs a bit further north. This

reorganisation, however, need times, investments and can create problems in the reassessment of the city and its social centres.

The truth is that the port, if well used, adapted and integrated in the culture of the city (the new Mas museum in Antwerp is particularly concentrated on the history of the port of the city as well as the Maritime Museum Harbour in Rotterdam) is a positive source that can definitely bring more positive consequences than the negative ones. Moreover, the progress in the technology and the increasing attention to the environment policies are adjusting the high influence of the pollution coming from the port industries (related, connected and required) and the cities are promoting more and more methods of movement with less environmental impact, helped from the common acquisition of interest on the topic.

2.4. The network and the clusters

The division and separation of the two Ports from the public authority is far to be complete. Both the port of Antwerp and the port of Rotterdam are still influenced in one way or the other by the government. The freedom in acting of the boards of directors is limited to political and social constrains and the investments are specifically evaluated on economical and public impacts. Each one of the two port is in charge of its own business, and the decision taken are for the specific port's interest.

However, cooperation is needed.

The evolution of the container transhipments gave to the shipping companies more freedom in choosing the best-port option. The investments of the two ports in increasing the added value offered is enormous and the consciousness in evolving a network system has been acquired.

For this reason, we are able to see today a high interconnection between the two ports, starting from the pipeline that from Rotterdam and Antwerp arrives to Germany, passing through the high waterway interconnection of the two regions (Flanders and South Holland) and ending with the commercial routes (roads and rails) that pass through the both port cities.

The success of the two port in the last years lies then in the network of logistic ports (hub) that they were able to build. The private sector supports this ability of communication and probably the vicinity of the services to the utilities can be considered the true power

of the cluster. It is fair to say that the two ports are both serving the same area of competence, as it is the Benelux.

Figure 10: Logistical spill-overs and logistic zones

Source: "Thirty-five years of containerization in Antwerp and Rotterdam", Theo Notteboom, 2003

In the Figure 10 are represented the most important internal hub/logistic zones that the two port ports can easily serve and that, with their presence, contributed in building the added value that the two ports can offer.

Starting from the Netherlands, we can find the cluster of Tilburg-Eindhoven-Venlo that, via canals, railways and highways allowed the construction of hubs in those cities for the intermodal transportation that could then be easily stored, managed and resend towards the German borders.

The presence of water hubs is also important. In Figure 10 are represented the three-inland port-cities that helped the most the evolution of the network especially for the port of Rotterdam. The close city of Dordrecht, the one of Moerdijk and the further city of Flushing, situated on the North Sea and the estuary of the river Scheldt, had a strong impact on the cooperation of the Port Authorities. In particular, those cities, started to be logistical spill-overs of the port of Rotterdam.

The other cluster of Arnhem and Nijmegen also proved the importance of the connections to provide services to important European distribution centres.

Focusing on Belgium, the most important cluster is given by the province of Ghent and Brussels both served by the port of Antwerp (the province of Bruges could have been also

a served centres, but the port of Zeebrugge, in this case, is the one that most supply the hub).

The other cluster that the port of Antwerp is the most suitable to serve is the one that develops along the Albert canal, starting from Antwerp and ending in Liège. In this case, the network that the port was able to build is one of the most important of the Benelux. On this path, some of the most important international companies decided to base their European logistical headquarters (for example the company Nike is based on this axe, in Laakdal, close to Hasselt).

In the Appendix A, is shown the map reporting all the navigable canals of Europe. By taking a look at it, it is easy to see that all those logistic cluster are easily interconnected by each other and with both the port of Rotterdam and Antwerp, allowing both of them to benefit from the network that one or the other created.

The privatisation process that is going on within the two port (for example the port of Antwerp has already three docks that are under the control of the society DP World) is something that needs to proceed in coordination with the public authorities. It is thanks to them that there is cooperation between more logistic centres and a lot of investments have been done thanks to public financing. Even the European Commission had its role in this network evolution.

Thanks to this interconnection of the two ports that provides a high number of flows to the hinterland, the private sector is able to invest for the customers, with more and more differentiated products and increase the attractiveness of the whole big region of Flanders and South Holland.

2.5 The human capital

When the communication methods were not as diffuse as today, when the movement of goods was not as much automate as it is (and it will be) and when the petroleum was not powering the majority of engines, the influence, the added value of one company (or one port) than the others was mostly made by people.

The skills of the workers or the conception of new working methods (such as the construction line) could bring efficiency and forcefulness on the result aimed.

The port's structure was not different at all from any other type of industry and the reputation build during the industrial revolution and the expansion of the markets was

destined to last also nowadays and influence the traffics and relationships with private and public sectors.

The power of the port of Antwerp lies in the cooperation of the so called “naties” (as explained in chapter 2.1.1.) and the “stevedores”. In practice, the stevedore was the one that was operating on the ship, by checking the incoming and outgoing cargo, while the natie was the one responsible on the pier. The “reception natie”, after receiving the checked cargo by the stevedore, had the duty to bring it to destination either it being a storehouse in the port, a direct client in the city or another ship. Of course, this efficiency was possible only thanks to the limited market and area that the worker had to cover: it would have been impossible to cover the whole actual port’s space. Anyway, it was also true that this way of doing was not replicable in other ports, since it was possible and effective only thanks to the ability and experience of the naties operating in the docks, capable to serve every location not even with the best mode of transportation for the time: in terms of tools innovation, the port of Antwerp was far behind the competitors (for example compared to Rotterdam), since at least the beginning of the implementation of the Marshall and 10 years plan, or, perhaps, it is still today. Things changed during the years, but the adjective of a “fast port deliver” remain attached to the port, thanks probably also to the implementation and investment in a well organised system of railways that are branched in every dock of the port and served/helped by some of the most important public and private train operating companies.

The port of Rotterdam assumed a completely different approach to the in-port working methods. Instead of having a widespread organisation with the necessity of a huge flexibility and experience from the workers, the Dutch port chose a centric way of operating, with straight indication from the employers and less skilled dock workers with unscheduled shifts and occasional work. This situation for the port could not last. The problem was particularly visible during the years after the Second World War. After the demolition, the dockworkers had to adapt and contribute to the reconstruction of the area, but the availability of manpower was lower than ever. The problem lied in the fact that, in the same period, job opportunities were emerging in the city, with higher wages, better working hours and more suitable condition for the workers.

While the port was concentrating in the reconstruction phase (and at the same time, expansion phase) and the city was trying to change its image, by attempting to earn the “better” connotation of cultural city (or, as it is, of “city of architecture”) the employers

were than in deficit of dockworkers. The situation started to change with the adjustment of the regulation regarding the working policies: the shift through a labour-friendly situation for the previous “slaves” of the docks began. First of all, the organisation of the work passed to a concentration on stable schedules and an abandoning of the occasional work option. Secondly, the working hours have been reduced and more holidays were included. The necessity of flexible workers for the incoming cargoes and supplement of workforce for the moment of maximum incoming number of ships that could not be planned, was managed by commonly agreed organised shifts. These adjustments, combined with the investments in infrastructures, cranes and technologic implementations, gave the possibility to the port to reborn stronger than before. The opportunity given by the empty areas generated by the bombing of the war allowed a complete reorganisation of the spaces and brought the port to be the best one in Europe. The work in the port passed than from a merely physical job executed by the workers brought from the colonies of the Dutch Empire, to a specialised job with increasing rights and lower casualization day by day.

If the power of the port Antwerp was into the capacity of its workers to cooperate with each other and be flexible for the incoming demands, then, for Rotterdam, stability and innovation were the training factors for a well performing port. Most of these characteristics, with a continuous adaptation to the new engineering technologies, new communication methods, new logistics systems and by constantly being on the proactive part of the market (for example, by providing the ports with structures that could welcome the increased size of the vessels), continued to stay within the definition of the port still today, with Antwerp as a more adaptable and the port of Rotterdam more flexible.

Chapter 3. “The current evolution”

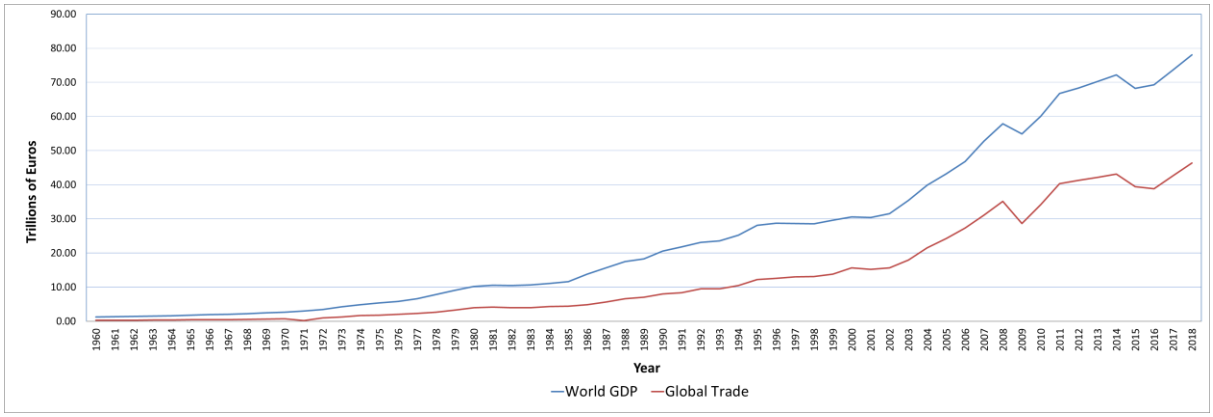
The World economy is growing. The interconnections between countries are growing. The rivalries are growing. The World is changing.

After the introduction of the container into the new ways of transporting goods, the logic behind cargo shipping changed dramatically. However, the boxes cannot be considered the main reason of development of the world economy, but only a way thanks to which the connections became faster, more efficient and cost-saving.

The explosion of the growing economy can be considered starting after the Second World war, when the empires crumbled, decolonisation happened and the liberalisation of the markets was the new way of action between Countries. In other words, the globalisation started.

If we consider the Gross Domestic Product with worldwide prospective, we can have an idea of the fast growing of the period 1960-2018. As we can see in the Graph 1, the GDP passed from 1.24 Trillion of Euros to 78.07 Trillion with an average annual growth of circa 7.5% per year.

Graph 1: The World GDP evolution and the World trade economy evolution



Source: Computation made from the data from The World Bank .

What is more interesting is seeing how the Worldwide trade, also represented in the Graph 1, moves in line with the GDP. The trades (data from the World Bank) are represented as sum of imports and exports. Initially they were represented as a simple percentage of the GDP, here they have been capitalised and transformed in monetary quantities to better compare their behaviour in relationship with the World economy.

It is important to notice that not only the trades are following the GDP, but also how much the world trades contribute to the World economy. Considered as a part of the GDP, the

world trade passed from a circa 24.12% in 1960, to a value close to 59.44% of the GDP in 2018 that, translated into economic value, is circa 46.41 Trillion of Euros made thanks to the Trades.

As the two lines moves together with similar paths, it is important to notice that also the two big crises that came up in the latest 58 years had side effect on the trade market and not only on the GDP.

The first oil crisis in the 70s had a strong impact on the World economy, but even a stronger one on the Transport industry. The consciousness of the limited resources and the less export from the extractor countries brought to political actions of safeguard of the ones available and an increase in prices. The most affected State in Europe were the Netherlands, towards where the OPEC (Organization of the Petroleum Exporting Countries) decided to stop exportation of oil till the January of 1975. For the two evolving ports (Rotterdam and Antwerp) that has been surely a serious blow. First of all the port of Rotterdam was situated in Holland, into the no-exporting area and, second of all, for the both ports, that was the period when (from the 60s) the port Authorities started to invest into petrochemical industries (port related) on the banks of the ports. Despite the crisis, the Global GDP continued to raise (even if at a slower percentage) and it went from 2.69 Trillion of Euros to 2.98 Trillion (from 1970 to 1971). But the world trade economy passed from a capital of almost 735 Billion of Euros (1970) to not much more than 218 Billion (1971). This drop is due to the lower percentage of the composition of the GDP that the Trade economy had to suffer. To be more precise, the contribution of the GDP from the trades went from 27.29% in 1970 to only 7% in 1971.

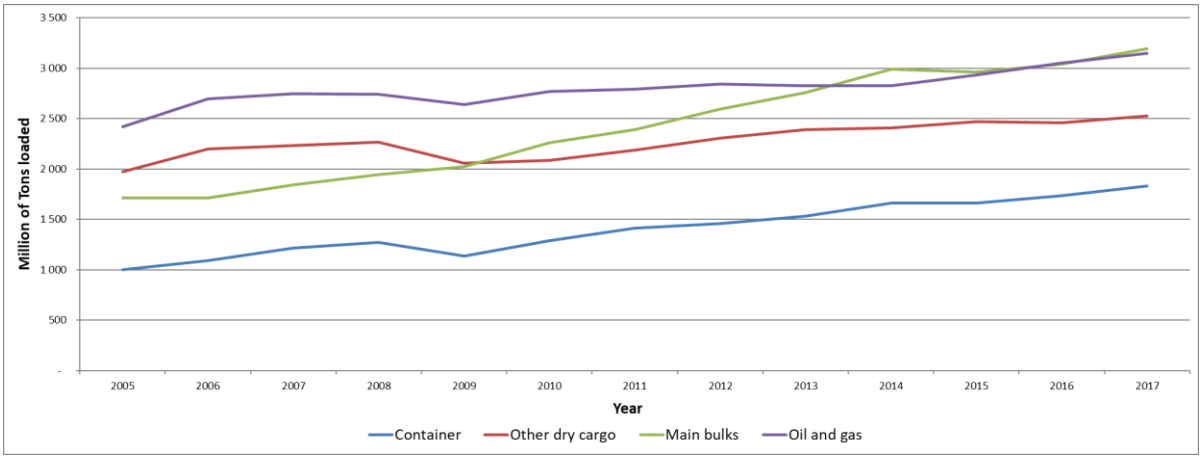
The second Big shock for the World has been the financial crisis of the 2009 started from the crisis in the subprime mortgages in 2008 and followed by a period of recession. Compared to the previous mentioned crises, this one was much more devastating. Even if the generation point of the recession was related to the homebuyers' market and a "bubble" given by the speculation over the mortgages and the so called "securitisation" (the combination of more mortgages together into a new financial instrument), it had, after the related bank crises, effect on every sector of the economy. The Global trade economy was not left behind. The global GDP passed from 57.89 Trillion of Euros in 2008 to 54.91 Trillion in 2009 with a loss in the World economy of 2.98 Trillion of euros. If we would focus on the Global trades, then we will see that in those years the contribution to the GDP was of 60.73% of the total amount in 2008 and it dropped to almost 52.24% in

2009. In monetary terms, the loss of the Trade economy is around 6.47 Trillion of Euros, passed from circa 35 Trillion in 2008 to 28.7 Trillion the year after.
The crisis was tried to be covered immediately by the governments of the major afflicted States and that is the reason why, if we look at the Graph 1, it is possible to see a straight catch up of the World GDP the year after 2009. However, the cycle of the recession was activated, the investors lost their trust in the market and then we can see a loss in year 2015 in the global economy. This time, the effect of the recession has been felt by the trade industry longer than the other industries. In fact, while the GDP had a loss of almost 4 Trillion Euros between 2014 and 2015, the one of the global trades continued for two years, and only the third one the growth started to be positive again (even if its value could not achieve the one of 2014). In particular, with a starting point of 43.08 Trillion of Euros in 2014, we had a loss of more than three and a half Trillion in one year (with a value of 39.45 Trillion at the end of 2015) and 606 Billion during the period 2015-2016 with a total ending value of 38.85 Trillion. In 2018 the Global Trade economy ended up with a value of 46.40 Trillion of Euros by covering completely the losses that it had during the previous years and with strong possibility to have a positive value also during the year 2019.

3.1. The Trades

In 2018, 46.40 Trillion of Euros was the amount of the global value of the trades all around the World. What is important are the shares of the various industries in the economy of transports. How much of that trades' value is generated thanks to the World connections via water ways? In other words, how much of the 46.40 Trillion of Euros are generated thanks to the ports?
The International Chamber of Shipping, a consultative organisation for the United Nation with headquarter in London and focused on shipping issues (from legal to operational) reported that "*The international shipping industry is responsible for the carriage of around 90% of world trade*". That means that almost 41.76 Trillion of Euros are generated thanks to the shipping industry. The analysis concerns every method of shipping: liquid/dry bulk cargoes, containers, passenger ships transported through both oceans and canals.
In the Graph 2, it is possible to see the subdivision of the international trades reported by the International Association of Ports and Harbours after the United Nation conference on trade and development.

Graph 2: Development of International seaborne trade by type



Source: World seaborne trade UNCTAD 2018.

This report is particularly interesting because, while most of the infrastructures of the ports worldwide are investing in new equipment for the managing of the containers, the most trade type of cargoes represented are the Main bulks and Oil and Gas (for the year 2017). Respectively, it is possible to see that the Main bulk arrived to 3 196 Million and the Oil and gas cargoes have a final value of 3 146 Million of tons loaded in 2010. However, the final result is meaningless without a comparison with the starting point and a possibility (especially for the investment) to understand where the trend of the economy is projected to.

If we look at the data regarding the growth of each single type of cargo, the situation is quite different.

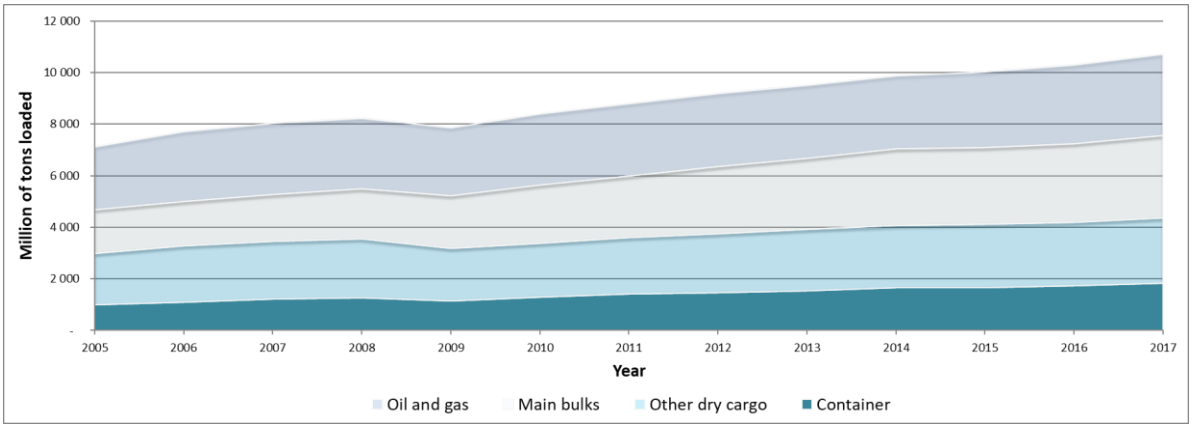
The containers in this sense, have the priority in the developing of the possibility of trades. In fact, the seaborne trade of the boxes passed from 1 001 Million of tons loaded in 2005 to 1 834 Million with an average annual growth of 5.36% and the spike in the period 2010-2011 (9.30% of growth). The constant growth was interrupted only between the years 2014-2015 (with a recession of –0.12%) due to the latter effects of the crises and of course during the period 2008-2009 with a decrease of 10.85% and a loss of 138 Million of tons loaded.

Even if the containers continue to have great importance in the evolution of the seaborne traffic, the Main bulk still compose the main part of the total value and they will continue to do so. The average annual growth (always in the period 2005-2017 represented in the Graph 2) is around the 5.40% (Even more than the containers). The constant increase of these type of cargo is also due to the positive adaptation during the years of the crises in 2008-2009. In fact, the Main bulk, composed, after 2006, by only iron ore, grain and coal

(in 2005 also bauxite/alumina and phosphate) is the only type of cargo that reported a decrease trend only during the years 2014-2015, with a bigger loss than the others type of cargoes: -0.90% (27 Million tons of material).

The Oil and Gas transhipments are the ones with more losses than the other types of cargoes, but with a more constant line, and no spikes (except perhaps for the year 2017) and a growth closer to the zero more than the one of the other cargoes: 2.27% (average annual growth period 2005-2017). This is may be due to the increasing focusing of the enterprises to find out new solutions that are more eco-friendly or new renewable type of energies and, by now, the constant consumption of the final clients (both factories and final users). However, as said before, the Oil and Gas still remain a fundamental part of the seaborne type of trades with "only" 50 Million of tons loaded less than the Bulk cargoes, with an added value for the port operator less than any other type of cargoes (in terms of job creation, stages of the process to bring it to the user, time of the ship in the port), but it is surely fundamental for the third operator, and, as it will be shown, for the important petrochemical clusters of Rotterdam and Antwerp.

Graph 3: Total amount of International Seaborne Trade



Source: World seaborne trade UNCTAD 2018.

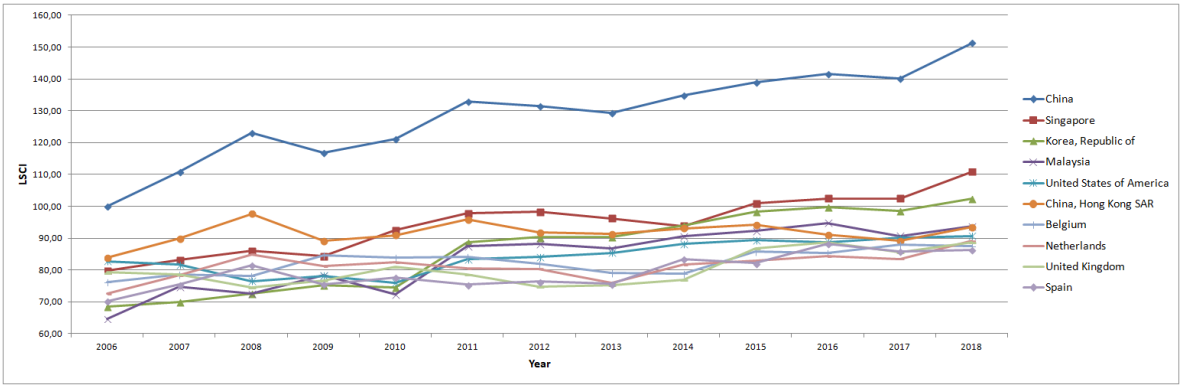
To conclude, it is possible to observe in Graph 3 the contribution of each type of shipping cargoes to the total amount of seaborne trade. Even if some of the cargoes had, in the period 2005-2017 few years of negative growth, by being covered from one or the other (without considering the year of the crises, 2008), the total tons traded continued to grow year by year, with an average annual increase of 3.51% passing from 7 109 Million of tons loaded in 2005 to 10 702 Million in 2017.

3.2. World connections

10 Million TEU of seaborne trade are generated thanks to the increasing interconnection between countries. The availability of a Country to reach and be reached by the others is a central part in the global game of trade.

The United Nation conference on Trade and Development, established a way to find out the capability of a country to be connected to the global shipping network, the Liner Shipping Connectivity Index (LSCI). In particular, the country is evaluated on: (1) the number of scheduled ship calls per week in the country, (2) the entire TEU capacity offered by the country, (3)the number of regular ships leaving and arriving at the country, (4) the number of shipping companies operating in the country, (5) the average size of the ships that are approaching the port (vessel size that can be handled). For the computation has been considered as index, the best performer (China) in year 2006.

Graph 4: Liner Shipping Connectivity Index (index: 2006=100)



Source: UNCTADstat 2018.

In the Graph 4, are reported the years from 2006 to 2019 the respective LSCI values for the first 10 ranked countries of the World.

As said before, the better-connected country can be considered China. This is due to the fact that within its borders, there are the 1st major container port in the world (Shanghai), the third and the fourth ones (Shenzhen and Ningbo-Zhoushan) and many others (in total, six ports are in the top 20) represented in the top port per container managed. That can immediately explain the difference existing between China and the rest of the list, starting from the second Country (Singapore). China had a fixed LSCI equal to 100 in 2006, but in the following years it grows and arrived till 151.30. If we consider that Singapore is 110.83, it is possible to state that China and the Chinese economy are circa 37% more connected than the second-best connected country in the World. In addition, in the Graph

4 is represented also Hong Kong SAR as a separated country. It is true that the territory of Hong Kong is an independent territory (SAR stands in fact for "Special Administrative Region"), however, if we would like to add the qualities of the territory of Honk Kong to the ones of the entire China, we would see that the final value would probably overtake the 200 LSCI (the sum between the two value in 2018 would be 244.84, however, it will not be correct to merely sum the two index, since some components, in this case, could be counted two times).

The rank is showing than the centrality in the World trades and economy of China and the territory of South-East Asia.

The first non-Asian Country in the top 10 ranked are the United State. In this case, the reason behind that position, is probably the possibility to trade on both the east and west coast of the country and the presence of the Panama channel that allowed even for the ports on the east side to be connected with the Pacific Ocean. If we consider also that, in terms of container, the only port within the 20 World's top port for TEU is the one of Los Angeles, then another the reason of the success of the States lies probably on the high numbers of ports that are still within the boundaries but with lower dimension than the world competitors. It is important to point out that all the "minor" ports of the U.S.A. are in anyway well provided with the right equipment and able to manage the incoming of high-volume vessels (and those two characteristics are important in determine the LSCI). For one reason or the other, The United Stated ports are not growing as fast as the Asian competitors (10% in the period 2006-2018 versus 51% of China) but they still remain a well-connected country, with an index of 90.69 LSCI in 2018.

The Netherlands and Belgium are respectively in 7th and 8th position and are the first countries in the ranking of the European Union. The two countries continuously overtake one with the other year by year in the ranking: in 2017, Belgium was over the Netherlands with respectively values of 87.93 and 83.49 LSCI; in 2018 the Netherlands went up in the 7th position with 89.12 LSCI and Belgium was downgraded to 87.51. The increasing development of the two ports in investing in infrastructures (once you have the given position of the country, the best that the government, or the single port Authorities, could do is to improve the equipment of the port and all the incoming/outgoing ways) gave, as a benefit, an average annual growth of the LSCI of about 1% for Belgium and 2% for the Netherlands, with a total growth of the connectivity index of 15% for Belgium and 23% for the Netherlands in 12 years (2006-2018). The ranking positions is surely given by the

presence of the two main ports of Europe (Antwerp and Rotterdam) that, combined give more than 24 Million TEU of containers traded and the possibility to embrace the biggest container vessels in the World.

3.3. The Routes

After observing the efforts of the ports in the possibility of being better connected with the other sources of the economy, it is necessary to take a view at the main roads that ships used to cover, in order to understand the main waterways connections and trade routes.

To do so, is used a map developed by the studio of data visualisation Kiln with data provided by the researchers of the Energy Institute of the University College of London of the year 2012.

In the Map (Figure 11) are presented the routes in in different colours and each of them represents a different type of ship cargo. In particular, the colour yellow represents the container ships, the colour blue the dry cargoes, the red stands for the liquid cargoes, the green one for the gas ships and the violet for the transhipment of vehicles.

Figure 11: World map representing the global ships trade on the 12th October 2012

Source: Kiln studio with the data provided by the Energy institute of the University College of London (direct connection: shipmap.org).

As it is possible to notice, between the main connections can be individualised precise paths that the ships use to follow.

One of that connection is the way between the West coast of the United State (where, if we look with enough attention, we can individualise the position of the port of Los Angeles, represented almost with a red dot) and Asia, trough the Pacific Ocean. In this

case, we can deduce that the ships passing over this path are mostly container's vessel, since the dominance of yellow lines connecting the borders of the Countries.
By not moving so far, there is also clearly the presence of liquid cargoes (oil) shaping the costs of Russia and arriving till the border with Asia where, after the beginning of the Japan sea they are overlapped with all the other lines.
The connection between Asia and South America passes through the Cape of Good Hope. Also, in this case as happened before with the port of Los Angeles, we can see the blue lines approaching the costs of Brazil probably in the busiest port of the Country: San Paolo (The Port of Santos). In this case, the transhipment between the two regions is surely mostly of Dry cargoes, understandable thanks to the clear presence of blue lines connecting the South Asia archipelago with South America State.
The same relation Asia-South America can be found between Asia and Oceania and also in this case most of the lines are blue coloured, meaning that most of the trades between the two World regions are mostly for dry cargoes (raw material). Surely, that is not true if we consider New Zealand. The Oceanian State shows the presence of a high number of traded containers, both imported and exported with the major trade partner the close economy of Australia.
If we then focus our attention to the Atlantic Ocean, we can see the presence of any kind of cargoes. The connections between North America and the old Continent and the relationships that derives from them are of any kind. Starting from liquid cargoes, going through dry cargos and ending up with container's vessels.
By moving norther, we can see the presence of many liquid vessels shaping lines around the southern part of the Scandinavian Countries (especially Norway) and passing by the north of the Great Britain thanks to the oil fields discovered after the crisis during the seventies.
In the Figure 12, is showing the European Continent where, the single dots (with the same indication for the colours of before), represent a single ship moving to/from a specific destination the 8th of August 2012. The picture (Figure 12) shows the three busiest transit points of Europe (even if the Suez channel is not part of the European Continent, is the main connection for the European transhipments with the Asian market, in this sense it is incorporated in the observation).

Figure 12: European map representing the ships trading the 8th August 2012

Source: Kiln studio with the data provided by the Energy institute of the University College of London (direct connection: shipmap.org).

In 2012 the Suez Canal saw 17 Thousand transits. The number of ships crossing the channel did not change much during the following 5 years (it remains at 17,000), however, the number of Tons increased from 928.5 to 1,041.6 Million in the period 2012-2017 (data from Assoporti, 2018).

The other busiest European point can be considered the Strait of Gibraltar with circa 60 Thousand vessels (data from the Gibraltar Port Authority) passing every year.

The difference between the two water ways is absorbed by the production and reception of the ports in the Mediterranean Sea that, even if none of the ports is as busy as the northern Europe or Asian ports, their influence in the commercial economy is still important.

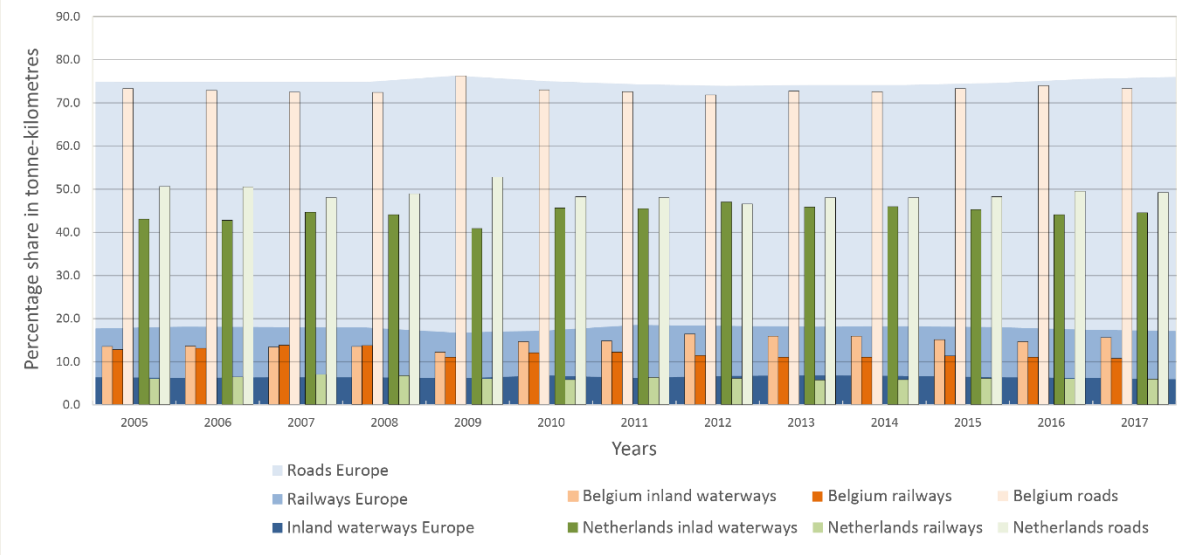
The last (but not least) most used narrow transfer is the English Channel. In this case, it is hard to find out how many vessels could pass every year through that channel: as we can see in the Figure 12, most of the ships approaching the three biggest European ports (Antwerp, Rotterdam and Hamburg) are passing (before or after the load/unload) across the English Channel and also most of the vessels leaving from the East coast of England are also using the Channel. Anyway, according to Maritime and Coastguard Agency, there are more than 500 ships passing the channel every day (*"The Dover Strait, navigation rules",2007. Archived from the original on 31 August 2010. Retrieved 8 October 2008*) making the Channel one of the busiest of the World.

3.3.1. Inland mode of transport

The focus on the English Channel is limited to the transitions happening between the regions of the Northern Range, including the ports on the other side of the sea (the ones in England) and the rest of the World. This "limitation" refers to the presence of the various type of inland interconnections that allow the possibility of the cargoes, once they have reached the ports, to be carried in the hinterland to the other hubs. In other words, what the Figure 11 is not able to show, are all those type of goods that are sent to the internal storage location of final consumption via the pipelines, roads, railways and, of course, waterways. The inland waterways, especially in the area of Antwerp, Rotterdam (and more in general in the Low Countries, Belgium and Luxemburg) are an example of a widespread way of delivery that allows the industries to take advantage of the economy of scales that this type of transport allows and as consequence, have the lowest marginal cost per ton as much as the barges/inland vessels is filled. Moreover, the presence of a high number of used waterway connection, could allow a strong decrease in terms of pollution, since the inland shipping is the type of transportation that pollutes the less.

The request of the waterway connections, however, in comparisons with the other types such as roads and railways (the pipeline is more commonly used in the connection between the petrochemical districts of Rotterdam and Antwerp), is the lowest used to transit the freights.

Graph 5: Modal split of inland freight transport



Source: EUROSTAT, "Modal split of freight transport".

In the Graph 5 are represented the methods of transportation used for bringing the goods around Europe as a percentage share of a tonnes per kilometre moved, with a special focus on the Belgium and Netherland countries. In blue (and its shapes) are reported in the background the data regarding the entire territory of the European Union (28 countries) and the two States within the Schengen agreement, such as Switzerland and Norway, in orange (and its shapes), the type of connection used in Belgium and in green (and its shapes), the ones in the Netherlands.

As it is clear, in the freights moved within the territory considered, the means of transportation in the 28 countries of Europe combined, preferred in terms of the most used ones, are those that use the road as a connection between nodes, such as trucks and other special vehicles. In fact, roads in Europe are used for 75.5% on average (period 2005-2017) in the transportation of freight, while the less polluting railways are used on average (always period 2005-2017) in the 18.0% of the cases and the most eco-friendly type of connections (the waterways and the inland shipping) only 6.5% of the shipping. What is also interesting, is that in the year 2009, with the intervention of the crises and a deflection in the consumption of goods, the European market opted, for that year, to use more roads, than the others cheaper ways of delivery, and the share of the cake passed from the railways and the waterways to the wheeled vehicles. The most affected from this transfers of share were the railways that decreased its quota of 6.63% that year (passing from 18.1% of the share to 16.9%) while the inland shipping passed from 6.5% to 6.2% that, considered its already low level of share, is translated into a loss of 4.62%. The roads had, in this way, the possibility to increase their shares of nearly 2%, passing from 77.5% to 77% and defining its peak in the period 2005-2017.

The situation changes when the focus passes on the single state of Belgium and the Netherlands. Between these two Countries, the one that adopted the most different types of methods of communication is the Netherlands, with a completely different share in the roads and waterways than the average of the EU, but with a common tendency for the usage of the railways. Belgium, instead, reorganised its connection modes in the lowest part of the Graph 5, with a different subdivision of the waterway and railway usage and an orientation of the road adoption in line with the European's average.

In particular, the graph shows the importance for the Netherland of the inland waterways, a tendency that is confirmed, considering the high presence, as specified in the beginning, in the "low country" of this type of connection (in the Appendix A are

reported the inland navigable canals and rivers with the respective limits for power, high under the surface, etc.). The Netherlands than have a share on average of about 49.2% in the usage of the internal roads as a mode of freight transport and a close 44.7% for the utilisation of the waterways (in the considered period 2005-2017). The influence on the total 100% of the railways type of connection is, as anticipated before, more in line with the European average, or, more correctly, lower than the European's mean: 6.1%, almost twelve percentage points less. This situation suggests the importance for the Netherland of the inland shipping cargoes and, more than the other Countries, of the water resource, with most of this importance given by the river Rhine, that passes throw it and connects it with Germany and the important region of the North Rhine-Westphalia. This region, with the constant necessity of materials, allowed increase and constant transactions (first and foremost the important connection via water with the industrial cities of Düsseldorf and Köln) of inland shipping cargoes and the possibility to ships higher quantities of freight grouped together towards these big inland hubs, within (or close) to populated city centres, with less necessities of other passages on the logistic chain and increase back the share of trucks. As it is clear from the Graph 5, the success of the waterways is then at the expense of the roads usage more than the railways, but the relative contribution reverse the conclusion: from the European average, the utilisation of the road connection is 41% lower in the Netherlands, while the railways are used almost 66% percent less. Of course, this data has to be compared with the previous ones of general share and passing from 75.5% to 44.7% of usage can be consider a big step for the low Country in comparison with the other member States. What did not change, is the consequence of the crises of 2009 on the share of the freight mode of transportation: as it happened for the general Europe's view, the transition in the country moved toward an increase of the road usage to the detriment of the waterways and railways with an increase in share of the roads of nearly 8%. This difference, anyway, has been covered immediately in the following years (more by the inland shipping than the train cargoes). The highest peak, not considering the year of reassessment of 2010, has been registered for the waterways inland shipping in the year 2012 with a share of almost 50% of the total share of modes of transportation.

The implementation of Belgium in the usage of inland waterways, even considering the high number of canals within the Country is not as strong as the neighbour Holland (considered as the whole country). The Belgium territory reflects more closely the

European trends in the share of ways of connection for the freight's delivery. In particular, the average use of roads in Europe (75.5%) is only 2.68% less in Belgium, with an average share of 73.5% (period 2005-2017). Shortly different from average of the rest of Europe is instead the share of the railways and waterways. These two types of connection, as represented in the Graph 5, are more equalised with a diminishing in the share of the railways that benefits the one of the inland waterways. This adjustment is for sure connected to the morphology of the territory and the high interconnection, especially in the North (and in the logistic zone shows in the Figure 10) given by the canal's connections. However, the utilisation of these type of ways is not as high as in the Dutch territory with a probable higher request of direct delivery and no possibility of take advantage of the economies of scale given by the barges/inland vessel, used mainly instead of the freight trains. The inland shipping registered an average value of 14.5% of the total share, while on the railways passed "only" the 11.9% of the freight. As it happened for the entire Europe and the close Country of the Netherland, the 2009 signed the highest share of the road usage, with a 76.7% of the share and downsize for the waterways of almost 10% and for the railways of more than 19% from the previous year (both of them, as it was for Europe and the Netherlands, with a straight catch back the following year).

The last consideration that must be made, regarding the general overview of the freight situation in Europe, Belgium and the Netherlands and their movements, is the trend that they are following.

Table 2: Evolution of the Modal split of inland freight transport for the period 2005-2017

Territory / Type of way used for the freight	EU-28	Netherlands	Belgium
Roads	1.46%	-2.76%	0.00%
Railways	-3.35%	-1.67%	-16.41%
Inland waterways	-7.69%	3.47%	15.56%

Source: EUROSTAT, "Modal split of freight transport".

In the table 2 are represented the evolution in 12 years (2005-2017) of the share of the freight's ways of transportation. As presented at the beginning of the Chapter 3, the World's economy is constantly increasing, driven by emerging Countries and followed by the ones with saturated economies that settled new objectives of innovation,

decarbonisation and eco-friendly policies (such as the European Union). As explained, the trades represent an important part of the Global GDP, with a direct active and passive influence. In this sense, as the global trades grew of about 75% in the considered period (2005-2017), it is plausible to believe that the internal trades continued to raise as well, with an increase number of internal traffic, especially, as it will be presented later, considering the influence of the modal split cargoes and with a constant positive incrementation also for the general cargo that is not stored only in the receiving seaport, but is also transported in the internal hubs (based on the conformation of a regionalised port expressed by Theo Notteboom).

The European trend showed, in terms of efficiency, and pollution is not reassuring. The increment of 1.46% of usage of road as connection way can be considered the most efficient, but not the effective one for the policies that should be adopted in an optic of sustainable development. A different approach is the one of Belgium that, even if did not reduced the impact of the road vehicles, increased the usage of inland waterway connection (at the expense of the railways ones), considered, if well optimised, the better ways possible at the moment.

Positive is in the end the result of the effort of the Netherlands in an effective development towards a pollution reduction and transport efficiency. The increasing of inland shipping via canals and rivers brought to a decrease in the freight trains of about 1.7% and a positive -2.76% for the road usage.

Even if the general traffic on the road and all the others types of connection, augmented due to the evolution of the economies, interconnections and trades during the years, the general option chosen by the market has been oriented toward the fastest and easiest way of connection, without opting then, even in time of crises, for the cheapest way and abandoning the rational way of doing. This European aspect, as shown, is not spread to all the member states and reserved possibilities in doing it better.

3.3.2. Short sea shipping

In the definition and representation of the regional port of Theo Notteboom there is shown a seaport figured as a gateway with its interconnections to several internal hub/cities in the hinterland. Connection that are both towards and from the main seaport, considered as the main receiver or, to be more realistic, figured as the port that is able to welcome important (both for size and cargo) ships used for deep sea shipping. The Figure

2 represents also more arrows coming and going from/to the port in the sea part. The importance of these arrows should not be underestimated. The gateway seaports have in fact the task to work also as a hub for other smaller ports.

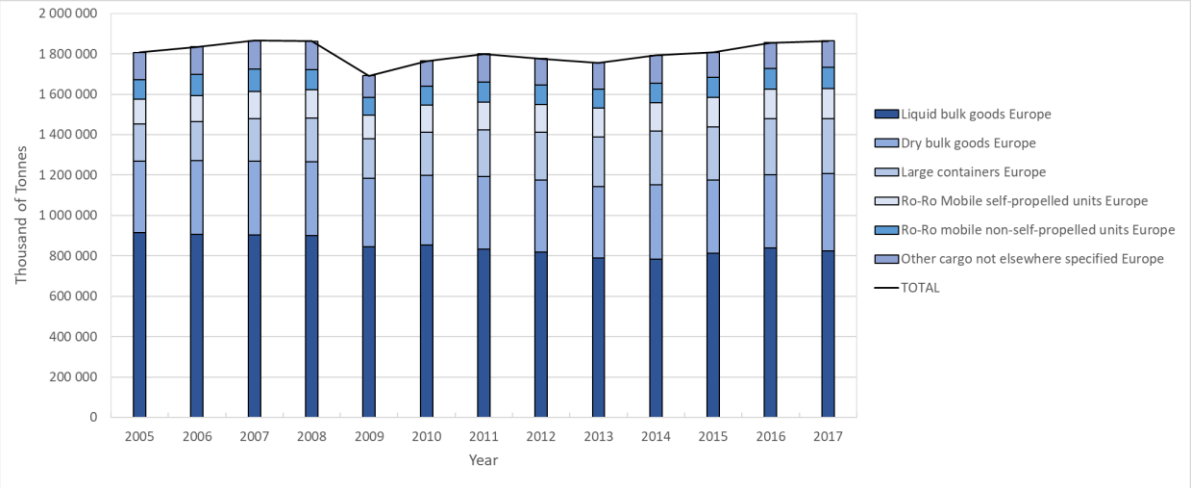
The incoming vessels approaching the main port (for example, the port of Antwerp, Rotterdam or also the port of Hamburg) and coming with huge quantities of cargoes due to the gigantism evolution process, are unloaded on the banks of these big receivers. The cargo has then two options: either being stored in the port's warehouses or moved onto another type of cargo and be brought to other storehouses or to the final client (being it a retailer or a factory that as to process for example an income of raw material). The location of this "customer" and its requests influence also the way of bringing the goods to the destination. As explained previously, there exists many ways to do so: via road and trucks, via inland waterways and inland vessels/barges, via railways and freight trains, via pipelines or, also, via short sea shipping.

The short sea shipping, as defined by the European Commission, is a type of maritime transport (and by that, with the exclusion of inland transport of freight) that happens in the European seas, or the ones close to it, and connects the ports defined as gateways to the ones that are considered feeders ports: smaller ports that, because of the inabilities of the previous adopted policies, or because of the inadequate infrastructures, or due to the morphology of their inland territory, are not able (or not researched) to receive the biggest oceanic ships. The area of competence within what is considered the space of a "short transportation", consists of the whole maritime members of the European Union and, more in general, the territories of the European Economic Area (European Union and, in this case, Norway and Iceland), the territories facing the Mediterranean sea and the shipping to countries touching the Black sea.

The decision whether or not using the short sea shipping methods for a company lies in various personal reasons. The necessity, as said before, of a port able to receive or not the Largest vessels is surely one of the most important. The fright's forwarders are interest into the possibility to ship as more quantities as possible in the oceanic transit, for example from the South China Sea to the North Sea or for the transatlantic trades. This first decision already excludes a huge quantity of ports that, because of banks that are not deep enough or because of a lack in the appropriate equipment or also (and still with a huge importance) because of time inefficiencies in the cargo handling, see the possibility of becoming a gateway ports vanishing. The division of the cargo after that the vessels

approached the port is managed then by considering the time, the distance and the cost of the transport to the final destination. One of the solution adopted is then the short sea shipping, via smaller vessels and cargo ships that, most of the times, connect the ports of the Northern range with the feeder ports for example in the Mediterranean Sea or, to do not aiming that far, the ports of England or France, Poland, Finland and so on.

Graph 6: gross weight of goods transported to/from main ports of EU, by type of cargo via Short sea shipping



Source: Eurostat

The Graph 6 represents the types of goods transported in the EU via the usage of vessels or cargo ships staying within the definition of short sea shipping. The quantities represented in thousands of tonnes, are a demonstration, in the period between 2005 and 2017, of the low variation in quantities consumed within Europe, the influence of the crisis and the shock that it gave to the European Union with a general difficulty into coming back to the levels of consumption had before 2009. The average growth during these 12 years, indeed is about 0.31%, an already important percentage, considering that during the years 2008-2009 has been registered a loss of nearly 10 percent of the tons and the catch back the following year has been only about 4.35%.

Important part in the values reported is made by the transportation of liquid material (interpreted as transactions of mostly petrochemical products): an average of nearly half (46.95%) of the shipping via short sea are made thanks to it (period 2005-2017). This high influence suggests two things. First of all, the high influence of the liquid cargoes allows modifications on the total values and make it strongly connects to the high fluctuations and indecisions that this type of goods generates. For example, the trading of the oil products are, as known, highly influenced by its price, its demand and the political choices and, since the large contribution of petrol in the composition of “liquid bulks”, it

is also fair to state that also its shipping will move along with it. As demonstration, the already mentioned crisis of 2009 and the one of 2011-2012 saw in the liquid bulks the highest decrease in tonnes transported compared to the others type of cargoes: 56 millions of tonnes less in the first crises and more the 36 in the beginning of the new decade. The second consideration suggested by the graph, lies in the in definition of short sea shipping itself. The high transhipment of liquid bulks suggests the connection of the European countries with the close oil producers. It stresses the relations with the North African countries such as Libya, Egypt and Algeria, the ones with the east Mediterranean like Turkey, the relationships in the Black Sea with Russia and, in the end, the ones with Norway in the North Sea.

The others important components of the short sea shipping are, in order of share on the total, the dry general cargoes, the containers and the Ro-Ro goods (not considering the contribute of the "other cargo" which is not specified).

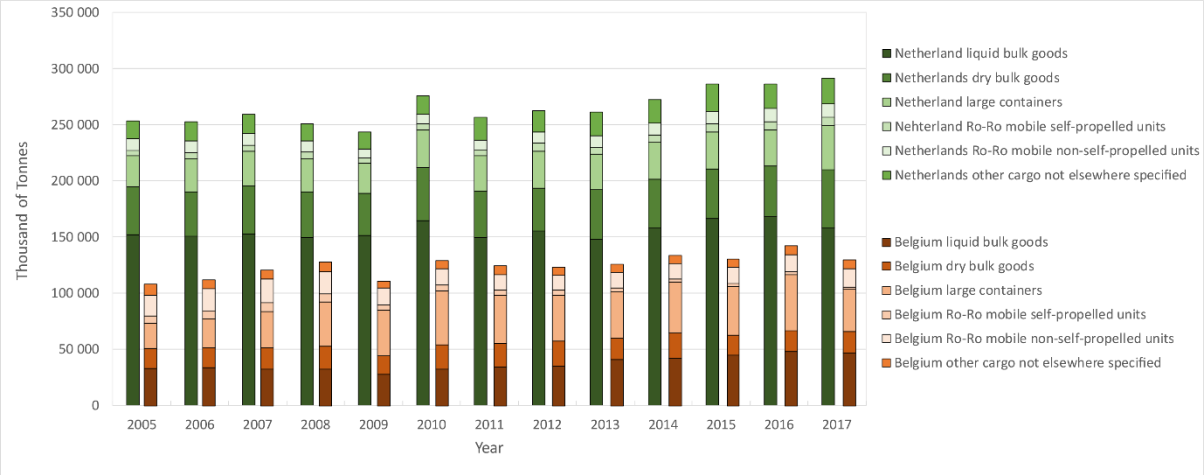
The tons of dry bulks highlight the commerce within the European territory of the raw material that doesn't come for important producers of this type of goods such as America or states from south Africa or, more in general, other continents (goods such as iron ore, coal, and grain). It compose an average of almost 20% of the total goods transhipped and has an average growth per year, in the twelve years, of about 0.76% (it is important to consider and compare this data with the one of the liquid bulks that, in the twelve-twelve years period, saw a decrease of about 0.80% of the tonnes shipped).

The contribution of the large containers on the total short sea shipping is the one that saw, during the years 2005-2017, the highest incrementation of its tonnes shipped and a consequent growth in its share. The tonnes passed from 183 million in 2005 to 271 million in 2017, with an average annual growth of about 3.45%. The containers represent then, also in the short sea shipping category, a high increasing component that allows and facilitate the modal split between Countries that do not have the possibility or ability to receive the big containers. Thanks to this type of transhipment, the time to transfer a cargo from one vessel to a smaller one has been reduced and now also the smaller ports can proceed with the evolution of their occupation. Most of the time, in fact, it happens for the historical ports where the configuration of the port, the position of the city and the restricted areas for the storage have limited the possibility for them to growth and diverted the market to other places (an example could be the many ports of Italy and their history, compared to the "new port" of Gioia Tauro, that, thanks to the position, the easy

access and the space that it can take advantage of, it became more important than many others national ports).

The Graph 7 shows the total gross weight of goods transported via the short sea shipping in the ports of Belgium and the Netherlands, pointing out the share of the single type of goods as it was for the general view of Europe.

Graph 7: gross weight of goods transported to/from main ports of Belgium and the Netherlands, by type of cargo via Short sea shipping



Source: Eurostat

The first thing that immediately stands out in the comparison, is the difference between the two States. Belgium is on average the 47.17% then the Netherlands in the twelve years, with peaks that arrive to 51%, but also negative ones, with differences that can arrive till 57% (and, in quantitative terms, it refers to almost 145 millions of tonnes of goods) and increase the gap between the two countries. This is probably due to the high contribution of the port of Rotterdam to the sum, that its alone gives an average of 188 million of tons of good to the total.

The second highlight lies in the share of the goods of the short sea shipping of the two Nations. While the ports of Belgium are more equally distributed, the Dutch's ports are more in line with the European level of transhipment. The largest share in Belgium is represented in the shipping of containers for the European traffic. In particular, the liquid bulk represented the biggest share till 2007, with 34 million tons handled in 2006. After that year, even if the total liquid bulk in Belgium continued to increase arriving till 48.6 million of tons in 2016, the presence of containers maintained its first place in the share on the total. The dry bulk share instead had a constant share of about 15% on the total, with peaks that differ (in positive and negative) of only +/-2%, while the Ro-Ro units have

an higher influence of the aggregate value (23.28% in 2005) and an higher variation during the years (only 12.29% of the total Belgium gross weight via short sea shipping was made by the Ro-Ro units in Belgium). In the case of the Roll-on/Roll-off units, the highest influence comes from the port of Zeebrugge, with an average of 12 million tons per year (2005-2017) and being one of the top 5 ports of Europe for this type of cargo in the short sea shipping.

The situation on the Dutch country, as said before, is more in line with the general European view. The major share in the considered period is given by the liquid bulks, with highpoints of even 62.18% of the total short sea transhipment and an average value of almost 156 million tonnes handled in the period 2005-2017 (in Belgium, the contribution to the total liquid cargoes was about "only" 37 million of tonnes). Furthermore, the Graph 7 shows that also the amount of dry cargos differ from the two Countries: as it is for the liquid bulks, also for the dry ones, the tonnes transported in Belgium represent almost half than the one in the Netherland (19 million on average against the 43 million of the Dutch Country). The situation changes in terms of containers. While in first years of the period considered, the Netherlands lead the quantities transported with a strong 27 millions of tonnes transported, Belgium took over in 2007, with 32 million transported (one million more than the Dutch ports) and increased the difference till 2016 with 17 million tonnes of containers more and a total amount of 50 millions of tonnes transported (of course with some variations during the years).

A study from the European Union in 2012 called "Modal share of freight transport to and from EU ports" pose attention on an important aspect of the short sea shipping study. The research shows a table comparing the various European countries and the division of the transportation by distance (Deep Sea Shipping vs Short Sea Shipping) in 2012.

Table 3: Breakdown of Belgium and the Netherlands seaborne traffic by distance range – 2012

Country	Total	SSS		DSS		Unknown	
	1000 tonnes	1000 tonnes	%	1000 tonnes	100%	1000 tonnes	%
Netherlands	549 563.00	267 579.00	48.7	274 156.00	49.9	7 827.00	1.4
Belgium	222 436.00	123 928.00	55.7	98 507.00	44.3	0	0.0

Source: study on "MODAL SHARE OF FREIGHT TRANSPORT TO AND FROM EU PORTS", European Union, 2015 (data source: Eurostat)

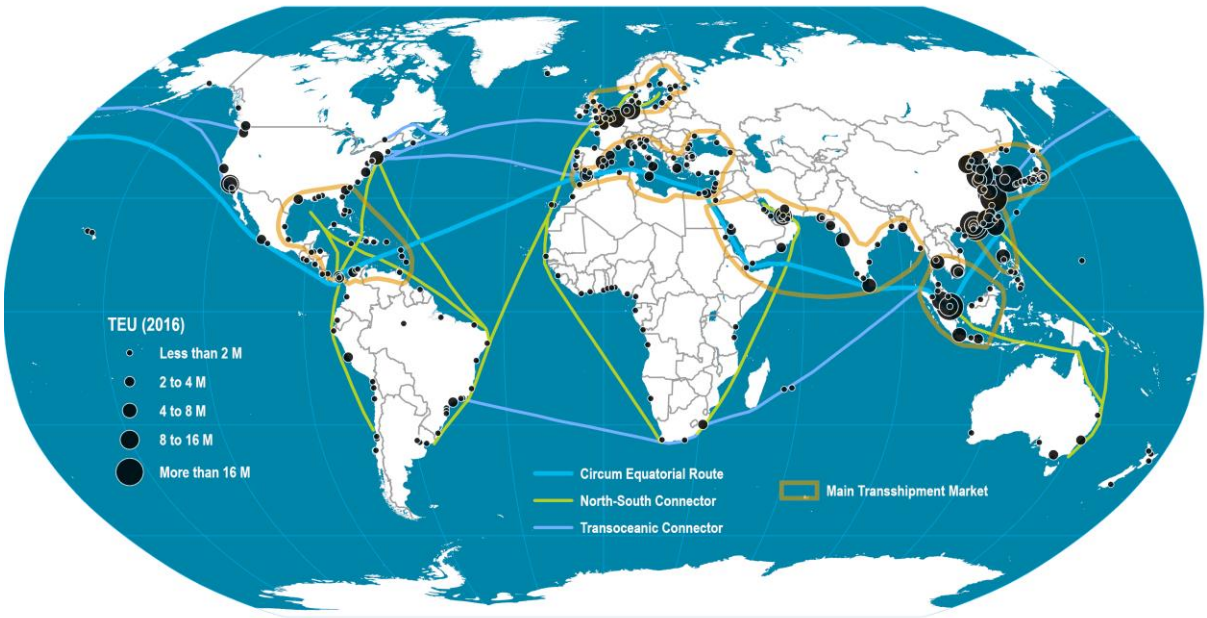
In the Table 3 is well represented then the importance of the Short sea shipping for the two Countries under observation. In fact, this type of transport implies the half of the transportation for almost the both countries (considering also the unknown part represented for the Netherlands). The study, however, demonstrate also an important factor: even if the port of Antwerp and Rotterdam represent the biggest ports in Europe, their contribute to their countries is different: the Netherland is, with a relatively large gap, the country with the highest tonnes transhipped in the European union, Belgium is not in the second place as it should be reasonable to think, but it stopped in the 7th position, after UK, Spain, Italy, Germany and France.

3.4. The ways of the future

In the whole Chapter 3 have been presented the current and past evolution of the international and European markets, with indicator for what are the general traded goods, what is the preferred way of carrying the cargoes (both inside and outside borders), the direction of the world trade economy and the possibility, for a country, to be considered a well-connected port or not.

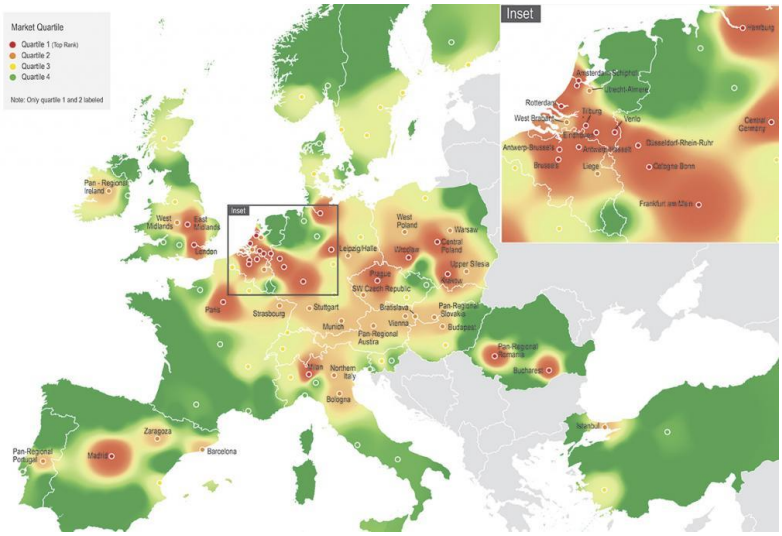
As it will be explained, however, the mission, for a port, consists also in predict the future trends and possible emerging market, analyse them and act in their direction, becoming passive and active actors at the same time.

Figure 13: Map Emerging Global Maritime System



Source: Maritime Transportation, Authors: Dr. Jean-Paul Rodrigue and Dr. Theo Notteboom, "The Geography of Transport Systems, FIFTH EDITION", Jean-Paul Rodrigue (2020), New York: Routledge

Figure 14: Europe's Most Desirable Locations by Market



Source: "CUSTOMER GROWTH STRATEGIES: EUROPE'S MOST DESIRABLE LOGISTICS LOCATIONS", Prologis, 2017

In Figure 13 are presented the future and prediction of commercial routes, markets and container's transhipment ports expecting in the next years. In Figure 14 instead is focused on a European regional level, presenting the places that are considered the most desirable ones for logistic locations (2017).

The two pictures shows the importance of the location of the both port of Antwerp and Rotterdam in the future of the trades: they are located in the centre of the busiest European area in terms of logistic prospective and development and are placed in one of the busiest area of the maritime systems.

The map regarding the desirable logistic locations can be seen indeed as the map of concentration of the European commerce, where the proximity of the warehouses and factories production to the consumers (either regarding other type of businesses or the final customers) have an additional value in terms of costs saving and market size. Costs savings can come from the possibility of direct delivery to the clients with derivative low expenses in terms of transportation, the markets sizes are represented as a concentration of profitable urban areas where there is a high presence of industries and work opportunities, creating a fertile field for trades. It is possible to see then a reconfirmation of the logistic spill-overs presented in the chapter 2, Figure 9, as centres of internal logistic hubs for the two ports and their continuity in the relation with the neighbour's States and industrial cities as important part in the supply chain of the international (or, in this case, more important for the regional) commerce.

The maritime system is accommodating this logistical position (of course, with the consideration that the maritime system is driving but it is also driven by the action of the ports), putting the two port in one of the most important transhipment markets, with transoceanic routes and North-South connection and the possibility also to be close to the global line of the Circum Equatorial route. The criteria of individualisation of the main transhipment markets are based on the sizes of the vessels that the ports can serve, the frequency of the transhipments, influenced by the quantities of ships coming and going from the various harbours and the quantity of ports in the area, helping the major ports in serving more destination and developing the inside market's trades. With these conditions than, Antwerp and Rotterdam could take advantage of all their characteristics: their investment in infrastructures allowed them in welcoming the biggest vessels, facilitating the long distance transhipments on the main roads; the efficiency of the two ports and their availability in space made them the busiest ports in Europe, entering in a loop of request due to the lower time necessary for the ships in the port (and representing one of the highest expenses for the shipping company); the presence of the other ports of the North range helped them in serving the high requests in the immediate north Europe hinterland.

Thanks to its numbers then, the entire North range, with Antwerp and Rotterdam, had the possibility and it will continue to be possible in the future to be central players in the global maritime system, passing and increasing its importance over best located ports and dangerous competitors such as the Mediterranean ones.

CHAPTER 4 “The business”

The observation of the growing of the World GDP, the recognition of the World share in trading commerce, the individualisation of the “best connected countries” and the picture of the most common “water-roads” of trading, draw the global frame of the directions of the World’s exchanges. Moreover, the identification of the steps that brought the ports to what they are today, settled down the evolution phases to a common ecosystem of World’s interconnection.

The introduction of the port’s organisation of Rotterdam and Antwerp showed the necessity of high integration and relation between the private and public actors and, nevertheless, the necessity of “act-in-time” and adjust the plans by following the market, but without forgetting to try to be pro-active within it. The government is needed, since a pure private port could not afford the high expenses needed for the innovations and, on the other side, the State itself has interest in providing a good procurement of the wares needed, with the formation (for both the Netherland and Belgium) of a “common” inland network.

In this situation of high interconnection between several actors that are so different from each other and with goals are not usually shared at all, the implication of several factors influences the definition of “who is the best”. If the performances of the ports could have been described by only the evolution and management of the treated containers, then it would have been easy to individualise the port of Rotterdam as the one with the best performances, with the higher number of containers throughput: 125.14 Million tons against the 107.66 Million of the port of Antwerp (Eurostat, 2018). However, as showed in the Graph 2, even if the containers are the one with the fastest growing percentage rate, they are not the most traded good via the sea.

Other elements than need to be involved in the analysis, other factor that could change the point of view, such as all the other types of cargoes that transit in the two north ports or the area, the productive area that the ports are able to take advantage of or, again, the efficiency of the ports with the influence of innovation.

Nevertheless, is important to consider also the tendency of world’s policies to concentrate more and more towards eco-friendly business developments and, of course, sources of pollution such as the ports are not exempted to adopt measures to favourite the green-orientation and the safeguard of other environment aspect that can be

considered crucial for the long living life of the ports themselves, such as the damage of the river bed.

4.1. Maritime transport of goods, Antwerp and Rotterdam

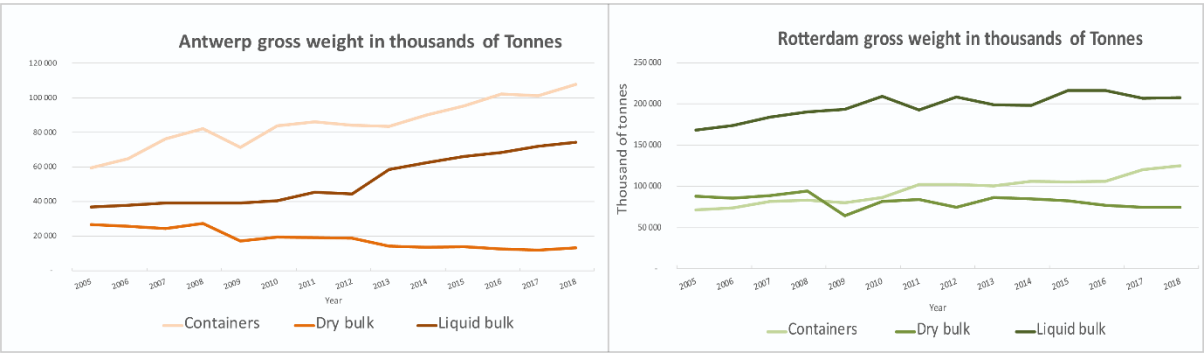
The last report published by the Eurostat, pointed out the data about the last quarter of 2018 of the best-performing ports of Europe (with the integration of the data regarding Norway, Turkey and Montenegro), with the division of the gross type of cargoes for all the ports, w the common measures of thousands of tons handled.

By looking at the Eurostat's database, it is possible to individualise the quarterly data from the first quarter of 2005 till the last quarter of 2018.

In this way, can be analyse the quantities (in weight) that transit through the ports in the last thirteen years and compare them with the evolution of the single port.

A clarification must be made before than starting the observation: the weights refer to genal cargos and then can be related to either containers, dry bulk or liquid bulks, without the specification of the single good and, more importantly, the definition of the precise value of it. In this way, in not possible to refers to the added value that a single cargo brought to the port or to the region, but it can at least give an idea of the quantities of goods that can pass through the ports: the weight of a cargo of iron and the volume that it occupies, are different than the one of cacao or coffee, even if they both can be carried as general dry cargoes.

Graph 8: Gross goods handled during the period 2005-2018 for dry, liquid bulk and large containers



Source: Eurostat, Maritime transport of goods

In the Graph 8 are then reported the data of Antwerp and Rotterdam, that can be compared with the international ones represented in the Graph 2 and already analysed.

An important difference stands in the sharing of the volumes of the different types of goods, first between the two ports, and then between the ports and the international seaborne trades.

4.1.1. Containers and Dry bulks

The containers, for instance, represent the most weighted type of cargo handled by the port of Antwerp since 2005, with a total amount of 107 million tons managed in 2018, while, in Rotterdam, the ranking is different: the containers, even if the tons managed are higher than the ones in Antwerp, with a total weight of 125 million tons in 2018, they are not the weightiest handled cargo. Moreover, containers were not even in the second position till 2009, when, due to the decreased amount of dry bulk managed because of the financial crisis, there has been a drop from 93 Million tons to 64 Million of dry bulk handled, with a decrease of more than 31%, while the weight of containers handled reduced by "only" 4.06% passing from 83 Million tons to 79 Million, and, when the quantities increased again the following years, the dry cargoes did not catch back the (following constant increasing) level of containers.

Regarding the port of Antwerp, the situation about the management of the dry bulk cargoes is represented in the graph as a constant decrease, since the very first year reported (2005). The only year when it is possible to observe a growth is the 2008, with a significant increasing weight of 12%, followed by the immediate drop in quantities as the competitor Rotterdam in 2009 and a slight assessment during 2010.

The destiny for the transhipment of the dry bulk cargoes seems to have anyway a bad ending, with the number of years of negative growth higher than the one of positive ones for both ports, even if the port of Rotterdam in a more smooth way and more close to the international tons values, the decrease of dry bulks handled is a fact.

The reduced weighted quantities of the port of Antwerp and Rotterdam in the handling of dry bulks could be connected to the possibility to transfer the general cargoes into the containers: the grouping of the different types (iron ore, coal, and grain) of dry goods in the boxes with the changes through the modality process of transfer, could give the possibility to bring the cargoes far from the port, where the rents for the storage are lower, for example. Moreover, the food cargoes, such as grain, due to legal issues, are no longer storable in the ports, but "*future markets require the goods to be stored within the administrative borders of designated ports in order to safeguard product quality*" ("the

Kempen nexus", Arjen van Klink, 2003, Struggling for Leadership: Antwerp-Rotterdam Port Competition between 1870 –2000, 155), and for this reason than, also the activities and the consumption of goods within the national borders matter.

The perception of the loss in both ports of the dry cargo handled can be focused on different aspect and have different perceptions: first of all, it can be pointed out that the loss of Antwerp was about 51% of weight from 2005 to 2018, while for Rotterdam it was "only" 15%; on another point of view however, the quantities can be seen in terms of effective weight and give a complete different image, with a total dry cargo handled of about 12 million tons, much closer to the one of Antwerp, 13 million.

What is clear is that this percentages are completely different from the global values expressed for the dry cargos in the Graph 2, representing a general growth in the period 2010-2017 of about 31% (sum of the "main bulk", with a total increase of 41.48% in the period and "other dry cargo", with a lover growth of about 21.03%) tons managed through the international trades. Moreover, in the global view, with the data provided, there is a substantial difference also in the share of quantities: while the weights represented show a total heaviness of the containers higher than the one of the dry wares, the amount of tons managed worldwide is definitely in favour of the main bulks and other dry cargoes. Only about the 17% of the international seaborne trades are made with containers, in response, more than the 55% and 30% of the total weights handled concerns containers for respectively the port of Antwerp and Rotterdam. For the international trade, the share of the dry wares is the highest on the total: the main bulks consist of more than the 23% and the other types of dry cargoes (grouped in a common category) share almost the 30% with a total sum for the general dry cargoes that achieves more than the 50% of the total tons traded by sea (data from the World seaborne trade and Eurostat, 2018). The dry bulks for Antwerp and Rotterdam do not achieve these shares in the handled tons, even if can be said that they remain an important component of the economy of the ports and, more specifically for the industry and heavy industry.

4.1.2. Liquid bulks

Only between Antwerp and Rotterdam there are 117 km of common pipeline and then, all that conveying of oil, gas, etc. over long distances continues till Feluy, in the Walloon region of Belgium or it can go from Antwerp to both France (Lille, and Waziers and then in the hinterland of France) or Germany, arriving till the border with Austria thanks to

the connection between Ludwigshafen and Burghausen and is integrated by connections that could allow the carrying all within the centre Europe.

Liquid cargoes refers to grouped petrochemicals, black oil products, liquid fertilisers and other kind of liquefied gas products and, all this type of cargos, are the ones that allowed the construction, during the sixties, of the petrochemical cluster in Rotterdam and Antwerp, and the raise of the ports as industry-related harbours.

Today the situation has drastically changed for both the port of Antwerp and the port of Rotterdam, in two different ways.

For both ports, the influence of the crisis during the seventies and the introduction of the containers had a strong impact on the growing business of chemical and petrochemical implants in the area. Moreover, legislations regarding the environment and the health of the population living in the cities gave to the entrepreneurs a hard life. In this field, however, as explained before, the Dutch port had the strong advantage of the presence on the territory of the royal company "Shell", that allowed a faster-growing evolution of the sector within the port's region (not only within the border of the harbour, but the "benefits" have been shared by the villages around the delta of the Rhine). In this "race" than, Antwerp has always stayed behind, trying to cover the gap in terms of productivity existing between the two rivals.

The trend, for both the port of Antwerp and Rotterdam has been, anyway, positive in the considered period as shows in the Graph 8, with more up and down for the Dutch port and a lower increment, and a higher growth, in proportion, for the Belgian port. In particular, the port of Rotterdam, starting from a high value of more than 167 million tons of petrochemical products handled in 2005, had the capacity to increase and it arrived at 207 million tons in 2018. However, this straight forward increasing of tons, saw few years of negative growth, that were not reflecting the international trades. The Global increase in the exchange of oil and gas shows in the Graph 2 can be better represented instead by the port of Antwerp, which had a duplication of the liquid tons moved during the 13 years under observation. The port of Antwerp, in 2005, had to handle more than 36 million tons of liquid bulks and it constantly growth till 74 million in 2018. Still, the amount of the petrochemical products managed by the port, is not even close to the ones handle by the competitor, and, it still has to double again all the amount of liquid managed in order to arrive at the level that Rotterdam was in 2005. Another option is to expect a decrease in the petrochemical industry, or, to be more precise, in the petrochemical liquids handled

by the Dutch port: from 2011 till 2018 the tons of liquid managed by Rotterdam saw more negative years than positive ones, with the biggest lost in 2011 with a minus 7% of tons handled (16 million tons from one year to the other) and the highest value that it has not been registered in 2018, but in 2015, with a total value of 216 million tons.
In total, the port of Antwerp, from 2005 to 2013, had an increase of tons handled of about 101.5%, while the port of Rotterdam of 23.5% for the liquid cargoes. The international seaborne trade referred not to all the types of liquid goods, but only to the category "oil and gas", which surely represent the majority of it, had an increase in tons of about 29.3% between 2010 and 2017. The port of Rotterdam then is the one that better represent the trend of the global transhipments, reflecting also the downgrade of tons in 2013 (with an overall loss of about 12 million on the international market) in the tons managed (minus 5 million tons handled for the Dutch port between 2013 and 2014 regarding the liquid bulks).

4.2. The productive area

As shown in the evolution of both ports, as explained in the necessities of renting the land and stay within the condition of safety expressed by the governments, the two Benelux ports, expanded through the rivers with port-related activities, such as the petrochemical implants that need the close access to the raw materials brought in the two countries by sea. As explained in the previous chapter, the influence in the port's economy (in sense of port's activity) of the liquid bulks that stoke this type of business, is a substantial part of the Dutch's handling throughput, while it has a way less impact in the port of Antwerp.
This aspect is reflected in the quantities of chemical-related activities, implants and structures that the two cities host, by renting or selling the public territory for this type of business.
The port of Antwerp has 37 companies operating in both the oil and chemical sector, while the port of Rotterdam counts 6 refineries, 37 implants between chemical manufacturers, biofuel manufacturers and edible oil refineries and 9 coal, gas and biomass fired structures.
The importance this kind of activities and the ability of the port to develop and direct the evolution of the area is, as already pointed out, connected to the import of the liquid bulks. This type of cargos are also strictly connected to the basic possibility to physically import them: the port of Antwerp is not allowed to let enter within its waters the biggest liquid

cargoes that could increase the throughput of the port in this category, due to limited access in the river. Moreover, the availability of an opening directly on the sea is one of the most powering resources for this kind of cargoes and that is why even smaller ports such as Marseilles, le Havre and Zeebrugge, have higher possibilities to invest in this business, since the access to the opening waters are stopped from Antwerp by the Dutch land.

Another aspect that needs attention, are the relatively low job opportunities that this type of cargo can generate: the necessity of employment for the handle and treatment of the liquid bulks is lower than the other categories of cargoes and then, the added value that it could generate is less than containers for example.

The influence of the broad series of pipeline does not help the increase of added value that the liquid products could bring within the region, but if contributes to the spread of the imported resources to the whole network and even the Belgian port imports material for its refineries from the close competitor.

The field of the other industries port oriented or port induced are instead spread all around the two cities and benefit from one or the other thanks to the many connections existing in the regions. Examples of international big companies are already been made such as Nike and Crysler, but, besides international famous brands, the influence of the two ports brought the cities to focus on different type of economies. Of course, the internationalisation and the connections that the two hubs can count, had a strong impact on logistic and petrochemical industries as said before and, still connected with the possibility to glean raw material directly from the incoming cargoes, other type of industries had the possibility to develop alongside the rivers, such as iron and steel. Other categories of industries that gown on the rivers and had benefits from the water or open spaces given by the specific geography of the territories, can be the wind farms (existing in the border of both cities), to the three nuclear implants operating on the river Schield (two in Belgium and one in the Netherland), and to the already existing fields and roofs that use solar energies (and the projects that are planned to start).

Not only the energy or raw material connected industries can relate to the importance and benefits given by the ports but also other specific businesses can derives from the interconnection and past histories of the two cities such as the diamond business and the fashion interest for Antwerp and the important business district in Rotterdam that

welcomes big companies such as the headquarter of Unilever (with London) and many financial/insurance companies.

4.3. Fair competition

The import and export of material, the computation of the throughput in all the different type of measures (such as tonnes and TEU) or the weights and volumes of goods treated, could be the best ways to compare, evaluate and rate the capacity of a port to compete and effectively succeed into the world competition.

However, this could not represent properly the added value that can be generate in the single port and it could mislead to a wrong image of what and how the port can contribute to the region that it serves.

In order to avoid this possible mistake and doing an analysis on the ports based on the proper added value the research and idea brought on the field by J. Smagghe (1988) and repurposed by Jacques Charlier (1995) gave a strong impact to the evaluation. It has been considered the possibility to divide the values of the tons handled by the ports and categorised into the five big groups of “crude oil”, “liquid bulks”, “dry bulks”, “container vessels” and the other type of general cargoes. For each category has been given a number to divide the tons for and, in this way, obtain the so called “tonnes equivalent”, that should represent better the benefits brought by the flows.

The values given to each category goes from 12 to 1 (the numbers are used as the denominator of a division operation and by doing so, it is not of course possible to do the computation by dividing by 0, in this sense the lowest number given is 1), where 12 is the type of cargo that brings the lowest added value to the area and 1 is the type that allows more interventions, job rotation and job creation and more value for more subject.

12 is the denominator given for the tons of the crude oil, by defining it as the good that need less management and brings the less added value to the region served by the port.

9 is used for the other type of liquid cargoes, and so that can refers to all the other petrochemical products that are not specifically “crude oil” and still do not need much intervention to be carried around (most of them, as it is for the crude oil, are in fact transported through the pipe lines, and, especially in the area, though the high interconnection of tubes existing between the two cities), but, unlike the crude oil, are good promoters for what is considered one of the most important chemical and oil district of Europe and the World as the one of Rotterdam and Antwerp.

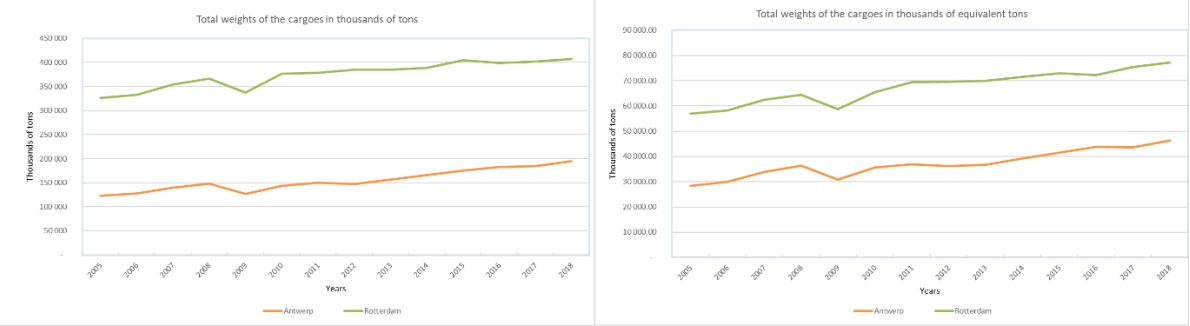
The vessels with dry cargoes are considered in the middle of the scale, with a denominator value of 6, since the necessity of being stored and carried around, but with the connected possibility of high economies of scale.
The containers that have seen the raise since the 60', which are an element of high value generation especially if it is considered the whole territory, since the possibility to carry the highest variety of goods within them and allow to other type of manufacturing once arrived in the port, should divide the tons registered by 3. The reason stands in the fact that as much as the containers are easy to manage and allowed a better communication of semi-finished product (or any other kind), they are also easy to carry in the inland waters (or railways or highways), by bringing away the possible value (that, most of the times, remains anyway within the region served).
The last type of cargo, the "general cargo", is the only one that can be considered in its entirely weight, with a complete benefit for the port (and its region) that welcome the cargos.
To approach some data and compare them with the one observed in the paragraph 8 and ,by doing so (with only considering the categories already observed of liquid/dry bulks and container vessels), some deduction could also explain the difference in jobs opportunities in the ports.

4.3.1. The relevance of the cargos

The identification of the proper added value by the evaluation and rule of proportion given by J. Smagge and Charlerie, drops down the perception of tons moved in the ports. By observing the data reported in the Graph 8, referred to the port of Antwerp and Rotterdam, there is already the possibility to identify the significance of the falling in the ton's weighted. In particular, it will be reasonable to think that the port of Rotterdam will see a decrease higher than the port of Antwerp, since the high influence, on the total weights handled, of the liquid bulks, which are considered the ones that bring the less value to the region. Besides, the influence and presence of a similar amount of container handled in both ports, would not have a strong impact in the reassessment in the equivalent tons. All the game is than in the hand of the dry bulk and it is necessary to see whether the best performing port of Europe possesses quantities that, even in term of added value, allows it to remain above the competitors.

In the Graph 9 are then reported the data regarding, on the left, the total weights of the port of Rotterdam and Antwerp as a sum of the liquid and dry bulks handled and the container cargoes managed; on the right, the values have been adapted by using the logic of tonnes equivalent. In this particular case, since the limitation in dividing the categories of the cargoes in more practical details, such as the identification of how much part of the liquid bulks can be considered as crude oil (the category that brings less added value to the region and port), and the absence, in the research used, of data regarding the "other generic cargoes", which would have brought a direct impact on the total tonnes equivalent (but it can also be considered generally the less traded type of cargo); the computation of the weight of the cargoes had to be done by dividing the data for the direct number of the referred category: 3 for the containers, 6 for the dry bulks and 9 for the liquid ones.

Graph 9: Total weights handled in Antwerp and Rotterdam and adaptation of the data with J. Smagge and Charlerie's criteria



Source: Eurostat, Maritime transport of goods; adaption with the data from J. Smagghe (1988) and repurposed by Jacques Charlier "L'essor portuaire de Zeebrugge", 1995

As it is possible to see from the vertical axis, the drop given by the conversion, is in the order of thousands of tonnes: the starting point in 2005 for the port of Antwerp of 123 million tonnes handled passed to 28 million, while the competitor had a decrease from circa 327 million tonnes to almost "only" 60 million. The same difference is reported also for the situation in 2018, with a drop of 76.24% for the Belgian port and 81.04% for the Dutch one.

For the considered period, the port of Rotterdam is the one that "suffered" more for the reassessment of the tonnes by their added value, with an average drop of about 82% of the weight, while Antwerp decreased on average of about 76%.

The interesting difference is the one that can be registered by observing the evolution of the handled cargoes of the two ports and the consequent benefits that these should have brought.

The port of Rotterdam remains the best performing port of Europe under any possible aspect. The point is however that, while in the considered period (2005-2018) the Dutch port saw higher quantities managed of cargoes, the port of Antwerp can claim the fact that the improvement of the port is higher. In particular, the Belgian port had an increase of 158% in the thirteen years in terms of weights managed, while Rotterdam "only" 124%. If these two percentages are than adapted to the data presented in equivalent tonnes, the gap between the evolution (still in percentage) between the two ports is even higher, with a 163% of increasement for por in the Flanders and 135% for the one in the south Holland.

This difference can be traced back to the high influence on the total of the containers. The gap in quantities of containers managed in the two ports is not that spread: the port of Antwerp in 2018 handled 107 million tons, while Rotterdam 125 million, however, in the Dutch port, the boxes had an impact of about 30 percent on the total, while in the Belgian one, 50%. If than this thought is brought to the added value consideration in both Antwerp and Rotterdam, the importance of the containers increases dramatically. In Antwerp the containers represent more than 75% of the total added value and in Rotterdam, more than 50%. By this is clear than the reason of higher improvement in the past thirteen years of the Flemish port than the competitor, which manages anyway quantities overall much higher, with the exception (in fact) for the containers.

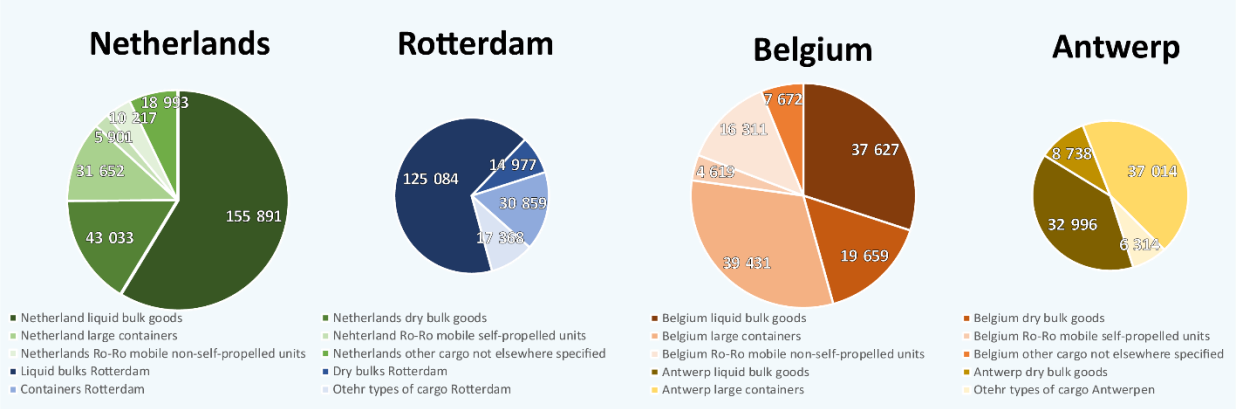
4.4. The short shipping of Antwerp and Rotterdam

In the chapter 3.3.3. has been explained the importance of the Short Sea Shipping, the share of the type of goods transported and has been focused the attention on a general view of the two countries where the port of Antwerp and Rotterdam are located: Belgium and the Netherland. Now the focus passes directly on the two ports in question, always with a view to the European's transfers and short sea shipping attention.

First, the contribution of the single port on the national level. The port of Antwerp and Rotterdam, as anticipated, are the major contributors to the national results and, by that, the variation of shipments in one of the two ports reflects on the entire nation's values more than could be done by other ports of the respective countries.

The port of Antwerp represents the main contribute to the National level of transportation via Short Sea: 67.88% of the total goods transshipped of the 125 thousand tonnes are transported through the port of Antwerp. For the port of Rotterdam, the percentage of contribution to the Netherlands is even higher (even if not much) and it arrives almost till 71%, by making the port of Rotterdam the most important port per short sea shipping in the whole Europe.

Graph 10: Share of the various type of good transported in the ports of the Netherlands and Belgium compared to the ones with their main ports via Short Sea Shipping



Source: computations on data from Eurostat

In the Graph 10 are represented the values of the goods transported from the both ports under discussion via short sea shipping, compared with the ones of the singles States. The data are presented as the average of the total values of the period 2005-2017. The size of the pie charts showing the shares of the two ports are proportioned as the percentage of contribution to their own country (the pie chart of Rotterdam is 71% of the pie of the Netherlands and the one of Antwerp is 68% of the pie chart of Belgium).

The graph allows to understand the proportion not only of the entire quantities transported in the single port compared to the national level, but also the division of the singles type of good.

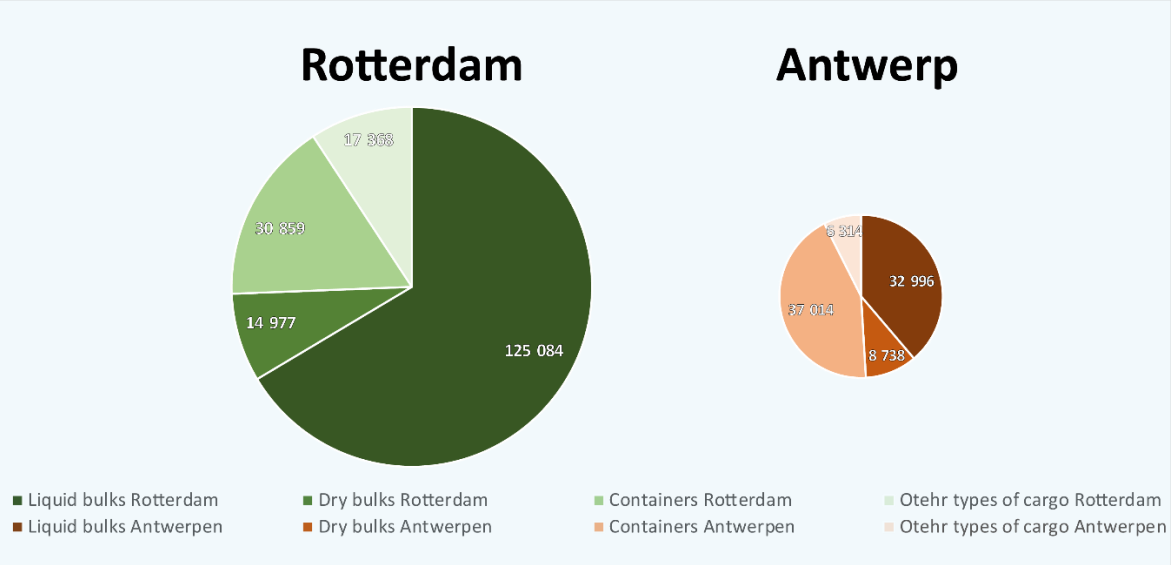
In the Netherlands, is clear the contribution to the transportation of the liquid bulks of the port of Rotterdam, with more than 80% of the overall tonnes shipped by the port (125 million tonnes of the almost 156 million of the value of the Country). Great contribution is also made to the transfer of big containers, with the port having 97.50% of the business over the National level (30 million of the 31 total tonnes). The category that received the less participation on the Netherlands' levels, are the dry bulks. The port of the South Holland moved "only" 14 977 thousand tonnes of the 43 million transported from the

whole ports. The contribution is then only by nearly 35%, putting the biggest port of Europe in the second place for this category of cargo, overtook by another National port: Amsterdam (that constantly managed more tonnes in the period 2005-2017 than Rotterdam).

On a general view, it is possible to state that, compare to Rotterdam and the Netherlands, the port of Antwerp contributes more to its nation than the close competitor or, at least, in a smother way. 93.87% of the Belgium's containers moved via short sea shipping are transported via Antwerp, 87.69% of National liquid bulks derives from the Flanders' port and 44% of the dry cargoes of the Country are managed in the port. The port however, is no longer the leader of the dry bulks in the country took over from the close Flemish port of Ghent in 2011, but with a similar average of contribution in the period of twelve years considered.

As far as the Ro-Ro units are considered on the National aspects of the transport via short sea shipping, the contribution of the two ports to it is not considered enough and it has been grouped with the "other types of cargo". Onto International level, the best position of this type of goods is in the hand of the ports of Calais and dover, where, due to the connections in the English Channel and the only port in the two Nations under debate is, as said, the seaport of Zeebrugge, in the Flanders.

Graph 11: Share of the various type of good transported in the port of Antwerp and Rotterdam via Short Sea Shipping as average of the period 2005-2017



Source: computations on data from Eurostat

After the comparison between the two ports and the respective national states in terms of contribution of the short sea shipping, the attention in the Graph 11 is moved to the difference between the two ports in (always in terms of short sea shipping). As it was for the previous pie charts, the sizes of the two graphs are proportioned to the real difference of the tonnes transported in the ports.

The first thing that comes up, as it was for the national values of the short sea shipping and for the total of the good handled in the ports, are the sizes of the charts. The port of Antwerp is the 45.18% than the port of Rotterdam in terms of tonnes managed meaning that the Dutch port is more than the half of the port from the Flanders. The liquid bulks alone could include the average of the entire transhipment of Antwerp in itself.

The internal proportion of the ports then reflect more or less the ones of the total handled cargo (short sea shipping, deep sea shipping and inland shipping). For the port of Rotterdam the dominant share is composed by the liquid bulks (66.43%), the second biggest portion of the pie is represented by the containers and then the "other type of cargoes", leaving the dry cargo in the last position, as it was for the global overview. The difference in these proportion, as a result of the average of the period considered, with the shares showed in the Graph 8 move differently than the values referred only to the short sea shipping: the tonnes of the containers traded in the dry bulks of the limited EU vision by the port of Rotterdam remained markedly under the quantities of the containers moved since 2005; in the overall transhipments however, the containers took over the tonnes of the dry bulks only in 2009 after the influence of the crisis that broke down the exchanges in grain, iron, etc. and after that could not increase back faster than the boxes (as explained in the chapter 4.1).

The situation for the port of Antwerp for the short sea shipping differs from the total tonnes shipped in the port: the highest share is made by the transport of the containers (43.51%) that makes the Belgium port the best performing port in the European Union for this type of cargo in the years from 2005 till 2016 (nevertheless considering the short range shipping). The liquid cargoes represent still an important component of the total cargoes, with an average of almost 33 million tonnes shipped (38.79% on the total) and achieving the second position in Europe in this category in 2013 (before the second best performing was the port of Marseille). The dry bulks represent the smallest share of defined type of goods in the pie of Antwerp in the Graph 11, with only 10% of influence on the total and followed by the "other types of cargo" (7.42%).

The low presence of the dry cargoes, especially in Rotterdam, compared to the other type of cargoes and the contribution that it has on the international level, is due to the low exchange of raw material within (and between) Europe. The short sea shipping, as the definition explained in the chapter 3.3.3., represent the transportation of the goods via vessels sent in the seas touching the European Union, both between the member states and not. The data suggest than, due to the differences in quantities between the Deep sea shipping (deduced as a difference between the total data presented in the chapter 4.1 regarding the total ship of goods of the two ports in general and the values presented in the Graph 11) and the short one, a tendency (or at least an orientation) toward the oceanic shipping for the two ports and this type of cargo. While for Antwerp the transfer of the dry bulks is made for the 46.55% via short shipping, the "European" interconnections for Rotterdam are less than 20% (18.3%) of the total.

Table 4: Comparison of the shipping of the various type of goods via Short sea Shipping and total tonnes handled in the port of Rotterdam and Antwerp (data as average of the totals from the period 2005-2017)

Type of goods	Antwerp			Rotterdam		
	Total (1000 tonnes)	SSS (1000 tonnes)	%	Total (1000 tonnes)	SSS (1000 tonnes)	%
Liquid bulks	49 949	32 996	66.06%	196 567	125 084	63.63%
Dry bulks	18 771	8 738	46.55%	81 903	14 977	18.29%
Containers	83 050	37 014	44.57%	93 640	30 859	32.96%

Source: elaboration on the data Eurostat

In the end, considering the Table 4, it is possible to observe the contribution on the total of weight of goods handled in the two ports transported via short sea shipping and, considering the low percentages of the port of Rotterdam compared to the port of Antwerp, it would be possible to state that the Dutch port is more Global-oriented than the close competitor. Exception make for the liquid bulks that are traded in the European territory (as said before, due to the important producers that operates close to the European Union) and contribute more than half to the entire tonnes traded, the two other categories are transported over longer distance. The port of Antwerp in this sense is more balanced, with contributions closer to the 50% for the short sea shipping and a more weighted orientation to both close and far markets.

4.5. The Gigantism

With the beginning of the globalisation, the opening up of markets, the starting of a World Economy and the shipments toward long maritime ways of any type, the incrementation of size of the ships, canals, cranes, and infrastructures began as well.

The research, on one side (the one of the shipping agencies), in less marginal costs by adopting vessels as large as possible and, on the other side (the one of the ports), to attract those operating companies, increase their handled quantities and sustain a constant development of the port (and the city) gave birth to what is the Gigantism.

Nowadays the possibility of a port to welcome some big oceanic vessels is considered an entrance barrier in the global game of container and shipping commerce.

But, as said, this game has been played from both side (ports and shipping companies) and helped also by the Public institutions.

The ports started their role in the progressive gigantism with the introduction of the container, for which the private companies, had the highest opportunity of scale economies. The fast adaption of the docks and quays with the storage possibility and the construction of the appropriate cranes, were the key to the success of the port in the beginning of the containerization. But it was not the only one. The progressive incrementation of the global trades come with the incrementation of the single ports.

How could the two ports of Europe (Antwerp and Rotterdam) adapt as well as the Asian ports and why the American ones, located in a strong Country's economy, could not follow the busyness of the others and felt in the 17th position on a global scale?

The answer comes from a combination of public and private actions.

First of all, the American ports were forced into limiting their infrastructures for fair reasons (more than environmental ones): even if there was the possibility of a development of the port in terms of new better/bigger infrastructures, in order to avoid the conflict of interest with other American's ports, the interventions were limited. Second of all (and probably the most important reason), the decision in the cost attribution. In the United States, contrary to Europe and Asia, the expenses for the construction of bigger canals/cranes is accounted on the shipping company balance: "if you need the port for your ship, you have to build it". In this way, if the shipping companies have the necessity of developing economy of scales in order to diminishing the delivery costs and serve a specific market, have to take into consideration, in the building of a new ship, also the construction of the infrastructure in the port's destination.

This process of adaption for the infrastructures did not happened in Europe and Asia, where the only limitation is the budget that a port or, to better say, a region, has to offer in order to modify the assessment, the configuration of the port itself and creating the space for the ships, for the containers and for the freights. This, as already mentioned, is also the problem for many historical ports, where, due to impossibility in the modification of the territory due to the presence of historical monuments, or living areas, or the morphology of the territory itself (in Genova, for example, there is a high limitation due to the proximity of the hills to the coast and the low availability of free open spaces).

If a port then, can expand thanks to its surroundings, can invest thanks to the availability of funds and it has political permissions (in this sense, for example, there were problems in the construction of the Maasvlakte and Maasvlakte 2 due to environmental protests for the construction of the new peninsula where there was nothing but sea, protests that did not stop the construction, but delated it), has the possibility and high probability (if served with a good basin of clients, enterprises and activities) to enter in the game.

Antwerp and Rotterdam satisfied the requests, one more than the other.

In the expansion war and cumulation of connection, the port of Rotterdam succeeds better than the close competitor. Starting with the extension of the harbour concluding with the number of handled tonnes.

The port of Rotterdam had the possibility to follow the river Maas, connected with the Rhine, till the North sea, conquer the banks, modify them, amplifying the draft of its quays and build land area over the water, where the possibility of "going deep" was higher.

The port of Antwerp, instead, even if expanded its border as much as possible, has been stopped by the boundaries of the Netherland and could not progress till the sea. Due to this, also limitation to the depth of the terminals for practical reasons were adopted and the possibility for the port to welcome the biggest vessels of liquid bulks vanished.

The *Appendixes B,C,D* and *E* show the majors quays, terminals, docks and piers of the port of Antwerp (*Appendix B*) and the port of Rotterdam, for which the division in pictures has been done accordingly with the evolution, during the years, of the port itself. As it is possible to notice from the table on the sides of the pictures, the construction of the Maasvlakte and Maasvlakte II in Rotterdam, gave to the port the possibility to welcome vessels that could arrive, as it is for the dock of "Shell", till 23.65 meters of depth (liquid bulks vessels in this case). Anyway, on a general scale, it is possible to state that the port of Rotterdam has the possibility of a higher number of docks, deeper and larger. In

Antwerp, instead, the average depth is lower and the maximum draft for a ship is not higher than 15 meters (depending, of course on the weight of the cargo also).

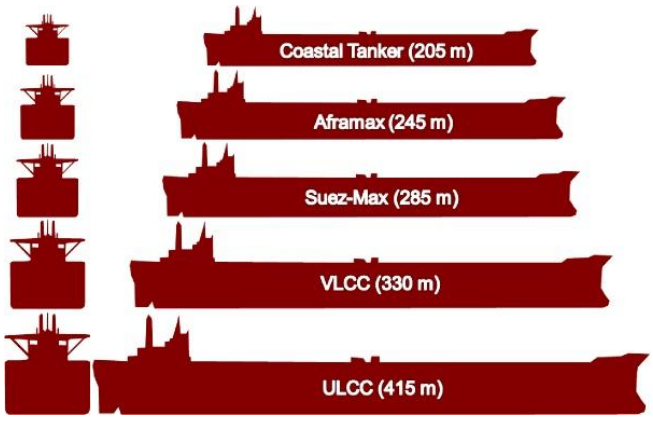
With these differences, the port of Rotterdam had the possibility to increase more than the rival and any other port in Europe, arriving at more than the double in sizes in liquid bulks and dry bulks (in terms of tonnes handled).

In the container business however, the difference is not that much as the other type of cargo. The reason lies in the shipping companies, dimension of the vessels and international limitation, such as the Panama channel.

On general bases, the container ships and the cargo ships (liquid and dry bulks, but also general cargoes) have different parameters and different sizes.

The are eleven types of tankers that can be ranked from the biggest to the smallest ones according to international standards coming from the necessity to pass across the narrows points and junctions, such as, for example the Suez canal.

Figure 55: Comparison of Tanker sizes



Source: maritime-connector.com

In the Figure 15 are summarized the categories of the tankers into five groups: the Coastal Tankers, the Aframax, the Suez-Max and the VLCC/ULCC (the biggest ones), with, for every category, the average length's size. Only the first two type of ships can dock in the port of Antwerp, all the others are too large, with too much draft for the canals and the river in Antwerp. In the port of Rotterdam, however, thanks to the expansion of the Maasvlakte, all the ships can dock.

The Coastal tankers are represented as the "Handysize" ships, used for the shipping in canals (for example the ones that are moving inside the North America and USA), with a low level of draft of around 10 meters. This type of cargoes, represented with a large number of spread ships, can operate and provide their service to the majority of the ports

around the world and, sometimes, are equipped with already built in cranes, that allows port with no transhipment equipment to be served.

The Aframax ships are those ships used in many international ports that cannot afford the bigger ships, such as Antwerp. The average carried can go from 70 to 100 thousand metric tonnes. The term Aframax represent the acronym of Average Freight Rate Assessment, a standard measurement for contracts pointed out by Shell.

After this category, before than reaching the sizes of the Suez-max vessels, there are the Panamax ships, introduced after the extension of the Panama channel (smaller, narrower and with lower depth than the Suez channel) and adopted for the shipping also to Antwerp, with a drought of about 15.2 and able to dock in the PSA Nordeese, PSA Europa and Antwerp Gateway.

The next type of ships are the Suez-max, referring to those ships that are on the limits for passing along the Suez channel. From this type of ships, there is no longer the possibility to dock in the port of Antwerp and, by referring to the game of gigantism, this limitation can be considered the first and most powerful weapon of Rotterdam against all the other European competitors. The draught can arrive for this type of ships till 21.1 meters (depending on the cargo) and Rotterdam can provide the shipping companies, as shown in the Appendix, with few docks for this type of vessels, especially carrying liquid bulks.

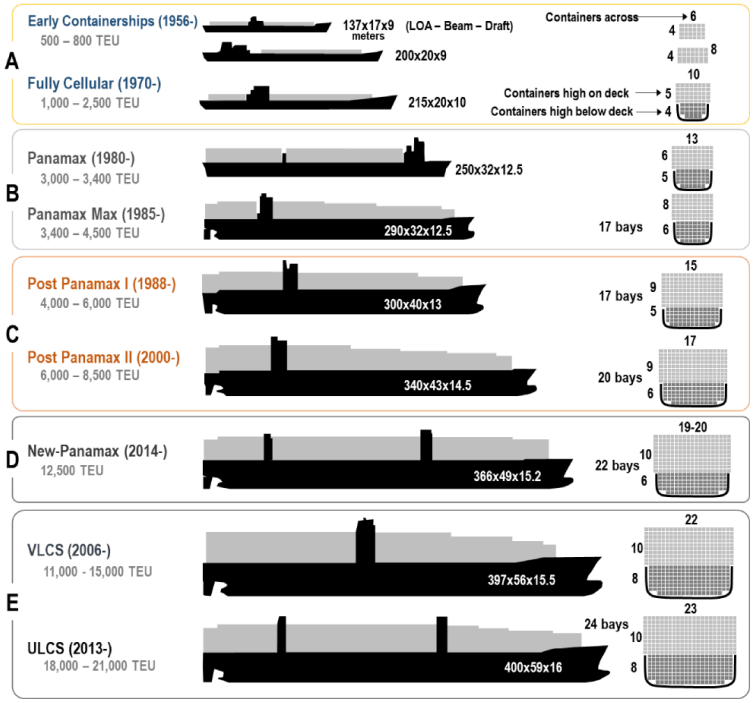
In the end, there are the giants of the sea, the VLCC and ULCC, the largest shipping vessels in the world (ULCC). This type of ships are used for shipping crude cargo around the World, from the Arabian Gulf, to any other country. Due to their sizes, however, the possibility for these kinds of ships to dock in the ports are limited: only few receivers have the proper tools, infrastructures and ways to allow them to come in, being handled and leave the harbour. Indeed, Rotterdam can only welcome the “smaller” types of VLCC. This is because the Very Large Crude Carriers and Ultra Large Crude Carriers can arrive till 31 meters depth (VLCC) or even 35 meters of draught (ULCC).

The situation changes for the consideration of the container ships, based on the maximum standard of the Panama channel.

In the Figure 16 are presented the various type of container vessel, in chronological order of evolution, with the respective sizes and number of containers that each ship can carry. As already mentioned, and as it is possible to notice, there is a difference between the biggest tankers for crude transportation and the container vessels represented in the same category. The VLCS (Very Large Container Ships) and ULCS (Ultra Large Container

Ships) are than on a completely different level than the VLCC and ULCC. If the two type of ships would have been compared one another, then the container's ones would be included in the categories lower than the Suez-max type of tankers. Indeed, the containers vessels are welcome in more ports of the world than the other type of ultra-ship and, more importantly, gave the possibility to more ports to compete with each other (sure, the enter barriers in the sizes and canal deep levels are still existing) as it is in this category for Antwerp and Rotterdam

Figure 16: Container vessels size chart



Source: maritimemanual.com

As it is possible to see from the figure x, the "revolution" happened with the introduction of the standards for the Post Panamax vessels, adopted after the expansion and enlargement of the canal that connects the Pacific to the Atlantic Ocean. With this introduction, the depth for the container vessels passed from nearly 13 meters to circa 15, increasing considerably also the quantities of boxes that each ship can carry.

In terms of VLCS and ULCS, has to be said that, since 2010, when the Scheldt was deepened, also the Ultra Large Container Ships can come and go from both the port of Antwerp and Rotterdam.

In terms of container ships, there is to keep in mind not only the necessity for the vessels to being able to enter in the port (for banks and water depth), but also there must be the availability of infrastructures, especially cranes and spaces, that are able to handle such

quantities. In this sense, the investment of the port has to be observed also under the aspect of technology engineering and "hardware", finding in the available equipment another barrier to entry in the game.

The rush in the gigantism of the ports and the ships than is limited and powered by also third parties, such as the public authorities who had for example to decide how deep would have been the Panama channel or the Suez Canal.

The level and dimensions of the ships are also moved by the level of the commerce: the purpose of the ship owners when a project for a new large vessel starts, is also to be able to fill the future ship with the total capacity of containers that it can carry (and, in this way continue in the direction of cost saving and economic advantages by amortise more the cost of the ship).

The three-actors game is then a consequence of a common adaptation to quantities and measures and there is no reward, just a common prediction and influence on the trends that decide the players.

Conclusions

The port of Antwerp and the port of Rotterdam, which one is “better”? The answer will be: “it depends”.

The paper passes through different topics regarding the analysis of the two ports and represents the reality of the both harbours considering similar and different characteristics of them and the professional position of an individual will be a key contribution factor in how they choose to interpret and act on the information and data provided.

First, the consideration on the technology of the two ports and their evolution. As it is clear, the both ports are passing the same phase in the stages of development of the ports: the network step and the connection with the regional orientation, with the consideration also of the responsibility that they are not only part of a value chain but a value network and that, in some cases, the duty of one port braids with the other. In fact, after a common evolution and annexation of the surrounding villages, the two ports amplified the connections with the further cities and, thanks to the various connection, via water, via railways, via roads and via pipelines, they are able to serve the same flourishing market. Where and if one port cannot provide its services, the other comes in. Example can be the refuelling of petrochemical products from Rotterdam (able to welcome the big liquid bulks vessels) to Antwerp (with less deeper docks) via the pipelines.

In terms of agents, people in power, land utilisation and rets, the two ports adopted similar, but different solutions and, again, it will not be possible to state which one is better.

In the case of roles organisation, the port of Rotterdam has independent decision makers for the ordinary administration, while the participation and contribution of the state remain in a financial form (and then still with interest and influence on the port’s development), the port of Antwerp incorporated the public opinion in the decision process. Therefore, Rotterdam opted for a more efficient organisation, moved by technical decisions, Antwerp toward a more relational orientation, where the stakeholders contributes more in the port’s evolution.

The delicate role of the port’s land passed through a lot of stages, ending with a decision in renting it for Rotterdam, that advantaged the port in financial terms, with negative effect for the infrastructure’s development (or infrastructure’s development) due to the

necessity of the port itself in providing all the necessary equipment, while in Antwerp the land could be sold, giving the opportunity to the private sector to invest, but also having the damage coming from the infrastructures' obsolescent, with all the concerning added costs.

The area operates an important characteristic that employers and employees port required and port oriented must take into consideration. The both ports are located in high polluted zones, with the duty to contributes in the development of models helping the innovation toward renewable energies. It will always be the balance between industry and living that have a volatile border and it is moved by social and personal interests. The presence then of more ports that help in accommodating the main ones and the internal hubs contributes to the ports' relations and empowerment, based, most of all, only by ideological borders, since the liberalisation of the markets in Europe, with preferred zones in the Kempen nexus that can be more or less industrialised (and then drive more commerce for Antwerp or Rotterdam). This area however, due to traffic and industrialisation, became also one of the most polluted (every kind of pollution) in the European continent, playing an important role in the people's decisions.

The actual inland and short sea connections as well as the long-distance relationship helped by the future prospective help in defining the current and next position of the two ports in the globalisation process. The easy connection and the quantities moved define the two ports, one with the objective in numbers of materials (Rotterdam with its high number of road and water connections, able to take advantage of the economies of scale) and the other with the fast direct delivery (Antwerp with the road and truck services). The definition of the two services then allows to understand the businesses that the two ports serves: a well settled industry, with the necessity of managing high quantities at regular intervals, would refers more to the port of Rotterdam, while a "smaller" firm, with the need of a specific and direct service, would prefer opting for the shipping from/to the port of Antwerp.

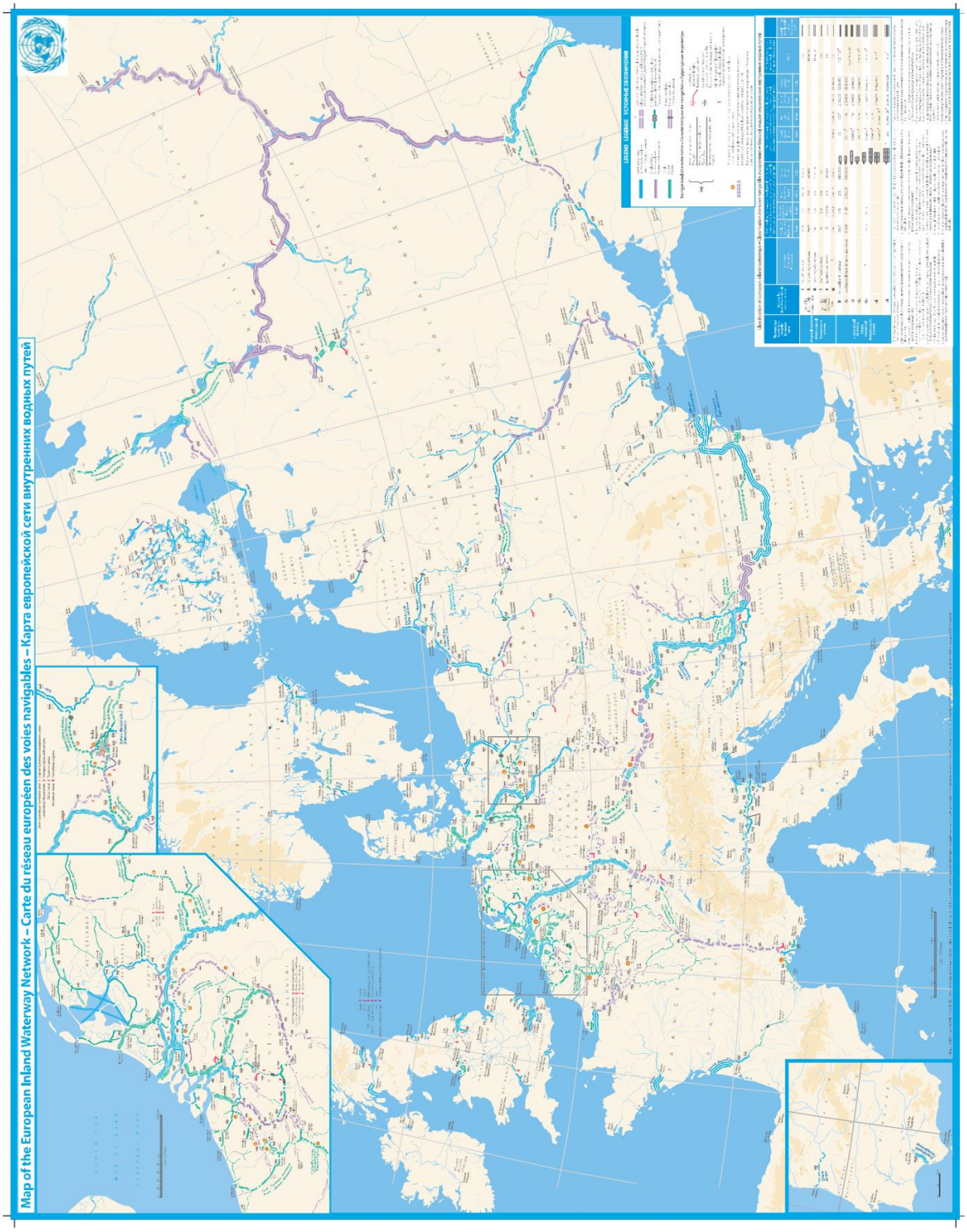
The final chapter, presenting the specific data of two ports, as well as the (quantities) capacities of the ports themselves, confirms and specify the position and trends of the businesses of Antwerp and Rotterdam. The importance of the liquid bulk for one, referring to the petrochemical sector as the one of major interest (helped by the national agencies such as Shell and the structure of the port's itself with its deep docks) is, in the other, substituted by the handling of the containers, with their great versatile

possibilities. The relevance of the cargo is also adapted in order to understand the added value represented for the port, the city and the harbour, bringing a better image of the two ports and noticing the influence of limitations of Antwerp against Rotterdam in the trades such as the necessity of more space and deeper river bed (the first one limited by political reasons and the second one by nature reasons), balanced by the low impact of the type of cargo that uses these resources the most (the liquid bulks are considered, for example, the ones that bring the lowest added value and, at the same time, their ships are the deepest ones).

The international and industrial relationships of the ports can be reflected also in the dry bulks and what kind of shipping refers to them the most: the difference between the two ports in the trading of this cargo, especially in the short sea shipping, is not much (considering the differences of available space). This aspect can be interpreted as an empowerment for Antwerp in a regional attention, serving more the heavy industry (in proportion), considered the one that is more bounded to the territory.

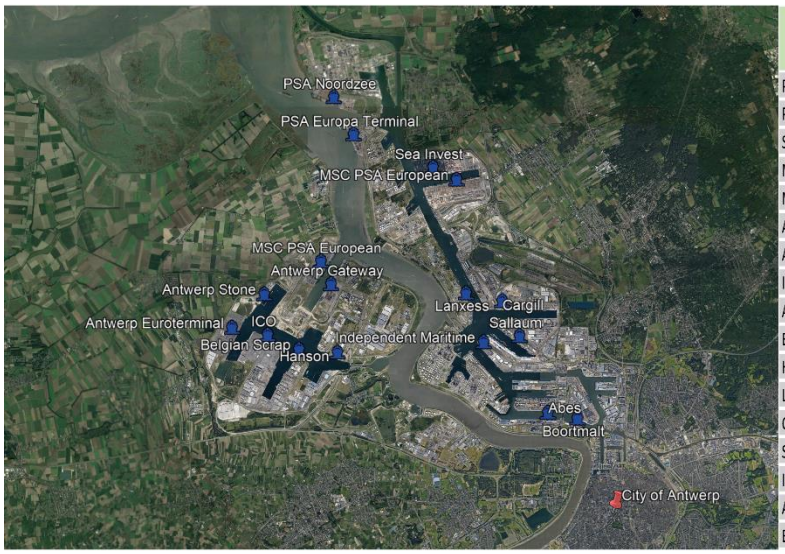
In the European study of 2015, the port of Antwerp has been defined a port with container and bulk specialisation, while Rotterdam as a multipurpose port. The reality is that the both ports have the capability of being considered multipurpose ports, with the possibility of operating in every sector and the pure difference of one having more advantages thanks to its morphological and territory constitution than the other. This diversity is only the power and implementation not of one port over the other, but of the two ports, combined together.

Appendix A: European Inland Waterways



Source : https ://www.unece.org/fileadmin/DAM/trans/main/sc3/European_inland_waterways_-_2012.pdf

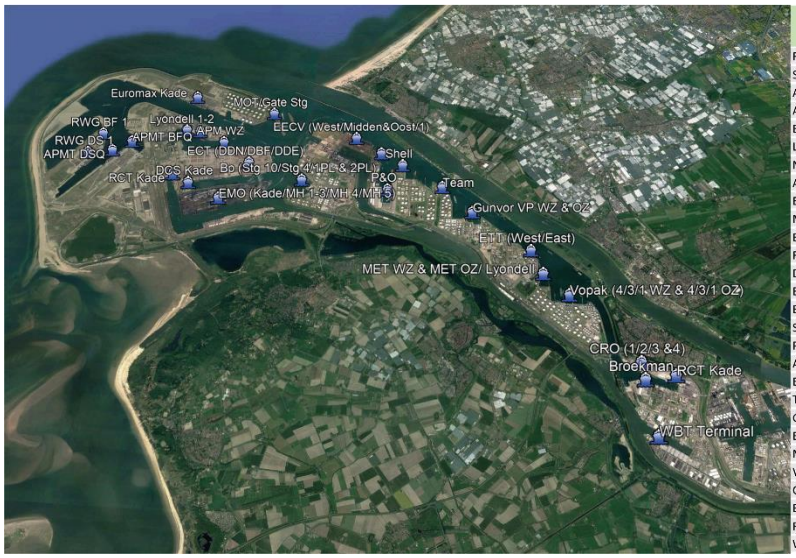
Appendix B: Main Docks, Quays, Terminals, Piers in the port of Antwerp



Name of the Dock/Quay/Terminal/Pier	Lenth (if specified) in meters	Depth (meters)
PSA Noordzee	1 000	15.00
PSA Europa	1 100	15.00
Sea Invest	1 650	13.10
MSC PSA European	2 450	13.10
MSC PSA European	1 670	15.00
Antwerp Gateway	1 630	15.00
Antwerp Stone		13.10
ICO	2 940	13.10
Antwerp Euroterminal	577	13.10
Belgian Scrap	500	13.10
Hanson		13.10
Lanxess		13.10
Cargill	600	13.10
Sallaum	1 190	13.10
Independent Maritime	700	13.10
Abes		13.10
Boortmalt		13.10

Source: images elaborated with Google Earth, data from "4 All Ports"

Appendix C: Main Docks, Quays, Terminals, Piers in the port of Rotterdam (Maasvlakte and Maasvlakte 2)



Name of the Dock/Quay/Terminal/Pier	Lenth (if specified) in meters	Depth (meters)
RWG DS 1	1 150	19.65
SWG BF 1	310	12.65
APMT DSQ	1 000	19.65
APMT BFQ	500	1.65
Euromax Kade	1 820	16.65
Lyondell 1-2		15.65
Neste/lol dolres		14.65/14
APM WZ	1 420	14.65
ECT (DDN/DBF/DDE)	990/880/2620	16.65/10.65/16.65
MOT/Gate Stg		23.65
EMO (Kade/MH 1-3/MH 4/MH 5)	740/920/460/270	6.4/21.65/23/16.65
RCT Kade	250	10.65
DCS Kade	250	10.32
Bp (Stg 10/Stg 4/1PL & 2PL)		15.65/13.65/22.25
EECV (West/Midden&Oost/1)	420/670/780	23.65/18.65/4.85
Shell		23.65/17.65
P&O		8.65
ADM Zeestg Buiten		18.65
EBS Zeestg Buiten		16.65
Team		15.75/23.65
Gunvor VP WZ & OZ		13.65
ETT (West/East)		19.65/22.65
MET WZ & MET OZ/ Lyondell		21.65/15
Vopak (4/3/1 WZ & 4/3/1 OZ)		18.5/21.65//5.65
CRO (1/2/3 &4)		12.65
Broekman	660	12.65
RCT Kade	480	11.65
WBT Terminal	320	6.50

Source: images elaborated with Google Earth, data from "4 All Ports"

Appendix D: Main Docks, Quays, Terminals, Piers in the port of Rotterdam (Europoort and part Botlek, Eemhaven, 1st and 2nd Petroleumhaven, Merwehaven, Waalhaven)

Name of the Dock/Quay/Terminal/Pier	Lenth (if specified) in meters	Depth (meters)
Steinweg Kade 3/2	450/440	13.65/11.65
Veroime Kade 4/5/6	400/400/300	11/10/8.6
Buiten STR		14.65
ERM 2/EPS Kade/Jewo Kade	230/200/250	12.2/12.2/9.65
EBS 1-5/8-12	850/577	14.5/10.65
BTT Pier 1-4/Rubis STG 2/Stoltnielsen STG/Akzo Berth 5		13.65/13.65/12.65/12.65
Cargill Berth 1		15.20
Vopak Berths		10.65/12.65
LBC STG		12.65
Esso		12.65
Odfjell Berths 6&7		12.65
OTM Berths 1-5		13.50
Shell		12.5/10.65
Reko Kade	520	14.50
Kole Berths 1&2		12.65
Shell		6.65/12
CTT STG 1	140	12.00
DFDS Ramp 1/2/3		10.50
VSBV Kade	180	12.00
RBT 1	230	12.00
ERS 1		9.00
SCA Logistics Kade	500	12.65
Prins Willem Alexanderhaven	1 650	13.65
RST KADE EH ZZ	330	9.65
Prinses Beatrixhaven RST ZZ	98	8.60
Steinweg RST Noord 1	350	11.65
Prinses Beatrixhaven, Steinweg Noord 2	400	8.65
Prins Johan Frisohaven, Steinweg 1-4	1 330	10.65
Wetering Paal		7.10
Damen Docks		6.65
Arcelor Sigdek	323	6.00

Source: images elaborated with Google Earth, data from "4 All Ports"

Appendix E: Main Docks, Quays, Terminals, Piers in the port of Rotterdam (remaining part of the Botlek, Eemhaven, 1st and 2nd Petroleumhaven, Merwehaven, Waalhaven and Old 95arbor)

Name of the Dock/Quay/Terminal/Pier	Lenth (if specified) in meters	Depth (meters)
Waalhaven Kade/BCW Pier	181/200	6.5/9.65
Rog/Rotterdam Offshore group	/190/	9.65/9.5/8
Smit Pier 2	25	9.60
Schmitt Pier 8 ZZ		5.65
Uniport Pier	768/420/360	14.15
Steinweg	850/251	10.65/9.65
Jansen Pier		10.65
Westerstuw	150	9.65
Metaaltransport Kade	333	9.50
RHB 1-3	730	10.65
Rhenus Pier	900	9.65
SJR Kraanbaan 1	285	10.65
Franklin Kraanbaan 13NZ	218	15.35
Gevelco Heypl	285	10.65
Metaaltransport Heypl	235	9.65
Gemrdam		6.65
BNFW 4/ BNFW Kade 2	180/210	8.65/6.65
Uden 1	470	9.65
Separaat 1		9.65
Pacorini LDS 1-3	575	10.65
Opticool 1&2	335	9.65
Hiwa 1-3	560	9.65
Continental 1&2	400	10.65
Groenburgwal 1&2	250	4.65
Evides	80	3.65
Rhoonse	300	3.65
Brielselaan 2	200	3.65

Source: images elaborated with Google Earth, data from "4 All Ports"

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